

Agricultural and Environmental Science and Technology (AEST)

This document contains the 2002 AEST curriculum (Pages 2 - 324) which has been replaced by the 2010 AEST curriculum (Pages 325 - 1149). The 2010 AEST curriculum has been broken out into 5 different courses each in its own curriculum document.

MISSISSIPPI
CURRICULUM FRAMEWORK
FOR
AGRICULTURAL AND ENVIRONMENTAL SCIENCE AND TECHNOLOGY
(Program CIP: 02.0201 - Agricultural Animals-AEST)
(Program CIP: 02.0401 - Agricultural Plants-AEST)
(Program CIP: 02.9999 - Concepts of Agriscience-AEST)
(Program CIP: 03.0102 - Agricultural Environment-AEST)
(Program CIP: 01.0201 - Agricultural Mechanization-AEST)

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FOREWORD

The courses in this document reflect the following statutory requirements as found in Section 37-3-49, Mississippi Code of 1972, as amended:

The State Department of Education shall provide an instructional program and establish guidelines and procedures for managing such programs in the public schools as part of the State Program of Educational Accountability and Assessment of Performance. . .

The department shall provide that such program or guidelines . . . are enforced through the performance-based accreditation system.

The local school board must adopt the objectives that will form the core curriculum that will be systematically delivered throughout the district.

Standards for student performance must be established for each core objective in the local program and those standards establish the district's definition of mastery for each objective.

There shall be an annual review of student performance in the instructional program against locally established standards.

Each secondary vocational-technical course consists of a series of instructional units which focus on a common theme. All units have been written using a common format which includes the following components:

- Unit Number and Title
- Suggested Time on Task - An estimated number of clock hours of instruction that should be required to teach the competencies and objectives of the unit. A minimum of 140 hours of instruction is required for each Carnegie unit credit. The curriculum framework should account for approximately 75-80 percent of the time in the course.
- Competencies and Suggested Objectives
 - A **Competency** represents a general concept of performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies.
 - The **Suggested Objectives** represent the enabling and supporting knowledge and performances that will indicate mastery of the competency.
- Suggested Teaching Strategies - This section of each unit indicates strategies that can be used to enable students to master each suggested objective. Teachers should feel free to modify or enhance these suggestions based on needs of their students and resources available in order to provide optimum learning experiences for their students.

- Suggested Assessment Strategies - This section indicates strategies that can be used to measure student mastery. Examples of suggested strategies could include classroom discussions, laboratory exercises, and student assignments. Again, teachers should feel free to modify or enhance these suggested assessment strategies based on local needs and resources.
- Suggested Resources - This section indicates some of the primary instructional resources that may be used to teach the competencies and suggested objectives. Again, these resources are suggested and the list may be modified or enhanced based on needs and abilities of students and on available resources.

The following guidelines were used in developing the curriculum framework in this document and should be considered in developing local instructional management plans and daily lesson plans:

- The content of the courses in this document reflects approximately 75-80 percent of the time allocated to each course. The remaining 20-25 percent of each course should be developed at the local district level and may reflect:
 - Additional units of instruction within the course related to topics not found in the state framework.
 - Activities which develop a higher level of mastery on the existing competencies and suggested objectives.
 - Activities and instruction related to new technologies and concepts that were not prevalent at the time the current framework was developed/ revised.
 - Activities which implement components of the Mississippi Tech Prep initiative, including integration of academic and vocational-technical skills and coursework, school-to-work transition activities, and articulation of secondary and postsecondary vocational-technical programs.
 - Individualized learning activities, including worksite learning activities, to better prepare individuals in the courses for their chosen occupational area.
- Sequencing of the units of instruction within a course is left to the discretion of the local district. Naturally, foundation units related to topics such as safety, tool and equipment usage, and other basic skills should be taught first. Other units related to specific skill areas in the course, however, may be sequenced to take advantage of seasonal and climatic conditions, resources located outside of the school, and other factors.

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SECTION I:
PROGRAM DESCRIPTION
FOR
AGRICULTURAL AND ENVIRONMENTAL SCIENCE AND TECHNOLOGY

June 21, 2002

PROGRAM DESCRIPTION

AGRICULTURAL AND ENVIRONMENTAL SCIENCE AND TECHNOLOGY

Agricultural and Environmental Science and Technology (AEST) is a program which introduces students to new technologies and instructional areas leading to careers in related industries. The AEST curriculum is designed to start students with a broad base of knowledge. As they progress academically, the students are offered more specialized courses to meet their interests and the occupations offered in the local area. Workplace skills are provided along with an exposure to technology, production, environmental stewardship, agricultural literacy, and leadership.

To help students of careers in agriculture, each student will participate in a supervised experience program throughout the year. To see that these programs are learning experiences, teachers will visit each of the students during the school year and summer months to supervise the individual programs and monitor their progress.

The program consists of a series of six courses which are designed to introduce students to agricultural and environmental science and to develop the technology of agribusiness practices. Participating school districts in the pilot program must provide the core courses and will be allowed to select any two of the elective courses. Each of the courses listed are scheduled for one year and award one Carnegie unit for successful completion:

<u>Course</u>	<u>Grade Level</u>
Concepts of Agriscience Technology (Required Core Course - first in sequence)	9-10
The Science of Agricultural Animals (Elective)	10-12
The Science of Agricultural Environment (Elective)	10-12
The Science of Agricultural Mechanics (Elective)	10-12
The Science of Agricultural Plants (Elective)	10-12
Agribusiness and Entrepreneurship Technology (Required Core Course - last in series)	10-12

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SECTION II:
CURRICULUM GUIDE
FOR
CONCEPTS OF AGRISCIENCE TECHNOLOGY

June 21, 2002

**CONCEPTS OF AGRISCIENCE TECHNOLOGY
COURSE DESCRIPTION
(CIP: 02.9999)**

Concepts of Agriscience Technology is a course to introduce students to the sciences, technologies, and applied practices of the progressive agriculture/agriscience industry. Emphasis is on an active learning environment enriched with technology and science-based applications. The course serves as the entry-level course for other courses in agriculture, including horticulture and forestry. The focus is to begin the preparation of students for further study leading to successful careers in the agricultural industry. (Grades 9-10; 1 Carnegie Unit)

**CONCEPTS OF AGRISCIENCE TECHNOLOGY
COURSE OUTLINE**

<u>Unit No.</u>	<u>Title</u>	<u>No. of Hours</u>
Unit 1	Introduction to Concepts of Agriscience Technology	4
Unit 2	Leadership and Human Relations	10
Unit 3	Supervised Agricultural Experience	3
Unit 4	Principles of Animal Science	10
Unit 5	Principles of Soil Science	10
Unit 6	Principles of Plant Science	10
Unit 7	Principles of Crop Production	10
Unit 8	Principles of Horticulture	10
Unit 9	Principles of Forestry	10
Unit 10	Principles of Natural Resources	10
Unit 11	Principles of Aquaculture	10
Unit 12	Principles of Physical and Mechanical Technology	10
Unit 13	Principles of Agriculture Marketing	10

CONCEPTS OF AGRISCIENCE TECHNOLOGY
UNIT 1: INTRODUCTION TO CONCEPTS OF
AGRISCIENCE TECHNOLOGY

(4 hours)

Competencies and Suggested Objectives:

1. Examine the nature of the agricultural industry.
 - a. Explain the meaning of agriculture.
 - b. Identify and define the major areas of agriculture in the agricultural industry.
 - c. Describe the role of agriculture in the quality of human life and meeting human needs.
 - d. Explain the importance of education and training in the agricultural industry.

Related Academic Topics (See Appendix A): C1, C2, C4
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
2. Examine the relationships among the sciences, agriculture, and agriscience.
 - a. Describe the different areas of pure science.
 - b. Describe the applied sciences as related to agriculture.
 - c. Investigate the role of physical science in agriculture.
 - d. Describe the broad areas of agriculture.
 - e. Discuss the concept of agriscience and its relationships to the sciences and agriculture.
 - f. Use the scientific method to conduct research.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
3. Examine the size and scope of the total industry of agriculture from the global to local level.
 - a. Describe the role of agriculture in the global economy.
 - b. Describe the role of agriculture in the United States economy.
 - c. Describe the role of agriculture in the Mississippi economy.
 - d. Describe the role of agriculture in the local economy.

Related Academic Topics (See Appendix A): C1, C2, C4, C6, M7, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
4. Investigate current and emerging trends related to agriculture/agriscience.
 - a. Identify sources of information on current and emerging trends in agriculture/agriscience.
 - b. Discuss examples of new and emerging trends and practices in agriculture/agriscience.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
5. Examine standard agricultural safety and work practices.
 - a. Identify safety and work standards for the agricultural classroom and laboratory.
 - b. Identify on-the-farm safety and work standards.
 - c. Identify agricultural industry related safety and work standards.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Examine the nature of the agricultural industry.*
 - a. *Provide textbooks or reference materials to students for supervised study. Follow with class discussion and use student input to develop an outline of the major concepts.*
 - b. *Administer the AgriScience Interest Inventory to help students identify their interests in the major areas of the agricultural industry. Use student scores on the Inventory as a basis for helping students identify areas of particular interest as they pursue education and career training.*
 - c. *Form students into cooperative learning groups to investigate the role of agriculture in meeting human needs. Have each group identify and classify as many products as possible that humans need that are produced by the agricultural industry. Allow each group to report to the overall class.*
 - d. *Have students investigate and give an oral report on an occupation in the agricultural industry that is of particular interest.*
2. *Examine the relationships among the sciences, agriculture, and agriscience.*
 - a. *Introduce the students to the different areas of pure science including biology, chemistry, and physics. Discuss with the students the elements which compose each pure science.*
 - b. *Describe to the students the different areas of applied sciences in agriculture such as genetics, crop science, soil science, animal science, biotechnology, etc. Discuss how these applied sciences relate to the pure sciences.*
 - c. *Investigate the role of physical science in agriculture.*
 - d. *Describe the broad areas of agriculture.*
 - e. *Discuss the concept of agriscience and its relationships to the sciences and agriculture.*
 - f. *Oral and written assignment to use the scientific method to conduct research.*
3. *Examine the size and scope of the total industry of agriculture from the global to local level.*
 - a. *Show videotape that describes the global agriculture industry and how global economics affect agriculture at the national, state, and local levels.*
 - b. *Discuss with the students the role of agriculture in the United States economy. In the discussion, include references to current events in the news that affect agriculture.*
 - c. *Discuss with the students the role of agriculture in Mississippi. Identify some of the major agricultural enterprises including forestry, poultry, aquaculture, row crops, and beef cattle.*
 - d. *Discuss with the students the role of agriculture in the local area. Identify the major agriculture enterprises and the businesses, industries, and governmental agencies which support them.*
4. *Investigate current and emerging trends related to agriculture/agriscience.*

- a. *Show students sources of information that can be used to identify and learn more about current and emerging trends in agriculture. Include examples such as experiment station bulletins and newsletters, agricultural journals, the Internet and World Wide Web, television programs, etc. Point out to the students that they will have to utilize these resources throughout the course to develop a better understanding of current and emerging trends in the agriculture/agriscience industry.*
- b. *Provide students with some illustrations of current and emerging technologies such as precision farming, tissue culture, embryo transplants, etc. Use these examples to further demonstrate the interrelationship between the sciences, agricultural enterprises, and agriscience.*
5. *Examine standard agricultural safety and work practices.*
 - a. *Identify safety and work standards for the agricultural classroom and laboratory.*
 - b. *Identify on-the-farm safety and work standards.*
 - c. *Identify agricultural industry related safety and work standards.*

Suggested Assessment Strategies:

1. *Examine the nature of the agricultural industry.*
 - a. *Use a written or oral test over objectives a-d.*
 - b. *Observation of student reports in class.*
 - c. *Observation of individual participation in cooperative learning groups.*
2. *Examine the relationships among the sciences, agriculture, and agriscience.*
 - a. *Unit test covering objectives a-f.*
3. *Examine the size and scope of the total industry of agriculture from the global to local level.*
 - a. *Unit test covering objectives a-d.*
4. *Investigate current and emerging trends related to agriculture/agriscience.*
 - a. *Unit test covering objectives a-b.*
5. *Examine standard agricultural safety and work practices.*
 - a. *Unit test covering objectives a-c.*

Suggested Resources:

Introduction to Agriculture™ (computer-based module).

Choices [Computer Software]. (2002). Ogdensburg, NY: Bridges.com Inc.

Chronicle agricultural occupations guidebook. (1997). Moravia, NY: Chronicle Guidance Publication, Inc.

Cooper, E. L. (1997). Agriscience: Fundamentals and applications (2nd ed.). Albany, NY: Delmar Publishers.

Global vision™ (Videotape available from National Council on Agricultural Education,

Alexandria, VA 22314).

Morgan, E. M., Chelewski, R. E., Lee, J. S., & Wilson, E. (2000). AgriScience explorations. (2nd ed.). Danville, IL: Interstate Publishers, Inc.

CONCEPTS OF AGRISCIENCE TECHNOLOGY
UNIT 2: LEADERSHIP AND HUMAN RELATIONS

(10 hours)

Competencies and Suggested Objectives:

1. Examine the role of FFA in agricultural education.
 - a. Examine the history of the FFA.
 - b. Examine the types and degrees of membership in FFA.
 - c. Identify the leadership development and career opportunities in FFA.
Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP2, WP3, WP6, WP7, WP8
2. Examine the concept of leadership.
 - a. Explain the role of effective leadership.
 - b. List and discuss major traits of effective leaders.
 - c. Develop a plan for developing personal leadership qualities.
Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP2, WP3, WP6, WP7, WP8
3. Develop interpersonal skills necessary for successful careers.
 - a. Identify and describe essential interpersonal skills.
 - b. Explain the concepts of team building and team member participation.
 - c. Participate in communication exercise(s) to build interpersonal communication skills.
 - d. Demonstrate skills in parliamentary procedure.
Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP2, WP3, WP6, WP7, WP8
4. Describe the role of work ethics and values in establishing and building a successful career.
 - a. Identify and describe universally accepted work ethics and values.
 - b. Practice work ethics and values in the agriscience classroom and lab.
(ongoing)
Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP2, WP3, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Examine the role of FFA in agricultural education.*
 - a. *Oral and written report to examine the history of the FFA.*
 - b. *Oral and written report to examine the types and degrees of membership in FFA*
 - c. *Practical exercise to identify the leadership development and career opportunities in FFA.*

2. *Examine the concept of leadership.*
 - a. *Use supervised study followed by class discussion to define the concept of leadership and identify its role in leading teams of people to plan, develop, and manage advances in science and technology related to agriculture.*
 - b. *Identify and discuss the characteristics of an effective leader including integrity, honesty, courage, tact, enthusiasm, and loyalty.*
 - c. *Identify and discuss with the students opportunities and activities through which they can develop leadership skills through youth organizations. Provide examples of such activities available through the FFA.*
 - d. *Have each student develop a plan for developing his/her own leadership qualities. The plan should include a description of each quality and means for further development.*
3. *Develop interpersonal skills necessary for successful careers.*
 - a. *Identify and discuss with the students other interpersonal skills associated with successful careers including team work, getting along with coworkers and supervisors, serving clients and customers, negotiation, and working with persons from diverse cultures. Discuss examples of how these skills apply on the job and relate to successful career advancement.*
 - b. *Discuss the team concept as applied in agriscience today and the duties and responsibilities of different team members. Discuss the concept of team building.*
 - c. *Have students conduct a basic communication exercise in which each student must effectively communicate some idea or concept to another student.*
 - d. *Practical exercise to demonstrate skills in parliamentary procedure.*
4. *Describe the role of work ethics and values in establishing and building a successful career.*
 - a. *Identify and describe the universally accepted work ethics and values in American society. Include traits such as honesty, promptness and punctuality, concern for the rights of others, etc.*
 - b. *Have students develop a checklist to document their practice of the universally accepted work ethics and values in their school and personal lives. This should be an ongoing activity throughout the school year.*

Suggested Assessment Strategies:

1. *Examine the role of FFA in agricultural education.*
 - a. *Oral and/ written report - Examine the history of the FFA.*
 - b. *Oral and/ written report - Examine the types and degrees of membership in FFA*
 - c. *Practical activity - Identify the leadership development and career opportunities in FFA.*
2. *Examine the concept of leadership.*
 - a. *Unit test on objectives a-c.*
 - b. *Evaluation of student's personal plan for developing personal leadership qualities.*

3. *Develop interpersonal skills necessary for successful careers.*
 - a. *Unit test on objectives a-b.*
 - b. *Evaluation of student performance on basic parliamentary procedures exercise.*
 - c. *Evaluation of student performance on interpersonal communications exercise.*
 - d. *Practical activity - Demonstrate skills in parliamentary procedure.*
4. *Describe the role of work ethics and values in establishing and building a successful career.*
 - a. *Unit test on objective a.*
 - b. *Evaluation of checklist on a periodic basis.*

Suggested Resources:

Cooper, E. L. (1997). Agriscience: Fundamentals and applications (2nd ed.). Delmar Publishers.

Morgan, E. M., Chelewski, R. E., Lee, J. S., & Wilson, E. (2000). AgriScience explorations. (2nd ed.). Danville, IL: Interstate Publishers, Inc.

CONCEPTS OF AGRISCIENCE TECHNOLOGY
UNIT 3: SUPERVISED AGRICULTURAL EXPERIENCE

(3 hours)

Competencies and Suggested Objectives:

1. Explain basic concepts associated with supervised experience.
 - a. Describe the purpose and benefits of supervised experience in agriscience.
 - b. Identify and describe the types of supervised experience.
 - c. Identify personal interests associated with selecting a supervised experience.
Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP4, WP6, WP7, WP8
2. Plan supervised experience(s).
 - a. Identify long-range and short-range goals of supervised experience.
 - b. Identify resources and opportunities for supervised experience to include a training agreement and a net worth statement.
 - c. Develop a plan for conducting supervised experience during the current year.
Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP4, WP6, WP7, WP8
3. Implement and evaluate a supervised experience.
 - a. Identify records required for each type of supervised experience and discuss their purpose.
 - b. Maintain records of supervised experience.
 - c. Prepare an end-of-the-year summary of the supervised experience.
Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP4, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Explain basic concepts associated with supervised experience.*
 - a. *Describe the major purposes and benefits of supervised experience in agriscience, emphasizing its connection to the real world and its role in the total program of agricultural education.*
 - b. *Identify the different types of supervised experience in agriscience including exploratory, entrepreneurship, placement, and research/experimentation experiences. Discuss the characteristics and benefits of each type of experience and provide illustrations of successful experience in each type.*
 - c. *Have students complete a personal interest inventory to identify their own interests associated with agriscience and supervised experiences. (Note: Some students may have already completed an inventory in previous years. They should compare results if possible to see how their interests have changed. An interest inventory and other self-appraisal tools are available in the Choices™ career guidance software package found in many school career or guidance centers.)*
2. *Plan supervised experience(s).*

- a. *Discuss with the students the relationship of short-term and long-term goals in planning supervised experience and future careers. Provide examples of suitable short-term and long-term goals for different supervised experiences.*
- b. *Identify and discuss the different resources required to conduct each of the different types of supervised experience. Also discuss different opportunities commonly found in the school district.*
- c. *Provide students with examples of long-term and short-term plans for the different types of supervised experience. Have students prepare a long-range plan and then a short-term plan for the rest of the school year. (Note: This plan should relate to the student's career/educational plan maintained by the school guidance department. A copy of the supervised experience plans may be included in the student's folder.)*
3. *Implement and evaluate a supervised experience.*
 - a. *For each type of supervised experience, identify the records that should be maintained by the student. This includes income and expenses, time spent in supervised experience, activities and skills performed, and results of the experience.*
 - b. *Have students maintain necessary records for their supervised experience. These records should be checked throughout the year.*
 - c. *At the end of the year, have students prepare an end-of-the-year summary of their experience(s), including their own evaluation of the effectiveness of each experience and the skills and knowledge learned.*

Suggested Assessment Strategies:

1. *Explain basic concepts associated with supervised experience.*
 - a. *Unit test covering objectives a-b.*
 - b. *Evaluation of student's completion of interest inventory.*
2. *Plan supervised experience(s).*
 - a. *Unit test on objectives a-b.*
 - b. *Evaluation of student's short-term and long-range plans.*
3. *Implement and evaluate a supervised experience.*
 - a. *Periodic evaluation of the student's supervised experience records throughout the year.*

Suggested Resources:

Cooper, E. L. (1997). Agriscience: Fundamentals and applications (2nd ed.). Albany, NY: Delmar Publishers.

Morgan, E. M., Chelewski, R. E., Lee, J. S., & Wilson, E. (2000). AgriScience explorations. (2nd ed.). Danville, IL: Interstate Publishers, Inc.

CONCEPTS OF AGRISCIENCE TECHNOLOGY
UNIT 4: PRINCIPLES OF ANIMAL SCIENCE

(10 hours)

Competencies and Suggested Objectives:

1. Explore the animal agriculture industry and enterprises.
 - a. Identify ways animals benefit people.
 - b. Describe the different classes of domestic animals, including food animals.
 - c. Identify and discuss the major animal industry enterprises including poultry and eggs, catfish, beef cattle, dairy, swine, and goat production.
 - d. Describe the development of important breeds of animals.
 - e. Discuss the concept of animal well-being as related to agricultural animal enterprises.

Related Academic Topics (See Appendix A): C1, C2, C4, C6, S3

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

2. Describe the role of biological science in animal production.
 - a. Identify important body structures including cells, tissues, and organs.
 - b. Explain how animals grow by cell mitosis and maturation.
 - c. List and explain the life processes of animals.
 - d. Identify the body systems of animals and explain the functions of each.
 - e. Identify the major external body parts of cattle, swine, and sheep.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S3

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

3. Examine the role of genetics and breeding in animal production.
 - a. Explain basic concepts of heredity and genetics.
 - b. Describe the role of breeding systems in animal production.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, S3

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

4. Explore current and emerging trends, technologies, and career opportunities associated with animal science.
 - a. Identify trends in technology related to animal science.
 - b. Describe the impact of emerging technology on careers in animal science.
 - c. Determine sources of information using the Internet and other resources.

Related Academic Topics (See Appendix A): C1, C2, C4, C6, S3

Workplace Skills (See Appendix B): WP2, WP3, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Explore the animal agriculture industry and enterprises.*
 - a. *Form cooperative learning groups and use computer-based module materials on animal science and production.*
 - b. *Provide textbooks, references, and other materials for supervised study followed by discussion, journaling, and testing with feedback and re-teaching.*
 - c. *Discuss with the students the concepts of animal well-being as related to agricultural animal enterprises.*

2. *Describe the role of biological science in animal production.*
 - a. *Use computer-based materials that address the basic biology of different classes of domestic animals including food animals (cattle, hogs, poultry, sheep, and goats). Have students describe the role of each class of animals as related to humankind.*
 - b. *Use microscopes and prepared slides of cells for students to identify the major parts of a cell. Each student should prepare a sketch of the cell.*
 - c. *Supervise study of printed and computer-based material to identify and describe the life processes of animals.*
 - d. *Use drawings of internal organs, organ systems, and external parts for identification of major animal parts. Have students label the major parts on a drawing of an animal.*
3. *Examine the role of genetics and breeding in animal production.*
 - a. *Supervise study of printed and computer-based material to explore heredity, genetics, and related areas in animal production.*
 - b. *Supervise study of printed and computer-based materials to describe breeding systems used in animal production and determine the advantages and disadvantages of each.*
4. *Explore current and emerging trends, technologies, and career opportunities associated with animal science.*
 - a. *Supervise study of printed and computer-based materials to identify trends and the technologies associated with them.*
 - b. *Form cooperative learning groups to study the impact of technology on career opportunities in the animal industries.*
 - c. *Use independent investigation of Internet resources on animal science.*

Suggested Assessment Strategies:

1. *Explore the animal agriculture industries and enterprises.*
 - a. *Unit test on objectives a-e.*
 - b. *Observation of student performance in learning groups and with supervised study.*
 - c. *Oral or written reports on the major animal enterprises.*
 - d. *Demonstrated care of animals in supervised experience to reflect animal well-being.*
2. *Describe the role of biological science in animal production.*
 - a. *Unit test on objectives a-e.*
 - b. *Observation of student performance in using microscope to identify cell parts and prepare a sketch of the cell that was observed.*
 - c. *Written reports and journal entries on the life processes of animals.*
 - d. *Demonstrated ability of individuals to identify internal and external body parts of animals.*
3. *Examine the role of genetics and breeding in animal production.*
 - a. *Unit test on objectives a-c.*
 - b. *Observation of student performance in supervised study using printed or*

- computer-based materials.*
4. *Explore current and emerging trends, technologies, or career opportunities associated with animal science.*
 - a. *Unit test on objectives a-c.*
 - b. *Observation of student participation in cooperative learning groups and using resources to locate information.*
 - c. *Information identified as available through Internet resources.*

Suggested Resources:

Animal scienceTM (computer-based module).

Cooper, E. L. (1997). Agriscience: Fundamentals and applications (2nd ed.). Albany, NY: Delmar Publishers.

Morgan, E. M., Chelewski, R. E., Lee, J. S., & Wilson, E. (2000). AgriScience explorations. (2nd ed.). Danville, IL: Interstate Publishers, Inc.

CONCEPTS OF AGRISCIENCE TECHNOLOGY
UNIT 5: PRINCIPLES OF SOIL SCIENCE

(10 hours)

Competencies and Suggested Objectives:

1. Describe the physical characteristics of soil.
 - a. Explain the meaning and importance of soil.
 - b. Describe the process of soil formation.
 - c. Distinguish between physical and chemical weathering.
 - d. Identify the components of soil.
 - e. Classify the texture of a soil.
 - f. Identify the different profiles of a soil and discuss their importance.
 - g. Investigate the internal and external drainage of soils.
 - h. Discuss the use of chemical and physical soil amendments to improve texture and drainage.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7, S4

Workplace Skills (See Appendix B): WP2, WP3, WP4, WP6, WP7, WP8

2. Investigate the chemical characteristics of soils.
 - a. State the purpose of soil testing and develop a soil testing plan.
 - b. Describe how to take a soil sample.
 - c. Determine soil pH and describe how it affects the productivity of a soil.
 - d. Describe liming and acidifying practices.
 - e. Identify the macro and micro nutrients in a soil which promote plant growth.
 - f. Explain the meaning and importance of fertilizers.
 - g. Compare and contrast fertilizer grade and analysis.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M1, M4, M7, S4, S8

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

3. Determine the capability class of land.
 - a. Define land and distinguish land from soil.
 - b. Describe the concept of land capability classes and highest productive use.
 - c. Describe factors that determine the capability class of land.
 - d. Classify land as to its highest productive use.

Related Academic Topics (See Appendix A): C1, C2, C4, C6, S4, S8

Workplace Skills (See Appendix B): WP2, WP4, WP6, WP7, WP8

4. Examine soil conservation practices.
 - a. Discuss soil degradation.
 - b. Describe the different types of soil erosion.
 - c. Identify and discuss the applications of soil conservation practices.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S4

Workplace Skills (See Appendix B): WP2, WP4, WP6, WP7, WP8

5. Explore current and emerging trends, technologies, and career opportunities associated with soil science.
 - a. Identify trends in soil science areas.
 - b. Describe important areas of emerging technologies in soil science.

c. Describe career opportunities in areas related to soil science.

Related Academic Topics (See Appendix A): C1, C2, C4, C6, S4

Workplace Skills (See Appendix B): WP2, WP4, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Describe the physical characteristics of soils.*
 - a. *Use supervised study with printed or computer-based materials followed by discussion and/or feedback from individual students on the meaning and importance of soil.*
 - b. *Use supervised study with computer-based or printed materials on the process of soil formation.*
 - c. *Use specimens of materials in various stages of weathering and have students assess the condition of the materials as related to soil.*
 - d. *Identify the components of soil (air, water, mineral matter, and organic matter) and show the approximate percent of each in a desired soil. Identify the three types of soil particles (sand, silt, and clay) and compare the size of each.*
 - e. *Use learning materials that describe soil texture and show how soil texture is determined by the percentage of sand, silt, or clay.*
 - f. *Use materials that describe the layers of the soil profile (topsoil, subsoil, and parent material) and show how to identify each. Use cooperative learning groups for students to discuss how the depth of soil is determined in relation to the thickness of the topsoil and subsoil.*
 - g. *Use computer-based or printed materials that describe soil permeability and describe how the four degrees of permeability (moderate, slow, very slow, and rapid) are determined. Discuss slope surface runoff and the effect on soil drainage.*
 - h. *Use computer-based or printed materials that explain the use of soil amendments to alter the physical and chemical nature of soil.*
2. *Investigate the chemical characteristics of soils.*
 - a. *Use supervised study with printed or computer-based materials that describe the purpose of soil testing and show how to develop a soil testing plan.*
 - b. *Use soil sampling instructional materials or instructions from analysis kits to describe how to take a soil sample.*
 - c. *Use printed or computer-based materials in supervised study that describe the pH scale and show the desired pH scale for most agricultural crops as related to crop yield and soil productivity.*
 - d. *Use supervised study or presentations to explain how soil pH affects plant growth.*
 - e. *Use cooperative learning groups and supervised study to identify and describe the function of macro nutrients (N, P, K, Ca, Mg, and S) in the soil in relation to plant growth. Follow the same procedure to identify micro nutrients in the soil that promote plant growth.*
 - f. *Use independent or cooperative group study on the meaning and importance of fertilizers and how fertilizers are graded.*

- g. *Provide a sample fertilizer analysis label and have students describe the nutrient content of the product.*
3. *Determine the capability class of land.*
 - a. *Use supervised study with printed or computer-based materials that describe the meaning of land and the factors that are involved in assessing land.*
 - b. *Demonstrate how permeability, depth, slope, erosion and runoff are used to determine the highest land use.*
 - c. *Use printed or computer-based materials that describe the eight land capability classes and discuss the characteristics of each.*
4. *Examine soil conservation practices.*
 - a. *Use supervised study with printed and/or computer-based materials that explain soil degradation.*
 - b. *Provide materials and use supervised study or cooperative group learning to identify the types of soil erosion. Discuss the four degrees of erosion and show how to determine degree of erosion.*
 - c. *Use computer-based or printed materials that explain the management practices that reduce or prevent erosion of the soil such as cover crops, mulching, conservation tillage, terraces, strip cropping, and crop rotation.*
5. *Explore current and emerging trends, technologies, and career opportunities associated with soil science.*
 - a. *Use supervised study with printed and computer-based materials to identify trends in soil science and the technologies associated with them.*
 - b. *Use cooperative group study of the impact of technology on career opportunities in soil science.*
 - c. *Use independent investigation of Internet resources on soil science.*

Suggested Assessment Strategies:

1. *Describe the physical characteristics of soil.*
 - a. *Unit test on objectives a-h.*
 - b. *Observation of student performance with supervised study using computer-based and/or printed materials.*
 - c. *Demonstrated skill by individuals in assessing the classification of soil based on texture.*
2. *Investigate the chemical characteristics of soils.*
 - a. *Unit test on objectives a-g.*
 - b. *Demonstrated skill in taking a soil sample.*
 - c. *Demonstrated skill in testing a soil sample for pH and nutrients.*
3. *Determine the capability class of land.*
 - a. *Unit test on objectives a-d.*
 - b. *Demonstrated skill in classifying land as to its highest productive use.*
4. *Examine soil conservation practices.*
 - a. *Unit test on objectives a-c.*
 - b. *Demonstrated ability to select appropriate soil conservation practices.*
5. *Explore current and emerging trends, technologies, and career opportunities*

associated with soil science.

a. Unit test on objectives a-c.

b. Observation of oral and/or written reports prepared by students.

c. Observation of student performance in using the Internet to locate information on soil science.

Suggested Resources:

Cooper, E. L. (1997). Agriscience: Fundamentals and applications. Albany, NY: Delmar Publishers.

Land judging. (Current ed.). Mississippi State, MS: Mississippi Cooperative Extension Service.

Morgan, E. M., Chelewski, R. E., Lee, J. S., & Wilson, E. (2000). AgriScience explorations. (2nd ed.). Danville, IL: Interstate Publishers, Inc.

Soil scienceTM (computer-based module).

CONCEPTS OF AGRISCIENCE TECHNOLOGY
UNIT 6: PRINCIPLES OF PLANT SCIENCE

(10 hours)

Competencies and Suggested Objectives:

1. Investigate the physical characteristics and processes of plants.
 - a. Diagram a plant showing the major parts and describing the functions of the parts.
 - b. Describe the process of photosynthesis.
 - c. Describe the process of transpiration.
 - d. Describe the process of respiration.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7, S2
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
2. Explore the requirements for plant growth.
 - a. Identify and describe the functions of the primary plant nutrients.
 - b. Identify and describe the functions of the secondary plant nutrients.
 - c. Recognize symptoms of nutritional deficiencies in plants.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2, S8
Workplace Skills (See Appendix B): WP2, WP4, WP6, WP7, WP8
3. Examine the process of plant reproduction.
 - a. Describe the process of sexual reproduction in plants including the process of pollination in complete and incomplete flowers.
 - b. Describe common methods of asexual propagation including cuttings, layering, grafting, and tissue culture.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2
Workplace Skills (See Appendix B): WP2, WP3, WP6, WP7, WP8
4. Explore current and emerging trends, technologies, and career opportunities associated with plant science.
 - a. Identify trends in areas of plant science.
 - b. Describe important areas of emerging technologies in plant science.
 - c. Describe career opportunities in areas of plant science.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2
Workplace Skills (See Appendix B): WP2, WP3, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Investigate the physical characteristics and processes of plants.*
 - a. *Provide printed and/or computer-based materials that show diagrams and discuss the parts of a plant and their functions. Use these materials in supervised study or cooperative learning groups.*

- b. *Use supervised study involving printed and/or computer-based materials that describe the process of photosynthesis and discuss the chemical reactions which take place during the process. The materials should cover the effects of photosynthesis on plant growth and its beneficial effects on the environment.*
 - c. *Use cooperative learning groups or supervised study and provide computer-based and/or printed materials that cover the process of transpiration in plants and its implications for plant production and growth.*
 - d. *Provide printed and/or computer-based materials that discuss the process of respiration in plants, including the chemical changes which take place during the process and compare respiration to photosynthesis.*
2. *Explore the requirements for plant growth.*
 - a. *Provide printed and/or computer-based materials for supervised study that identify the primary plant nutrients. Discuss their sources and functions and the difference between plant nutrition and plant fertilization.*
 - b. *Provide printed and/or computer-based materials for supervised study that identify the macro nutrients. Discuss their function as related to plant growth.*
 - c. *Use printed and/or computer-based materials for cooperative group learning that examine the symptoms of nutritional deficiencies that decrease plant health, vigor, and growth.*
3. *Examine the process of plant reproduction.*
 - a. *Provide computer-based and/or printed materials that discuss the process of sexual reproduction in plants, including the process of pollination in complete and incomplete flowers.*
 - b. *Use student-oriented printed and/or computer-based materials that demonstrate common methods of asexual propagation including cuttings, layering, grafting, and tissue culture. Allow students to practice each in teams.*
4. *Explore current and emerging trends, technologies, and career opportunities associated with plant science.*
 - a. *Use supervised study with printed and/or computer-based materials to identify trends in plant science and the technologies associated with the trends.*
 - b. *Form cooperative learning groups for studying the impact of technology on career opportunities in plant science.*
 - c. *Use independent investigation of Internet resources in plant science.*

Suggested Assessment Strategies:

1. *Investigate the physical characteristics and processes of plants.*
 - a. *Unit test on objectives a-d.*
 - b. *Observation of student performance in supervised study with computer-based and/or printed materials on the parts of plants and their functions.*
2. *Explore the requirements for plant growth.*
 - a. *Unit test on objectives a-b.*
 - b. *Observation of student performance in supervised study and cooperative learning group participation as related to recognizing common nutritional deficiencies in plants.*

3. *Examine the process of plant reproduction.*
 - a. *Unit test on objectives a-b.*
 - b. *Evaluation of student performance in demonstrating common methods of asexual propagation.*
4. *Explore current and emerging trends, technologies, and career opportunities associated with plant science.*
 - a. *Unit test on objectives a-c.*
 - b. *Observation of student performance in supervised study or cooperative learning groups.*
 - c. *Quality of report on Internet resources available in plant science.*

Suggested Resources:

Cooper, E. L. (1997). Agriscience: Fundamentals and applications. Albany, NY: Delmar Publishers.

Morgan, E. M., Chelewski, R. E., Lee, J. S., & Wilson, E. (2000). AgriScience explorations. (2nd ed.). Danville, IL: Interstate Publishers, Inc.

Plant scienceTM (computer-based module).

CONCEPTS OF AGRISCIENCE TECHNOLOGY
UNIT 7: PRINCIPLES OF CROP PRODUCTION

(10 hours)

Competencies and Suggested Objectives:

1. Investigate the importance of crop production.
 - a. List the major uses of crop plant products.
 - b. Classify crops by the kind of product produced.
 - c. Classify crops by the part of the plant that is used.
 - d. Identify common crops based on seed, leaf structure, and other physical features.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, S2
Workplace Skills (See Appendix B): WP2, WP7, WP8
2. Identify cultural practices in crop production.
 - a. Determine the growing conditions needed by crops.
 - b. List important factors in crop selection.
 - c. Describe the selection of crop varieties.
 - d. Explain seedbed preparation and tillage.
 - e. Describe the process of planting seed and the types of planters used.
 - f. Describe the importance of using soil amendments based on soil analysis and crop needs.
 - g. Explain irrigation and how it is used.
 - h. List sources of potential loss in crop production.

Related Academic Topics (See Appendix A): C1, C2, C4, S8
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
3. Explore basic concepts of pest management.
 - a. Identify the different classes of pests and describe the ways in which they cause damage and loss in agricultural enterprises.
 - b. Identify the different classes of pest control strategies and describe their advantages and disadvantages.
 - c. Discuss principles and concepts of integrated pest management systems.
 - d. Describe safety and environmental concerns associated with the use of chemical pesticides.
 - e. Classify pesticides as herbicides, insecticides, and fungicides.
 - f. Interpret a pesticide label.
 - g. Select an approach in pest management for a given crop and situation.

Related Academic Topics (See Appendix A): C1, C2, C4, C6, S3, S5, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
4. Explain practices in harvesting crops.
 - a. Define harvesting and explain how the process varies with the kind of crop.
 - b. Select machinery appropriate for harvesting a crop.
 - c. Describe when harvesting should occur.
 - d. List advantages and disadvantages of crop storage.

Related Academic Topics (See Appendix A): C1, C2, C4, C5
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Investigate the importance of crop production.*
 - a. *Provide printed and/or computer-based materials for supervised study on crop production.*
 - b. *Present examples of processed food products and have students match the product with the kind of crop that was used to produce the food, such as bread from wheat and tortilla chips from corn.*
 - c. *Provide specimens of crop seed, leaves, flowers, and other structures for students to use in identifying crop plants.*
2. *Identify cultural practices in crop production.*
 - a. *Provide printed and/or computer-based materials for supervised study on cultural practices in crop production.*
 - b. *Assess seed for quality, including the presence of trash and germination. Have students perform a rag doll seed germination test and calculate the percentage of germination.*
 - c. *Provide bulletins and other materials that report crops grown in the local area and have students investigate the cultural practices for each crop.*
3. *Explore basic concepts of pest management.*
 - a. *Provide printed and/or computer-based materials for supervised study or for use in cooperative learning groups.*
 - b. *Provide local bulletins or other materials that depict pests and the problems caused as well as control measures in various crops.*
 - c. *Form cooperative learning groups for students to assess pest management situations with local crops and select an appropriate approach in managing the pests.*
4. *Explain practices in harvesting crops.*
 - a. *Provide printed and/or computer-based materials for supervised study on harvesting crops.*
 - b. *Have students provide written or oral reports on harvesting crops produced in the local area, including stage of maturity, weather conditions, equipment used, and post-harvest management.*

Suggested Assessment Strategies:

1. *Investigate the importance of crop production.*
 - a. *Unit test on objectives a-d.*
 - b. *Observation of student performance in supervised study and with cooperative learning groups.*
2. *Identify cultural practices in crop production.*
 - a. *Unit test on objectives a-h.*
 - b. *Observation of student performance in supervised study and in carrying out*

- learning activities.*
3. *Explore basic concepts of pest management.*
 - a. *Unit test on objectives a-g.*
 - b. *Demonstrated ability of students to apply integrated pest management in their supervised experience that involves crop production.*
 4. *Explain practices in harvesting crops.*
 - a. *Unit test on objectives a-d.*
 - b. *Observation of student participation in cooperative learning and with supervised study.*

Suggested Resources:

Biondo, R. J., & Lee, J. S. (1997). Introduction to plant and soil science and technology. Danville, IL: Interstate Publishers, Inc.

Crop productionTM (computer-based module).

Morgan, E. M., Chelewski, R. E., Lee, J. S., & Wilson, E. (2000). AgriScience explorations. (2nd ed.). Danville, IL: Interstate Publishers, Inc.

CONCEPTS OF AGRISCIENCE TECHNOLOGY
UNIT 8: PRINCIPLES OF HORTICULTURE

(10 hours)

Competencies and Suggested Objectives:

1. Examine the nature of horticulture.
 - a. Define and describe the major areas of horticulture.
 - b. Compare and contrast agriculture and horticulture.
 - c. Relate horticulture to the environment.
 - d. Identify the impact of horticulture on the economy.
 - e. Describe the nature and scope of horticulture in the local area.

Related Academic Topics (See Appendix A): C1, C2, C3
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
2. Determine the role of biological science in horticulture.
 - a. Classify horticultural plants based on life cycle, scientific classification, and cultivar.
 - b. Describe methods of plant propagation.
 - c. Identify examples of annual and perennial plants in horticulture.

Related Academic Topics (See Appendix A): C1, C2, C4, S2
Workplace Skills (See Appendix B): WP2, WP7, WP8
3. Examine how to use a greenhouse in growing plants.
 - a. Explain the importance of greenhouses in plant production.
 - b. Describe the four types of greenhouses and how they function.
 - c. Explain how to control light, temperature, humidity, and irrigation in a greenhouse.
 - d. List the types of systems used to control the greenhouse environment.
 - e. Describe the maintenance needed on a greenhouse.
 - f. Identify and practice safety in greenhouse work.
 - g. Describe general practices used in producing greenhouse crops.

Related Academic Topics (See Appendix A): C1, C2, C4
Workplace Skills (See Appendix B): WP1, WP2, WP7, WP8
4. Describe the fundamentals of landscaping.
 - a. Explain the phases in planning and installing a landscape.
 - b. Identify the steps in the landscape design process.
 - c. List and explain the five basic principles of landscape design.
 - d. Classify plants as trees, shrubs, ground covers, flowers, or turf and give examples of each.
 - e. Prepare a simple landscape plan.
 - f. Describe how to establish a lawn as part of a landscape plan including selecting turf variety, preparing the soil, using soil amendments, and irrigating.

Related Academic Topics (See Appendix A): C1, C2, C4, C6
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Examine the nature of horticulture.*
 - a. *Provide printed or computer-based learning materials for independent or cooperative group learning. As appropriate, use individual and class discussion of topics to reinforce learning.*
 - b. *Provide information about horticulture in the local area including the nature of the industry, number employed, and value of crops or services.*
2. *Determine the role of biological science in horticulture.*
 - a. *Use supervised study or cooperative learning group approaches with printed and/or computer-based materials.*
 - b. *Provide specimens of plants in the local area for students to classify by life cycle and other features.*
 - c. *Provide information on methods of propagation used with various species and cultivars of plants.*
3. *Examine how to use a greenhouse in growing plants.*
 - a. *Provide printed or computer-based learning materials for supervised study or cooperative learning.*
 - b. *Have students observe the school greenhouse for construction details including design and environmental controls.*
 - c. *Have students prepare a written plan for maintaining a greenhouse.*
 - d. *Have students construct a poster with the major safety rules for working in a greenhouse.*
 - e. *Have students prepare a cropping plan for a greenhouse that makes use of the facility on a year-round basis.*
4. *Describe the fundamentals of landscaping.*
 - a. *Provide printed or computer-based learning materials on the fundamentals of landscaping that can be used for independent or cooperative learning.*
 - b. *Have students prepare or modify an existing landscape plan to improve the aesthetics and function of an area.*
 - c. *Have students prepare a year-round calendar of activities in maintaining a landscape.*

Suggested Assessment Strategies:

1. *Examine the nature of horticulture.*
 - a. *Unit test on objectives a-e.*
 - b. *Observation of student performance in supervised study or cooperative learning groups.*
2. *Determine the role of biological science in horticulture.*
 - a. *Unit test on objectives a-c.*

- b. Observation of student performance in using learning materials to identify plants and describe methods of propagation.*
- 3. Examine how to use a greenhouse in growing plants.*
 - a. Unit test on objectives a-g.*
 - b. Quality of written plans prepared by student for maintaining a greenhouse and producing crops in a greenhouse.*
 - c. Quality of poster prepared to display in a greenhouse that lists important safety rules.*
- 4. Describe the fundamentals of landscaping.*
 - a. Unit test on objectives a-e.*
 - b. Demonstrated skill in preparing or modifying a simple landscape plan.*
 - c. Observation of student performance with independent and group learning activities.*

Suggested Resources:

Horticulture™ (computer-based module).

Reiley, H. E., & Shry, C. L., Jr. (1996). Introductory horticulture. Albany, NY: Delmar Publishers

Schroeder, C. B., Seagle, E. D., Felton, L. M., Ruter, J. M. Kelley, W. T., & Krewer, G. (1997). Introduction to horticulture science and technology (2nd ed.). Danville, IL: Interstate Publishers, Inc.

CONCEPTS OF AGRISCIENCE TECHNOLOGY
UNIT 9: PRINCIPLES OF FORESTRY

(10 hours)

Competencies and Suggested Objectives:

1. Examine the importance of forestry.
 - a. Explain the meaning of forestry.
 - b. List uses of forestry products.
 - c. Describe the benefits of forestry to the public.
 - d. Describe the purpose of a forest management plan.

Related Academic Topics (See Appendix A): C1, C2, C4
Workplace Skills (See Appendix B): WP2, WP7, WP8
2. Describe forest production and management.
 - a. Explain the natural forest cycle.
 - b. Identify ways of classifying forests.
 - c. Compare and contrast mensuration and biometrics.
 - d. Determine how forests are measured and select the appropriate measuring tool.
 - e. Classify common silviculture practices.
 - f. Identify common insect and disease pests in forest production.
 - g. Describe artificial reforestation methods.
 - h. List methods of selling timber.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, M4, M7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
3. Investigate forest fire prevention.
 - a. Explain a fire triangle.
 - b. Describe the advantages and disadvantages of forest fires.
 - c. Explain the importance of preventing uncontrolled fires.
 - d. Describe the use of prescribed fires.

Related Academic Topics (See Appendix A): C1, C2, C4, C5
Workplace Skills (See Appendix B): WP2, WP7, WP8

Suggested Teaching Strategies:

1. *Examine the importance of forestry.*
 - a. *Provide printed or computer-based learning material for supervised study or cooperative learning. As appropriate, use discussion to reinforce important concepts.*
 - b. *Use journaling, note taking, and other writing activities to reinforce learning and help assess student progress.*
2. *Describe forest production and management.*
 - a. *Use supervised study, independent learning, or cooperative learning with printed and/or computer-based materials.*
 - b. *Provide instruments for measuring trees and wood products. Demonstrate methods of using the instruments in forest measurements.*

- c. Use wood or tree specimens that illustrate damage to trees by insects, disease, fire, and other pests. Leaves, fruit, and other materials may be used to illustrate pest damage.*
- 3. Investigate forest fire prevention.*
 - a. Provide printed or computer-based learning materials for independent learning activities or for supervised study and cooperative learning.*
 - b. Draw a fire triangle for the day and write the current information. Assess the extent of fire hazard that currently exists.*

Suggested Assessment Strategies:

- 1. Examine the importance of forestry.*
 - a. Unit test on objectives a-d.*
 - b. Review of student notes or journaling.*
- 2. Describe forest production and management.*
 - a. Unit test on objectives a-h.*
 - b. Use of measuring instruments and accuracy of calculations of wood products in a tree or forest.*
 - c. Demonstrated skill by student to assess forest damage and identify the cause of the damage.*
- 3. Investigate forest fire prevention.*
 - a. Unit test on objectives a-d.*
 - b. Demonstrated ability to use the fire triangle to assess the level of fire hazard that exists.*

Suggested Resources:

Biondo, R. J., & Lee, J. S. (1997). Introduction to plant and soil science and technology. Danville, IL: Interstate Publishers, Inc.

Camp, W. G., & Donahue, R. L. (1997). Environmental science for agriculture and the life sciences. Albany, NY: Delmar Publishers.

Forestry™ (computer-based module).

CONCEPTS OF AGRISCIENCE TECHNOLOGY
UNIT 10: PRINCIPLES OF NATURAL RESOURCES

(10 hours)

Competencies and Suggested Objectives:

1. Identify the kinds and importance of natural resources.
 - a. List natural resources and classify as renewable or nonrenewable.
 - b. Describe the importance of natural resources in the environment of the Earth.
 - c. Explain concepts associated with sustainable resource use.
 - d. Describe natural resource conservation.

Related Academic Topics (See Appendix A): C1, C2, C4, C5
Workplace Skills (See Appendix B): WP2, WP7, WP8
2. Relate the importance of ecology in natural resources.
 - a. Explain the importance of biomes, ecospheres, and niches.
 - b. Compare and contrast producers, consumers, and decomposers.
 - c. Describe the role of trees, including both commercial and noncommercial forests, in the ecology of an area.
 - d. Explain the role of trees based on age and maturity.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, S2
Workplace Skills (See Appendix B): WP2, WP7, WP8
3. Describe the role of wildlife as natural resources.
 - a. Identify important wildlife species.
 - b. Explain the survival needs of wildlife.
 - c. Describe factors that determine the wildlife found in a habitat.
 - d. Explain endangered wildlife and how endangerment can be reduced.

Related Academic Topics (See Appendix A): C1, C2, C4, C5
Workplace Skills (See Appendix B): WP2, WP7, WP8
4. Identify important areas of waste management.
 - a. Determine major waste products from human activity.
 - b. Explain how waste can be reduced and more efficiently managed.
 - c. Develop a household waste management plan.

Related Academic Topics (See Appendix A): C1, C2, C4, C5
Workplace Skills (See Appendix B): WP2, WP7, WP8
5. Examine sources of alternative energy.
 - a. Describe wind as a source of energy.
 - b. Describe water as a source of energy.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, S6
Workplace Skills (See Appendix B): WP2, WP7, WP8

Suggested Teaching Strategies:

1. *Identify the kinds and importance of natural resources.*
 - a. *Provide printed and/or computer-based learning materials for independent or cooperative group study. Follow this with discussion and development of an outline of the information.*

- b. *Form cooperative learning groups and assign the development of a list of important natural resources in the local area. Have students classify the natural resources as renewable and nonrenewable and identify the top three in terms of importance.*
 2. *Relate the importance of ecology in natural resources.*
 - a. *Use printed and/or computer-based materials for supervised study or cooperative group learning.*
 - b. *Use cooperative learning groups for students to prepare a food web of a local habitat that illustrates the producers, consumers, and decomposers.*
 - c. *Provide a drawing of a tree and have students label the parts and identify the function of each part.*
 3. *Describe the role of wildlife as natural resources.*
 - a. *Provide printed and/or computer-based learning materials for independent or cooperative learning group use.*
 - b. *Assign each student the development of a list of important wildlife species in the local area. Indicate any that are being endangered.*
 - c. *Have students investigate the game species in the local area and laws that relate to sport hunting.*
 4. *Identify important areas of waste management.*
 - a. *Use printed and/or computer-based learning materials for supervised study or cooperative learning.*
 - b. *Have students study the waste from their household for seven days and identify sources of waste, ways the amount of waste can be reduced, and possibilities for recycling and composting.*
 - c. *Assign a conservation topic to each student and have them prepare a presentation.*
 5. *Examine sources of alternative energy.*
 - a. *Provide printed and/or computer-based learning materials for supervised study or cooperative learning.*
 - b. *Design and construct vertical and horizontal wind tunnels and provide examples of ways wind tunnels can be useful in agriscience.*
 - c. *Design a desalination condenser that might be appropriate for a small agricultural or horticultural application.*

Suggested Assessment Strategies:

1. *Identify the kinds and importance of natural resources.*
 - a. *Unit test on objectives a-d.*
 - b. *Observe individual performance in groups or supervised study.*
 - c. *Quality of natural resources list prepared by students in cooperative learning groups.*
2. *Relate the importance of ecology in natural resources.*
 - a. *Unit test on objectives a and b.*
 - b. *Observation of food web prepared by individuals and groups.*
 - c. *Accuracy and detail in labeling the parts and their functions on a drawing of a*

- tree.
3. *Describe the role of wildlife as natural resources.*
 - a. *Unit test on objectives a-d.*
 - b. *Observation of the lists of wildlife present in the local area prepared by individual students.*
 - c. *Report on game species and the laws on sport hunting these species in the local area.*
 4. *Identify important areas of waste management.*
 - a. *Unit test on objectives a-c.*
 - b. *Observation of performance in carrying out the seven-day study of household waste.*
 - c. *Observation of the individual student performance on the household waste management plan, including recycling, composting, and reducing the amount of waste produced.*
 5. *Examine sources of alternative energy.*
 - a. *Unit test on objectives a and b.*
 - b. *Observation of the design and construction of wind tunnels with applications in agriscience.*
 - c. *Observation of desalination condenser unit design.*

Suggested Resources:

Deal, K. H. (1998). Wildlife and natural resource management. Albany, NY: Delmar Publishers.

Natural resourcesTM (computer-based module).

Stutzenbaker, C. D., Scheil, B. J., Swan, M. K., Lee, J. S., & Mattics, J. D. (1998). Wildlife management. Danville, IL: Interstate Publishers, Inc.

CONCEPTS OF AGRISCIENCE TECHNOLOGY
UNIT 11: PRINCIPLES OF AQUACULTURE

(10 hours)

Competencies and Suggested Objectives:

1. Examine the nature of aquaculture.
 - a. Explain the meaning of aquaculture.
 - b. List the major aquaculture crops.
 - c. Identify reasons aquaculture is important.
 - d. Contrast and compare aquaculture with terrestrial agriculture.
 - e. Describe requirements for successful aquaculture.
 - f. Identify business records which must be maintained.

Related Academic Topics (See Appendix A): C1, C4
Workplace Skills (See Appendix B): WP2, WP7, WP8
2. Describe the importance of water in aquaculture.
 - a. List the chemical formula for water.
 - b. Explain the hydrologic cycle.
 - c. Explain the importance of dissolved oxygen.
 - d. Identify methods of testing water quality.
 - e. Identify the role of the nitrogen cycle in water.
 - f. Explain how oxygen, nitrogen, and other substances in water are measured.
 - g. Explain how water is managed to assure a good aquatic environment.
 - h. Explain how weather affects water quality in ponds.

Related Academic Topics (See Appendix A): C1, C2, C4, M4
Workplace Skills (See Appendix B): WP2, WP7, WP8
3. Explain the importance of proper nutrition.
 - a. Describe the digestive system of a fish.
 - b. List factors that affect the metabolic rate of fish.
 - c. List factors that affect the amount of food a fish will consume.
 - d. Describe the general nutritional requirements of fish.
 - e. Describe the kind of feed that is used with fish and how and when fish are fed.

Related Academic Topics (See Appendix A): C1, C2, S3
Workplace Skills (See Appendix B): WP2, WP7, WP8
4. Explain the importance of promoting fish health.
 - a. Describe the role of growing conditions in promoting good health.
 - b. Name common diseases and list methods of prevention and treatment.
 - c. Identify the role of stress in fish health.
 - d. Describe the role of competition and predation in fish production.

Related Academic Topics (See Appendix A): C1, C2, S3
Workplace Skills (See Appendix B): WP2, WP7, WP8
5. Describe marketing procedures.
 - a. Assess marketing alternatives.
 - b. Identify proper methods of harvesting, handling, and transporting fish.
 - c. List the equipment needed for harvesting.
 - d. Explain the size and condition of fish when harvested.

e. Explain the importance of producing quality fish.

Related Academic Topics (See Appendix A): C1, C2, C4, C5

Workplace Skills (See Appendix B): WP2, WP7, WP8

Suggested Teaching Strategies:

1. *Examine the nature of aquaculture.*
 - a. *Provide textbooks or other printed materials or computer-based modules for cooperative group learning or supervised study. If possible, follow with discussion and summarizing the information.*
 - b. *Have students use the Internet to investigate the nature and areas of aquaculture and prepare a report.*
2. *Describe the importance of water in aquaculture.*
 - a. *Provide printed or computer-based learning materials on water in aquaculture for supervised study or cooperative group study. As time permits, follow with class discussion and a summary of the information.*
 - b. *Use meters and test kits to analyze the properties of a water sample and assess its suitability for aquaculture.*
 - c. *Monitor the dissolved oxygen in a fish tank or pond for a week using an oxygen meter. Keep a log of your findings and summarize trends in the information at the end of the week.*
 - d. *Prepare a poster or other graphic material that depicts the nitrogen cycle.*
 - e. *Describe events at various stages of the cycle.*
3. *Explain the importance of proper nutrition.*
 - a. *Provide printed or computer-based learning materials on fish nutrition and digestive systems and use supervised study or cooperative learning groups to cover the material. Follow with class discussion in which students help develop a summary of the information.*
 - b. *Have students prepare a sketch of the digestive system of a fish and label the major parts.*
 - c. *Provide tags or labels from fish feed containers and have students summarize the information in an oral report indicating the stage of maturity and other conditions under which the feed would be appropriate to use.*
 - d. *Arrange for students to assist in feeding fish each day for a week in the school lab, with a home aquarium or during supervised experience on a local fish farm. Have students provide a short report on their experiences.*
4. *Explain the importance of promoting fish health.*
 - a. *Provide printed or computer-based learning materials on fish health. Have students use the materials in supervised study or cooperative learning groups. Afterward, use class discussion to summarize the information.*
 - b. *Have students prepare a list of the major signs of disease in fish. Indicate which are most likely to occur in an aquarium at the school or home and which are most likely to occur in a farm pond.*
5. *Describe marketing procedures.*
 - a. *Provide printed and/or computer-based learning materials on aquaculture*

marketing. Have students use the materials in supervised study or cooperative learning situations. Follow student use with class discussion to summarize the information.

- b. Have students identify a species of fish and the facility in which it is raised and develop a list of the equipment needed to harvest the fish.*
- c. Form cooperative learning groups and have each group develop a list of processing, wholesale, and retail markets for fish in the local area.*
- d. Have individuals design a small roadside facility for use on a fish farm to market fish.*

Suggested Assessment Strategies:

1. *Examine the nature of aquaculture.*
 - a. Unit test on objectives a-f.*
 - b. Review of report on the nature and areas of aquaculture.*
 - c. Observation of student participation in supervised study of cooperative group learning situations.*
2. *Describe the importance of water in aquaculture.*
 - a. Unit test on objectives a-h.*
 - b. Demonstrated ability to test samples of water using test kits and meters and assess its suitability for aquaculture.*
 - c. Demonstrated ability to use data from water tests and make mathematic calculations.*
 - d. Observation of poster or other graphic prepared by individuals that depict the nitrogen cycle.*
3. *Explain the importance of proper nutrition.*
 - a. Unit test on objectives a-e.*
 - b. Observation of the sketch prepared by students of the digestive system of a fish.*
 - c. Ability of students to interpret information in the label or tag on a container of fish feed.*
 - d. Participation by student in feeding fish and recording their experiences.*
4. *Explain the importance of promoting fish health.*
 - a. Unit test on objectives a-d.*
 - b. Observation of list of fish diseases prepared by students.*
 - c. Observation of student participation in supervised study or with cooperative groups.*
5. *Describe marketing procedures.*
 - a. Unit test on objectives a-e.*
 - b. Observation of list of harvesting equipment needed for harvesting a species of fish raised in a designated facility.*
 - c. Group lists developed of the market possibilities for aquaculture in the local area.*
 - d. Observation of individual student's work in designing a roadside fish market.*

Suggested Resources:

AquacultureTM (computer-based module).

Lee, J. S., & Newman, M. E. (1997). Aquaculture: An introduction. Danville, IL: Interstate Publishers, Inc.

Parker, R. (1995). Aquaculture science. Albany, NY: Delmar Publishers.

CONCEPTS OF AGRISCIENCE TECHNOLOGY
UNIT 12: PRINCIPLES OF PHYSICAL AND MECHANICAL
TECHNOLOGY

(10 hours)

Competencies and Suggested Objectives:

1. Examine the importance of physical and mechanical technology in agriscience.
 - a. Define physical and mechanical technology as related to agricultural mechanics.
 - b. Describe contributions made by mechanical applications to agriculture.
 - c. List inventors and their inventions of important mechanical technology in agriculture.
 - d. Identify hand and power tools, equipment, and fasteners used in agriscience.

Related Academic Topics (See Appendix A): C1, C6, S6
Workplace Skills (See Appendix B): WP2, WP7, WP8
2. Examine and identify basic safety processes and concepts associated with physical and mechanical technology in agriculture.
 - a. Explain how to create a safe place to work.
 - b. Demonstrate the use of appropriate safety rules.
 - c. Describe appropriate personal protection equipment.
 - d. Interpret the safety color coding system.
 - e. Describe the classes of fires and the types of fire extinguishers needed.
 - f. Apply basic first aid procedures with burns, spills, cuts, and electrical shock.

Related Academic Topics (See Appendix A): C1, C2, C6
Workplace Skills (See Appendix B): WP2, WP4, WP7, WP8
3. Explore the use of electrical power in agriculture.
 - a. Explain the basic principles of electricity.
 - b. Describe how electrical energy is measured and conducted.
 - c. Prepare a simple wiring plan using electrical symbols, including circuits with switches, outlets, and fixtures.
 - d. Describe the purpose and operation of circuit breakers and fuses.
 - e. Use test equipment on electrical circuits, including ammeters, voltmeters, ohmmeters, and wattmeters.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7, S6
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
4. Explore the principles of metals fabrication.
 - a. Describe processes used in metals fabrication.
 - b. Identify equipment and tools used in metals fabrication.
 - c. Explain the process of fusion welding.

Related Academic Topics (See Appendix A): C1, C5, S5, S6
Workplace Skills (See Appendix B): WP2, WP5, WP7, WP8
5. Explore the principles of plumbing in agriculture.
 - a. Determine how communities are supplied with water.
 - b. Identify common code requirements.
 - c. Explain advantages and disadvantages of using different types of pipes in

plumbing systems.

d. Identify pipe fittings and valves.

Related Academic Topics (See Appendix A): C1, C2, C4, C6, S6

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

6. Explore the use of internal combustion engine power in agriculture.

a. Describe the basic operating principles of an internal combustion engine.

b. Identify the parts of a cylinder and piston unit and describe their operations.

c. Identify the different types of internal combustion engines and discuss their applications and uses.

Related Academic Topics (See Appendix A): C1, C2, C4, C6, S6

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Examine the importance of physical and mechanical technology in agriscience.*

a. *Provide textbooks, references, and/or computer-based learning materials for independent use, supervised study, or cooperative group use.*

b. *Have students investigate prominent inventors of agricultural devices and provide oral or written reports.*

c. *Provide specimens of common hand and power tools and fasteners for identification.*

2. *Examine and identify basic safety processes and concepts associated with physical and mechanical technology in agriculture.*

a. *Use textbooks, references, and/or computer-based learning materials for individual or group use. Follow supervised study or cooperative learning group activity with discussion to summarize the information.*

b. *Demonstrate the proper use of personal protection equipment.*

c. *Have students prepare posters that list important safety rules for using hand and power tools.*

d. *Have students sketch an agricultural laboratory or other facility and label areas with safety color coding.*

3. *Explore the use of electrical power in agriculture.*

a. *Provide textbooks, references, and/or computer-based learning materials for student use in supervised study or cooperative learning group activity. Follow with class discussion and developing a summary of the information.*

b. *Demonstrate the use of electrical symbols in preparing diagrams of simple circuits.*

c. *Demonstrate the use of tools and materials in performing simple electrical work.*

d. *Demonstrate the use of equipment used in measuring electricity and testing electrical circuits.*

4. *Explore the principles of metals fabrication.*

a. *Provide textbooks, references, and/or computer-based learning materials for student use in supervised study or cooperative group activity. Use student input in class discussion to summarize the information.*

- b. Provide samples of the equipment and tools used in metals fabrication for identification.*
 - c. Demonstrate simple skills in metals fabrication.*
- 5. *Explore the principles of plumbing in agriculture.*
 - a. Oral and written assignment to determine how communities are supplied with water.*
 - b. Practical exercise to identify common code requirements.*
 - c. Practical exercise to explain advantages and disadvantages of using different types of pipes in plumbing systems.*
- 6. *Explore the use of internal combustion engine power in agriculture.*
 - a. Provide textbooks, references, and/or computer-based learning materials for student use in supervised study or cooperative learning group activity.*
 - b. Use models of small engines to demonstrate engine types, parts, and safe operation.*

Suggested Assessment Strategies:

- 1. *Examine the importance of physical and mechanical technology in agriscience.*
 - a. Unit test on objectives a-d.*
 - b. Observation of student reports on prominent agricultural inventors.*
 - c. Observation of student participation in supervised study and cooperative groups.*
- 2. *Examine and identify basic safety processes and concepts associated with physical and mechanical technology in agriculture.*
 - a. Unit test on objectives a-f.*
 - b. Observation of posters and sketches showing safety areas by color code prepared by individuals.*
 - c. Proper use of personal protection equipment when students are in laboratories and other facilities where safety hazards may exist.*
- 3. *Explore the use of electrical power in agriculture.*
 - a. Unit test on objectives a-e.*
 - b. Observation of diagrams and other materials prepared by individual students.*
- 4. *Explore the principles of metals fabrication.*
 - a. Unit test on objectives a-c.*
 - b. Observation of student participation in supervised study and cooperative group activities.*
 - c. Demonstrated processes used in producing metal products.*

5. *Explore the principles of plumbing in agriculture.*
 - a. *Oral and/ written report - Determine how communities are supplied with water.*
 - b. *Practical activity - Identify common code requirements.*
 - c. *Practical activity - Explain advantages and disadvantages of using different types of pipes in plumbing systems.*
6. *Explore the use of internal combustion engine power in agriculture.*
 - a. *Unit test on objectives a-c.*
 - b. *Demonstrated knowledge of individual students in orally identifying engine parts and functions.*

Suggested Resources:

Agriculture mechanicsTM (computer-based module).

Johnson, D. M., Harper, J., Lawver, D. E., & Buriak, P. (2001). Mechanical technology in agriculture. Danville, IL: Interstate Publishers, Inc.

Phipps, L. J., & Miller, G. M. (1998). Agriscience mechanics. Danville, IL: Interstate Publishers, Inc.

CONCEPTS OF AGRISCIENCE TECHNOLOGY
UNIT 13: PRINCIPLES OF AGRICULTURE MARKETING

(10 hours)

Competencies and Suggested Objectives:

1. Examine the role of marketing in the agricultural industry.
 - a. Explain marketing and the basic functions involved.
 - b. List and explain marketing channels.
 - c. Describe the infrastructure needed for agricultural marketing.
 - d. Distinguish between wholesale and retail marketing.
 - e. Identify important concepts in successful marketing.

Related Academic Topics (See Appendix A): C1, C2, C4, C5
Workplace Skills (See Appendix B): WP2, WP7, WP8
2. Relate agricultural marketing to the free enterprise system.
 - a. Describe the role of supply and demand in marketing.
 - b. Compare and contrast cash, contract, and futures marketing.
 - c. Explain how cash prices and futures markets are linked.
 - d. Describe how a futures market is used.

Related Academic Topics (See Appendix A): C1, C2, C4, C5
Workplace Skills (See Appendix B): WP2, WP7, WP8
3. Examine the importance of planning in successful marketing.
 - a. Identify the major purposes of a marketing plan.
 - b. Describe the major parts of a marketing plan.
 - c. Explain the procedures in developing a marketing plan.
 - d. List the reasons for developing and properly using a marketing plan.
 - e. Describe the role of promotion in implementing a marketing plan.

Related Academic Topics (See Appendix A): C1, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
4. Investigate marketing processes with agricultural products.
 - a. Explain the importance of reliable grading standards in marketing.
 - b. Compare and contrast the marketing of animals and animal products.
 - c. Compare and contrast the marketing of various grain and fiber crops.
 - d. Use information sources as aids in agricultural marketing.

Related Academic Topics (See Appendix A): C1, C4, C5, C6
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Examine the role of marketing in the agricultural industry.*
 - a. *Provide textbooks, references, and/or computer-based learning materials. Use supervised study or organize into cooperative learning groups using a structured process of investigation. Use student input in class discussion to summarize the information.*
 - b. *Have students identify infrastructure in the local area for marketing agricultural products.*

- c. *Have cooperative groups develop lists of wholesale and retail markets in the local area.*
 - d. *Use cooperative learning groups for students to investigate and prepare a report on the important concepts in successful marketing.*
2. *Relate agricultural marketing to the free enterprise system.*
 - a. *Provide textbooks, reference materials, and/or computer-based learning materials on free enterprise and other economic systems. Use supervised study or programmed activities for students to investigate the nature of the free enterprise system and how marketing is carried out in the system.*
 - b. *Have students refer to sections in the daily newspaper for agricultural marketing information and follow the prices for a commodity for one week. Prepare a written report on the trend of the prices for the commodity.*
 - c. *Use the Internet to collect information on agricultural marketing, including cash, contract, and futures marketing.*
3. *Examine the importance of planning in successful marketing.*
 - a. *Provide textbooks, reference materials, and/or computer-based learning materials on marketing planning. Have students use the material in supervised study or directed learning activities.*
 - b. *Form students into groups to develop a marketing plan for an agricultural, horticultural, or forestry product produced in the local area. Have each group submit a report to the class.*
 - c. *Have students select an appropriate marketing channel for any products produced in their supervised experience programs.*
4. *Investigate marketing processes with agricultural products.*
 - a. *Oral and written assignment to describe the importance of reliable grading standards in marketing.*
 - b. *Practical exercise to compare and contrast the marketing of animals and animal products.*
 - c. *Practical exercise to compare and contrast the marketing of various grain and fiber crops.*
 - d. *Practical exercise to use information sources as aids in agricultural marketing.*

Suggested Assessment Strategies:

1. *Examine the role of marketing in the agricultural industry.*
 - a. *Unit test on objectives a-e.*
 - b. *Quality of assignments prepared by individuals and groups on marketing infrastructure, and wholesale and retail marketing; and report on important concepts in successful marketing.*
2. *Relate agricultural marketing to the free enterprise system.*
 - a. *Unit test on objectives a-d.*
 - b. *Written report on the trends in commodity prices as compiled from the newspaper or Internet sources.*
 - c. *Information collected on cash, contract, and futures marketing.*
3. *Examine the importance of planning in successful marketing.*

- a. *Unit test on objectives a-e.*
 - b. *Observation of marketing plans developed by groups and the marketing channels selected for products produced in supervised experience.*
- 4. *Investigate marketing processes with agricultural products.*
 - a. *Unit test on objectives a-d.*
 - b. *Student reports on investigations of grade standards for agricultural commodities.*
 - c. *Observation of the reports provided by students comparing product grade with market prices.*

Suggested Resources:

Agriculture marketingTM (computer-based module).

Morgan, E. M., Chelewski, R. E., Lee, J. S., & Wilson, E. (2000). AgriScience explorations. (2nd ed.). Danville, IL: Interstate Publishers, Inc.

SECTION III:
CURRICULUM GUIDE
FOR
THE SCIENCE OF AGRICULTURAL ANIMALS

June 21, 2002

**THE SCIENCE OF AGRICULTURAL ANIMALS
COURSE DESCRIPTION
(CIP: 02.0201)**

The Science of Agricultural Animals is designed as a one-unit course that offers an in-depth study of the animal industry. This includes both traditional livestock and poultry enterprises as well as companion animals. Emphasis is on production methods used in beef operations, swine, dairy, and poultry. The course also includes equine science, companion and laboratory animal care, and aquaculture. Instruction is undergirded with fundamentals of biological science. (Prerequisite: Concepts of Agriscience Technology or Biology; Grades 10-12; 1 Carnegie Unit)

**THE SCIENCE OF AGRICULTURAL ANIMALS
COURSE OUTLINE**

<u>Unit No.</u>	<u>Title</u>	<u>No. of Hours</u>
Unit 1	Introduction to Agricultural Animals	8
Unit 2	Supervised Experience in Agricultural Animals	5
Unit 3	The Animal Industries	8
Unit 4	Consumer Trends and Concerns	5
Unit 5	Animal Well-Being and Behavior	5
Unit 6	Animals as Living Organisms	5
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THE SCIENCE OF AGRICULTURAL ANIMALS
UNIT 1: INTRODUCTION TO AGRICULTURAL ANIMALS

(8 hours)

Competencies and Suggested Objectives:

1. Investigate the nature of animal agriculture.
 - a. Explain the importance of animals.
 - b. Describe the nature of the class, including course outline and learning activities.

Related Academic Topics (See Appendix A): C1, C3, C4, S1, S2, S3, S7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
2. Investigate the opportunities in student and youth organizations in the animal industry.
 - a. List the requirements for Chapter, State, and American FFA Degrees.
 - b. Prepare for student development events on the local, state, and national levels.

Related Academic Topics (See Appendix A): C1, C2, C4, S3, S8
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
3. Demonstrate career and communication skills required for employment in the animal industry.
 - a. Identify careers in animal agriculture and the skills required by employers.
 - b. Prepare an appropriate resume.
 - c. Explain the importance of responding to authority.
 - d. Explain the importance of ethics in the workplace.
 - e. Demonstrate the proper use of a business phone.
 - f. Write a business letter following an acceptable format.
 - g. Use electronic media to communicate information.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C6
Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5, WP6, WP7, WP8
4. Use the Internet to identify emerging technologies.
 - a. Investigate a topic related to animal agriculture using the Internet and make an oral presentation to the class.

Related Academic Topics (See Appendix A): C1, C2, C4, C6, S3, S8
Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Investigate the nature of animal agriculture.*
 - a. *Use supervised study followed by class discussion to outline the importance of animals for food and other products, companion, service, and other uses. Have students give an oral report on one animal and its uses.*
 - b. *Review major course topics and kinds of learning activities with students.*
 - c. *Describe expectations and procedures in the conduct of the class.*

2. *Investigate the opportunities in student and youth organizations in the animal industry.*
 - a. *Use supervised study and presentations on degree requirements using the latest information from the National FFA Organization.*
 - b. *Use supervised study, team practice, and classroom presentations and discussions related to the respective development events appropriate for students enrolled in animal agriculture.*
3. *Demonstrate career and communication skills required for employment in the animal industry.*
 - a. *Use classroom presentations, resource persons in animal agriculture careers, and supervised study of career information to identify careers in animal agriculture and the skills required by employers. Job shadowing may also be used as appropriate.*
 - b. *Provide presentations on resumes, including purpose and contents. Provide sample resumes. Have students prepare resumes.*
 - c. *Provide class presentations on the structure of animal agriculture, including employers who have authority to hire and direct employees. Stress the importance of appropriately respecting the authority of employers, including student role playing of good and poor relationships and responses.*
 - d. *Use class discussion to examine the meaning of ethics and the attributes of ethical behavior. Use case studies of situations where ethical behavior was important. Have students discuss possible alternatives with the situations and decide the best ethical response.*
 - e. *Demonstrate proper use of the telephone and have students practice the procedures when using the telephone.*
 - f. *Present the use, importance, and appropriate format for a business letter. Provide samples of poor and good letters for students to critique. Have students write business letters, such as to apply for a job, for critique and improvement. Include how to prepare the envelope and fold the letter for mailing.*
 - g. *Have students prepare and exchange messages via the Internet. Print out samples of messages for critique and improvement.*
4. *Use the Internet to identify emerging technologies.*
 - a. *Provide instruction, as needed, in using computers to search the Internet for information on animal agriculture.*
 - b. *Use independent learning methods for students to use the Internet.*

Suggested Assessment Strategies:

1. *Investigate the nature of animal agriculture.*
 - a. *Use a written or oral test on objective a.*
 - b. *Student oral reporting on the expectations in the class as well as the deportment of students while in class demonstrating their knowledge of classroom procedures.*
2. *Investigate the opportunities in student and youth organizations in the animal*

- industry.
- a. *Written or oral test on FFA degrees as well as student participation in degree application processes.*
 - b. *Participation of students in development events related to the animal industry.*
 3. *Demonstrate career and communication skills required for employment in the animal industry.*
 - a. *Written or oral test on the general career skills required by employers.*
 - b. *Assessment of the quality of a sample resume prepared by the student.*
 - c. *Written or oral test on the meaning of authority and the needed attributes to relate to authority.*
 - d. *Written or oral test on the meaning of ethics and the demonstration of ethical behavior in responding to fictional events related to animal agriculture, including ethics in animal care.*
 - e. *Demonstration by students of acceptable telephone skills.*
 - f. *Preparation of a sample and fictional letter of application for a job in animal agriculture.*
 - g. *Use of e-mail and the Internet to send and receive information about animal agriculture, including using search engines to collect information on specific subjects related to animal agriculture.*
 4. *Use the Internet to identify emerging technologies.*
 - a. *Review the information collected by students about emerging technologies in animal agriculture.*

Suggested Resources:

Advisor's guide to the FFA student handbook. (Current ed.). Indianapolis, IN: National FFA Organization.

Chronicle agricultural occupations guidebook. (1997). Moravia, NY: Chronicle Guidance Publications, Inc.

FFA student handbook. (Current ed.). Indianapolis, IN: National FFA Organization.

Grozinger, J., & Thompson, B. (1997). The Internet guide for agriculturists. Moline, IL: John Deere Publishing.

Hunter, S., Stewart, M., Scheil, B., Terry, R., Jr., & Frazee, S. D. (1997). Developing leadership and personal skills. Danville, IL: Interstate Publishers, Inc.

Official FFA manual. (Current ed.). Indianapolis, IN: National FFA Organization.

Ricketts, C. (2003). Leadership: Personal development and career success. (2nd ed.). Albany, NY: Delmar Publishers.

June 21, 2002

THE SCIENCE OF AGRICULTURAL ANIMALS

UNIT 2: SUPERVISED EXPERIENCE IN AGRICULTURAL ANIMALS

(5 hours)

Competencies and Suggested Objectives:

1. Plan, implement, and expand supervised experience in animal agriculture.
 - a. Explain the purpose, kinds, and nature of supervised experience.
 - b. Explain how supervised experience is part of a carefully planned and long-term supervised agricultural experience program (SAE).
 - c. Describe how supervised experience relates to achievement of FFA proficiency awards and other activities.
 - d. Identify appropriate experiences for a supervised agricultural experience program.
 - e. Develop short-term, intermediate, and long-term SAE goals.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, S3, S8
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP6, WP7, WP8
2. Prepare and keep appropriate written documentation on supervised experience.
 - a. Develop a training plan.
 - b. Develop a training agreement.
 - c. Keep records of competencies developed, inventory, income, and expenses.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, S3, S8
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Plan, implement, and expand supervised experience in animal agriculture.*
 - a. *Use class presentations and discussion to explain SAE, including its purpose, nature of the experiences, and how a program is planned and carried out.*
 - b. *Use materials published by the National FFA Organization that provide information on Career Development Events, Proficiency Awards, and other programs.*
 - c. *Use regular supervision and observation of student performance with supervised experience.*
 - d. *Provide a form to make goal setting easier and use individual counseling with each student on the goals that are made.*
2. *Prepare and keep appropriate written documentation on supervised experience.*
 - a. *Provide examples of training plans and training plan forms. In consultation with parents, employers, and others, complete a training plan.*
 - b. *Provide examples of training agreements and a sample training agreement form. Use presentations and discussions to develop students' skills in developing a training agreement. Have students prepare a training agreement and provide feedback on their work.*
 - c. *Provide presentations on keeping records of personal experiences, inventory, income, and expenses. Use sample forms and have students complete forms and explain what they have done.*

Suggested Assessment Strategies:

1. *Plan, implement, and expand supervised experience in animal agriculture.*
 - a. *Written or oral test on the purpose, kinds, and nature of SAE.*
 - b. *Initiating and progressing in appropriate supervised experience in animal agriculture. This includes advancing with degrees of FFA membership.*
 - c. *Observations made during supervision of student while engaged in experience program.*
 - d. *Development and revision, as needed, of goals.*
2. *Prepare and keep appropriate written documentation on supervised experience.*
 - a. *Assessment of a completed SAE training agreement.*
 - b. *Accuracy and neatness of records kept of competencies developed, inventory, income, and expenses from supervised experience.*

Suggested Resources:

A guide to local program success. (1997). Indianapolis, IN: National FFA Organization.

Advisor's guide to the FFA student handbook. (1995). Indianapolis, IN: National FFA Organization.

Career development events. (Current ed.). Indianapolis, IN: National FFA Organization.

Hunter, S., Stewart, M., Scheil, B., Terry, R., Jr., & Frazee, S. D. (1997). Developing leadership and personal skills. Danville, IL: Interstate Publishers, Inc.

Official FFA manual. (Current ed.). Indianapolis, IN: National FFA Organization.

SAE best practices. (1997). Indianapolis, IN: National FFA Organization.

THE SCIENCE OF AGRICULTURAL ANIMALS

UNIT 3: THE ANIMAL INDUSTRIES

(8 hours)

Competencies and Suggested Objectives:

1. Examine the importance of animals in the United States.
 - a. Explain the major uses of animals in the United States.
 - b. Identify the economic importance of animal production.
 - c. List the per capita consumption of products from animals.
 - d. Justify the use of agricultural land to produce meat animals or animal products.

Related Academic Topics (See Appendix A): C1, C2, C4, C6, S7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
2. Assess the animal industries in the local area.
 - a. List the major animal enterprises in the local area.
 - b. Identify businesses and industries that support animal production and use.
 - c. Explain the role of entrepreneurship in animal agriculture.

Related Academic Topics (See Appendix A): C1, C2, C4
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
3. Identify the major species and breeds of domesticated animals.
 - a. List the breeds and descriptions of animals used for food products.
 - b. List the breeds and descriptions of animals used for non-food products.
 - c. Name the major species of companion, service, and pleasure animals.
 - d. List the species of fish that are found in the local area.

Related Academic Topics (See Appendix A): C1, C4, S3, S7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Examine the importance of animals in the United States.*
 - a. *Use student-oriented materials in supervised or independent study followed by class discussions to cover the major uses of animals in the United States.*
 - b. *Use a local animal producer as a resource person on the importance of animal production. Information from the U.S. Census of Agriculture may also be useful.*
 - c. *Use cooperative group investigations and discussion to justify land use for animal production. Group reports will be provided to the overall class.*
2. *Assess the animal industries in the local area.*
 - a. *Use resource persons, U.S. Census of Agriculture information, and presentations on animal enterprises in the local area.*
 - b. *Use student investigations to identify businesses and industries that support animal production and use.*
 - c. *Use local entrepreneurs in animal agriculture to explain the meaning of entrepreneurship. Independent study using the Internet and web site of the National FFA Organization will provide information on entrepreneurship.*
3. *Identify the major species and breeds of domesticated animals.*
 - a. *Use computer-based materials, including the Internet, for independent study.*

- b. Provide breed association materials for supervised study followed by discussion to identify the species and breeds of animals used for non-food products.*
- c. Use a companion animal store operator or producer as a resource person to provide local information.*

Suggested Assessment Strategies:

- 1. Examine the importance of animals in the United States.*
 - a. Written or oral test for objectives a-d.*
 - b. Student participation in supervised study and class discussion.*
 - c. Student use of independent learning approaches in gathering information.*
 - d. Participation and reporting by individuals and groups studying areas related to animal production and land use.*
- 2. Assess the animal industries in the local area.*
 - a. Written or oral test for objectives a-c.*
 - b. Participation in supervised study and independent investigations.*
 - c. Presentations that demonstrate use of computer-based learning methods and mastery of information.*
- 3. Identify the major species and breeds of domesticated animals.*
 - a. Unit test over objectives a-d.*
 - b. Oral reports that name and describe species and breeds of animals.*
 - c. Identification of animal species and breed using pictures or live animals.*

Suggested Resources:

Cheeke, P. R. (1999). Contemporary issues in animal agriculture. (2nd ed.). Danville, IL: Interstate Publishers, Inc.

Gillespie, J. (2002). Modern livestock and poultry production. (6th ed.). Albany, NY: Delmar Publishers.

Gillespie, J. (1998). Animal science. Albany, NY: Delmar Publishers.

Herren, R. (2000). The science of animal agriculture. (2nd ed.). Albany, NY: Delmar Publishers.

Lee, J. S., Embry, C., Hutter, J., Pollok, J., Rudd, R., Westrom, L., & Bull, A. (2000). Introduction to livestock and companion animals. (2nd ed.). Danville, IL: Interstate Publishers, Inc.

State and County U.S. Census of Agriculture Reports.

Various breed association materials, including journals, will provide useful information.

THE SCIENCE OF AGRICULTURAL ANIMALS
UNIT 4: CONSUMER TRENDS AND CONCERNS

(5 hours)

Competencies and Suggested Objectives:

1. Examine the importance of consumers in producing and marketing animal products.
 - a. Define consumer and describe why consumers are important.
 - b. Identify nutrition and health concerns of consumers.
 - c. Assess consumer concerns about feed additives and anabolic steroids.
 - d. Identify quality assurance programs.

Related Academic Topics (See Appendix A): C1, C4, S3
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP6, WP7, WP8
2. Explain consumer concerns about animal waste and its effects on the environment.
 - a. Determine the kinds of wastes resulting from animal agriculture.
 - b. Identify regulations on animal waste disposal.

Related Academic Topics (See Appendix A): C1, C4, S2, S4
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
3. Investigate animal food products and processing.
 - a. Assess consumer concerns about food product safety.
 - b. Explain general methods used in processing animal food products.
 - c. Explain the role of HACCP in food safety.

Related Academic Topics (See Appendix A): C1, C2, C4, S3
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Explain the importance of consumers in producing and marketing animal products.*
 - a. *Presentations and discussion to define a consumer and identify why consumers are important in producing and marketing animal products.*
 - b. *Use cooperative groups for students to design and carry out a simple survey to gain consumer opinions about meat food products.*
 - c. *Independent study of the meaning, use, and effects of feed additives. Use sample labels from animal feed containers that list additives.*
 - d. *Practical exercise to identify quality assurance programs.*
2. *Explain consumer concerns about animal waste and its effects on the environment.*
 - a. *Presentations and student independent investigations to identify methods used to dispose of animal wastes and potential problems and solutions.*
 - b. *Local information, resource persons, and/or student independent study using the Internet will be useful in investigating the major regulations on animal wastes.*

3. *Investigate animal food products and processing.*
 - a. *Use supervised study to identify general methods in processing animal products. Tour a local processing plant, meats merchandising facility, or meats laboratory.*
 - b. *Have students prepare reports on the meat food products. Use drawings of animal carcasses with cuts identified to illustrate the sources of meat products.*
 - c. *Use student independent investigations followed by reports to determine the meaning, nature, and role of HACCP in food safety.*

Suggested Assessment Strategies:

1. *Explain the importance of consumers in producing and marketing animal products.*
 - a. *Written or oral test covering objectives a-c.*
 - b. *Student participation in investigating and reporting information in the class.*
 - c. *Student participation in nutrition information on food labels.*
 - d. *Student evaluation of labels or tags from animal feed containers.*
2. *Explain consumer concerns about animal waste and its effects on the environment.*
 - a. *Written or oral test covering objectives a and b.*
 - b. *Student participation with investigations of animal waste production, problems, and potential solutions to the waste problems, if any, in the local area.*
3. *Investigate animal food products and processing.*
 - a. *Written or oral test covering objectives a-c.*
 - b. *Student participation with independent and group study of animal food processing methods as related to food product safety.*
 - c. *Identification of meat cuts and products as related to species of animals.*
 - d. *Student ability to define HACCP and describe its general implementation in the animal food processing industry.*

Suggested Resources:

Ensminger, M. E. (1991). Animal science. Danville, IL: Interstate Publishers, Inc.

Food science, safety, and nutrition. (1996). Alexandria, VA: The National Council for Agricultural Education.

Gillespie, J. (2002). Modern livestock and poultry production. (6th ed.). Albany, NY: Delmar Publishers.

Gillespie, J. (1998). Animal science. Albany, NY: Delmar Publishers.

Lee, J. S., Embry, C., Hutter, J., Pollok, J., Rudd, R., Westrom, L., & Bull, A. (2000). Introduction to livestock and companion animals. (2nd ed.). Danville, IL: Interstate Publishers, Inc.

National Pork Production Council. "Quality Assurance" (Information packet and videos

on animal food processing).

Seperich, G. (1998). Food science and safety. Danville, IL: Interstate Publishers.

Video: Agricultural issues: Food safety. Alexandria, VA: The National Council for Agricultural Education.

Video: Meats retail cut identification. Alexandria, VA: The National Council for Agricultural Education.

THE SCIENCE OF AGRICULTURAL ANIMALS
UNIT 5: ANIMAL WELL-BEING AND BEHAVIOR

(5 hours)

Competencies and Suggested Objectives:

1. Explain animal well-being.
 - a. Define animal well-being and describe how it is used in production.
 - b. Assess the use of animal confinement.

Related Academic Topics (See Appendix A): C1, C4, S2, S3
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
2. Explore the use of animals in research and laboratory production.
 - a. Explain why animals are used in research.
 - b. Assess the use of animals in laboratory production.

Related Academic Topics (See Appendix A): C1, C4, S3
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
3. Investigate the behavioral patterns of animals.
 - a. Observe and describe the social behavior of animals.
 - b. Observe and describe the reproductive behavior of animals.
 - c. Describe how animals can be trained to exhibit desired behavior patterns.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, S3, S7, S8
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
4. Examine the importance of personal safety in animal production.
 - a. Explain the importance of personal safety with animals.
 - b. Identify hazards related to livestock production.
 - c. List the safety practices necessary when working with animals.

Related Academic Topics (See Appendix A): C1, C2, C4, S1, S2, S3, S8
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Explain animal well-being.*
 - a. *Provide information that explains animal well-being and considerations in providing for the well-being of animals in production environments.*
 - b. *Have students investigate animal confinement, how animals are confined, and the advantages and disadvantages of animal confinement. Use cooperative student groups to examine and report animal well-being in production situations.*
 - c. *Provide information on potential problems with producing animals in confinement. Include ways of overcoming these problems.*
2. *Explore the use of animals in research and laboratory production.*
 - a. *Use supervised study of printed or computer-based materials on how animals are used in research, the benefits of animal research, and potential harm caused to animals by the research. Follow with class discussion of the major areas.*
 - b. *Have students investigate the use of animals in laboratories to produce*

important products for human use, such as tissues, fluids, and organs, as well as medical products. Use discussion to summarize and emphasize these roles of animals.

3. *Investigate the behavioral patterns of animals.*
 - a. *Have students observe animals for these behaviors in pastures, pens, aquaria, or other places animals are available for observation.*
 - b. *Present information on the reproductive behavior of animals, including courtship, mating, giving birth, and care provided young animals. Students may observe such behaviors with spawning fish in an aquarium, agricultural animals, and domesticated animals or wildlife.*
 - c. *Present information on animal training to exhibit desired behaviors. Have students identify examples of such training and how it is beneficial. Use a resource person from a dairy or kennel to explain how animals are trained.*
4. *Examine the importance of personal safety in animal production.*
 - a. *Provide information on the areas of safety that are important in animal production, including agricultural animals as well as companion, laboratory, and service animals. This should include both the hazards that are involved and approaches to prevent personal injury.*
 - b. *Use supervised study for students to identify and explain the hazards in livestock production. Use class discussion to summarize the hazards and describe methods of reducing exposure to the hazards.*

Suggested Assessment Strategies:

1. *Explain animal well-being.*
 - a. *Written or oral test over objectives a-b.*
 - b. *Behavior exhibited by students when responding to animals, including confined animals in production systems.*
 - c. *Identification and solutions to problems with animal confinement by students who have agricultural or companion animals.*
2. *Explore the use of animals in research and laboratory production.*
 - a. *Written or oral test over objectives a and b.*
 - b. *Student participation in discussion of issues and practices associated with research and laboratory animal production.*
3. *Investigate the behavioral patterns of animals.*
 - a. *Written or oral test over objectives a-c.*
 - b. *Student reports on animal social and reproductive behavioral patterns.*
4. *Examine the importance of personal safety in animal production.*
 - a. *Written or oral test over objectives a-c.*
 - b. *Student participation in discussion and reports of supervised study and independent investigations of safety with animals.*
 - c. *How students work with animals using practices that demonstrate personal safety.*

Suggested Resources:

Herren, R. (2000). The science of animal agriculture. (2nd ed.). Albany, NY: Delmar Publishers.

Lee, J. S., Embry, C., Hutter, J., Pollok, J., Rudd, R., Westrom, L., & Bull, A. (2000). Introduction to livestock and companion animals. (2nd ed.). Danville, IL: Interstate Publishers, Inc.

Animal welfare. (1995). Alexandria, VA: The National Council for Agricultural Education.

THE SCIENCE OF AGRICULTURAL ANIMALS
UNIT 6: ANIMALS AS LIVING ORGANISMS

(5 hours)

Competencies and Suggested Objectives:

1. Use scientific classification with animals.
 - a. Explain taxonomy and how it is used with domesticated animals.
 - b. Distinguish between mammals and non-mammals.
 - c. Give the scientific names of common domesticated animals.

Related Academic Topics (See Appendix A): C1, C2, C4, S2, S3, S7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
2. Examine the characteristics of life and living organisms.
 - a. Explain the role of protoplasm in living organisms.
 - b. Explain how cell specialization forms structures needed for life processes.
 - c. Identify the stages in the life span of living organisms.
 - d. Match names of young and mature animals with the species.
 - e. Name the life processes of animals and describe how these processes occur.

Related Academic Topics (See Appendix A): C1, C2, C4, S1, S2, S3, S7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
3. Examine the characteristics of animals as organisms.
 - a. Distinguish between and explain the importance of anatomy and physiology.
 - b. Describe the types of animal tissue and give the purpose of the tissue.
 - c. Name and explain the functions of the organ systems.
 - d. Identify the major external parts of animals.

Related Academic Topics (See Appendix A): C1, C2, C4, S1, S3
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
4. Assess the importance of heredity and genetics.
 - a. Define heredity and genetics and relate the terms to variability.
 - b. Identify the major heredity material of living organisms.
 - c. Explain how breeding is used to improve animals.
 - d. Explain the meaning of genetic manipulation in animal biotechnology.

Related Academic Topics (See Appendix A): C1, C2, C4, S1, S2, S3, S7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Use scientific classification with animals.*
 - a. *Provide student-oriented materials for supervised study followed by discussion.*
 - b. *List common and scientific names of food and fiber animals, companion animals, and service animals.*
2. *Examine the characteristics of life and living organisms.*
 - a. *Use line drawings of cells that show the location of protoplasm as well as prepared or temporary wet-mount microscope slides to identify the protoplasm.*
 - b. *Use supervised study followed by class presentations involving students in outlining the most important information related to cell specialization.*

- c. *Use examples of animals in various life stages to illustrate maturation.*
- d. *Have students develop a chart that shows the names of babies, young, and mature animals of various species important in the local area. Include the names by sexual classification, such as a young female bovine is a heifer and a mature female bovine is a cow. Classify each as a mammal or non-mammal.*
- e. *Use supervised study for students to investigate the life processes of animals and how they are carried out by a living organism.*
- 3. *Examine the characteristics of animals as organisms.*
 - a. *Use supervised study followed by class discussion and the development of an outline of the major concepts. Have students define the terms and distinguish between anatomy and physiology.*
 - b. *Form cooperative learning groups of two individuals for dissection of a fetal pig or fish for observation of major organs and organ systems. Have students prepare sketches and notes of their observations. Note: Follow proper protocol and safety with dissection. Prepared laboratory specimens are suggested.*
 - c. *Use handouts with line drawings of labeled external parts of common animals. Projected images or computer-based materials may also be helpful. Some practice and observations with live animal specimens will be useful.*
- 4. *Assess the importance of heredity and genetics.*
 - a. *Use supervised study and class discussion to develop an outline of the most important information on heredity and genetics. Relate genetics to animal breeding programs.*
 - b. *Use supervised study followed by discussion of the meaning and ethical use of biotechnology. Cooperative learning groups may be used for students to formulate positions on the ethics of genetic manipulation.*

Suggested Assessment Strategies:

- 1. *Use scientific classification with animals.*
 - a. *Use a written or oral test with objectives a and b.*
 - b. *Ability of students to call animals in the local area by their scientific names.*
- 2. *Examine the characteristics of life and living organisms.*
 - a. *Written or oral test on objectives a-e.*
 - b. *Participation of individuals in class discussion and development of an outline of the important information.*
 - c. *Written report on the life stages of animals including the names used with young and mature animals by gender (sexual classification) of common species in the local area.*
 - d. *Written or oral report on the life processes of living organisms.*
- 3. *Examine the characteristics of animals as organisms.*
 - a. *Written or oral test on objectives a-d.*
 - b. *Labeling the major organs and systems on a line drawing of a common animal and describing the functions of the systems with a living organism.*
 - c. *Labeling the major external parts of a common animal on a line drawing.*
 - d. *Naming the major external parts of a live animal specimen, such as a beef*

animal, hog, or fish. Assessment will continue as skills are developed in evaluating animals based on external features and the ability to use appropriate terminology related to external parts.

4. *Assess the importance of heredity and genetics.*
 - a. *Written or oral test on objectives a-d.*
 - b. *Describe or draw the organization of the genetic material in a cell.*
 - c. *Orally report on the use of various methods of breeding to achieve improved animals and the role of heredity and genetics in the process.*
 - d. *Reports on biotechnology and genetic manipulation of animals and the ethical considerations that are involved.*

Suggested Resources:

Ensminger, M. E. (1991). Animal science. Danville, IL: Interstate Publishers, Inc.

Gillespie, J. R. (2002). Modern livestock and poultry production. (6th ed.). Albany, NY: Delmar Publishers.

Gillespie, J. (1998). Animal science. Albany, NY: Delmar Publishers.

Lee, J. S., Embry, C., Hutter, J., Pollok, J., Rudd, R., Westrom, L., & Bull, A. (2000). Introduction to livestock and companion animals. (2nd ed.). Danville, IL: Interstate Publishers, Inc.

Taylor, R. E. (1995). Scientific farm animal production (5th ed.). Englewood Cliffs, NJ: Prentice Hall.

THE SCIENCE OF AGRICULTURAL ANIMALS
UNIT 7: ANIMAL GROWTH AND NUTRITION

(15 hours)

Competencies and Suggested Objectives:

1. Examine the role of nutrition in animal growth and health.
 - a. Explain metabolism.
 - b. List six nutrients essential to life and identify sources of the nutrients.
 - c. Discuss the relationship between proteins and amino acids.
 - d. Develop a complete ration for an animal.
 - e. Explain the differences in monogastric, ruminant, avian, and psuedo-ruminant feed utilization.
 - f. Explain the addition of microorganisms to ruminants in order to increase feed utilization.

Related Academic Topics (See Appendix A): C1, C2, C4, S1, S2, S3

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

2. Provide the proper care of pregnant and lactating females.
 - a. Explain the three phases of pre-natal growth.
 - b. Describe the functions of the placenta.
 - c. Explain the role of nutrition with pregnant females and the developing fetus.
 - d. Explain the role of nutrition with lactating females.

Related Academic Topics (See Appendix A): C1, C2, C4, S1, S3, S7

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

3. Provide post-natal care of females and offspring.
 - a. Explain the development of the central nervous, circulatory, respiratory, and digestive systems in new-born animals.
 - b. Explain the changes in feed requirement in the dam after birth.
 - c. Discuss expulsion of the afterbirth.

Related Academic Topics (See Appendix A): C1, C2, C4, S1, S3, S7

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

4. Identify animals based on food consumption.
 - a. Explain carnivore, herbivore, and omnivore as related to food sources and types.
 - b. Classify animals as being carnivores, omnivores, or herbivores.

Related Academic Topics (See Appendix A): C1, C2, C4, S1, S3

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

5. Assess the effects of hormones on animal growth.
 - a. List and discuss the major hormone producing glands and their effect on growth.
 - b. Identify issues with consumers on the use of hormones in food animal production.

Related Academic Topics (See Appendix A): C1, C2, C4, S1, S3

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

6. Assess the importance of vitamins and minerals in the diet of an animal.
 - a. List sources of vitamins in animal feeds.

- b. List sources of minerals in animal feeds.

Related Academic Topics (See Appendix A): C1, C2, C4, S1, S3
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
- 7. Assess the importance of concentrates and roughage in the diet of an animal.
 - a. Distinguish between concentrates and roughage food materials.
 - b. List sources of concentrates for use in feed rations.
 - c. List sources of roughage for animal rations.

Related Academic Topics (See Appendix A): C1, C2, C4, S1, S3
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
- 8. Identify the importance of water to animals.
 - a. Explain the role of water in metabolism.
 - b. List sources of water for animals.
 - c. List the types of watering systems.
 - d. Demonstrate the ability to determine water quality.

Related Academic Topics (See Appendix A): C1, C2, C4, S1, S2, S3
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Examine the role of nutrition in animal growth and health.*
 - a. *Use supervised study followed by class discussion of the role and importance of nutrition in animal production. Use examples of feed labels to assess the presence of the six nutrients, including the feedstuffs used to produce the feed.*
 - b. *Design a complete ration for an animal. Consider age, sexual condition, overall health, and other factors in designing an economical ration.*
 - c. *Distinguish feed needs and preparation based on the gastric systems of animals and feed stuffs available at economical costs.*
2. *Provide the proper care of pregnant and lactating females.*
 - a. *Use supervised study and student discussion or form students into cooperative learning groups to investigate the care of pregnant animals. Have each group identify examples in the school lab, on farms, or at homes of students, and in other situations where students can devise approaches in the care of pregnant and lactating females. Have each group provide a report on their plans to the overall class.*
 - b. *Tour a local farm or animal care facility to observe practices with pregnant and lactating females.*
 - c. *Use the Internet or published research reports for individual student investigation of relationships between nutrition and milk production by dairy cows.*
3. *Provide post-natal care of females and offspring.*
 - a. *Use supervised study and class discussion to outline the development of new-born animals.*
 - b. *Have students independently investigate changes in feed requirements of females following parturition and while lactating.*
 - c. *Describe the birth process and expulsion of the afterbirth, including factors associated with retained afterbirth.*

4. *Identify animals based on food consumption.*
 - a. *Form cooperative learning groups for students to investigate and classify animals as carnivores, omnivores, and herbivores. The groups should further identify and classify animals in the local area as carnivores, omnivores, and herbivores.*
 - b. *Distinguish feed stuff materials and food sources based on these classifications.*
5. *Assess the effects of hormones on animal growth.*
 - a. *Use supervised study and class discussion to develop an outline of the main topics associated with hormones in animal growth.*
 - b. *Form cooperative learning groups for students to explore issues among consumers with the use of hormone additives in feeds. Use the Internet and resource persons in the community and labels on feed containers for information.*
6. *Assess the importance of vitamins and minerals in the diet of an animal.*
 - a. *Provide textbooks and other materials for supervised study and student participation in developing an outline of the major areas on the writing surface.*
 - b. *Classify local feed stuffs on the basis of vitamin and mineral content.*
7. *Assess the importance of concentrates and roughage in the diet of an animal.*
 - a. *Use supervised study for students to gather information for class discussion and distinguish between concentrates and roughage. Use examples of feed tags or labels for students to identify the major sources of concentrates and roughage in commercially-prepared feeds.*
 - b. *Identify the major locally-grown sources of roughage for animal rations.*
8. *Identify the importance of water to animals.*
 - a. *Use supervised study and class discussion to illustrate the importance of water.*
 - b. *Identify the major sources of water for animals produced in the local area.*
 - c. *Use publications or equipment brochures to identify types of watering equipment.*
 - d. *Assess the quality of water based on source and characteristics of the water.*

Suggested Assessment Strategies:

1. *Examine the role of nutrition in animal growth and health.*
 - a. *Use an oral or written test for objectives a-f.*
 - b. *Student participation in assessing the ingredients in feed labels.*
 - c. *Use a rubric to assess the sample complete rations developed by students.*
 - d. *Student ability to select feed stuffs for animals based on their digestive system.*
2. *Provide the proper care of pregnant and lactating females.*
 - a. *Written or oral test for objectives a-d.*
 - b. *Oral descriptions provided by students of the phases of pre-natal growth.*
 - c. *Student ability to select the proper feed for pregnant and lactating females.*
3. *Provide post-natal care of females and offspring.*
 - a. *Written or oral test for objectives a-c.*
 - b. *Student participation in describing the development stages of young animals.*

- c. Ability to assess if afterbirth has been expelled or retained.*
- 4. *Identify animals based on food consumption.*
 - a. Written or oral test for objectives a and b.*
 - b. Student ability to classify animals as omnivores, carnivores, and herbivores.*
- 5. *Assess the effects of hormones on animal growth.*
 - a. Written or oral test for objectives a and b.*
 - b. Student ability to identify roles of hormones in animal growth, development, and maintenance.*
 - c. Student participation in identifying issues associated with hormone additives.*
- 6. *Assess the importance of vitamins and minerals in the diet of an animal.*
 - a. Written or oral test for objectives a and b.*
 - b. Student ability to select feed stuffs that meet the vitamin and mineral nutrition needs of animals.*
- 7. *Assess the importance of concentrates and roughage in the diet of an animal.*
 - a. Written or oral test for objectives a-c.*
 - b. Student ability to select feed stuffs for animals with proper balance of concentrates and roughage based on digestive system and animal maturity.*
 - c. Content of concentrates and roughage in rations designed by students for selected animals.*
- 8. *Identify the importance of water to animals.*
 - a. Written or oral test for objectives a-d.*
 - b. Student ability to select and provide water in the appropriate quality and quantity for an animal or group of animals.*
 - c. Identification and selection of the appropriate watering equipment for animals.*
 - d. Collecting and testing water samples using test kits to determine appropriateness for use with animals.*

Suggested Resources:

Ensminger, M. E. (1991). Animal science digest. Danville, IL: Interstate Publishers, Inc.

Gillespie, J. R. (2002). Modern livestock and poultry production. (6th ed.). Albany, NY: Delmar Publishers.

Gillespie, J. (1998). Animal science. Albany, NY: Delmar Publishers.

Herren, R. (1994). The science of animal agriculture. Albany, NY: Delmar Publishers.

Lee, J. S., Embry, C., Hutter, J., Pollok, J., Rudd, R., Westrom, L., & Bull, A. (2000). Introduction to livestock and companion animals. (2nd ed.). Danville, IL: Interstate Publishers, Inc.

THE SCIENCE OF AGRICULTURAL ANIMALS
UNIT 8: REPRODUCTION

(12 hours)

Competencies and Suggested Objectives:

1. Assess the importance of reproduction in animal production.
 - a. Define reproduction and relate it to animal production.
 - b. Identify male and female sex cells.
 - c. Distinguish between mating and conception.
 - d. Explain the process of fertilization.
 - e. Explain the importance of reproduction efficiency.

Related Academic Topics (See Appendix A): C1, C4, S3
Workplace Skills (See Appendix B): WP2, WP7, WP8
2. Examine the reproduction process with mammals.
 - a. List the male and female reproduction organs and give the function of each.
 - b. Identify the phases of the female mammal reproductive cycle.
 - c. Distinguish between natural and artificial insemination.
 - d. List the gestation lengths for common animals.
 - e. Select breeding animals for a specific goal in an animal enterprise.
 - f. Observe the artificial insemination method of breeding.
 - g. Observe the procedure for evaluation of semen for sperm count.

Related Academic Topics (See Appendix A): C1, C2, C4, S1, S3, S7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
3. Examine the reproduction process with poultry.
 - a. Describe poultry reproduction.
 - b. Indicate incubation period and conditions required by various species.
 - c. Care for newly-hatched poultry.

Related Academic Topics (See Appendix A): C1, C4, S3
Workplace Skills (See Appendix B): WP2, WP7, WP8
4. Examine the reproduction process with finfish.
 - a. Trace the general process of spawning and incubation with finfish.
 - b. Indicate conditions for spawning of a species common in the local area.
 - c. Explain incubation naturally and artificially to assure a good hatch.
 - d. Care for newly-hatched fry.

Related Academic Topics (See Appendix A): C1, C4, S3
Workplace Skills (See Appendix B): WP2, WP7, WP8

Suggested Teaching Strategies:

1. *Assess the importance of reproduction in animal production.*
 - a. *Use supervised study followed with class discussions and student participation in developing an outline of important concepts in animal reproduction, including male and female sex cells, mating and conception, fertilization, and reproduction efficiency.*
 - b. *Have students prepare a summary chart that compares reproductive processes in mammals, birds, and finfish.*
2. *Examine the reproduction process with mammals.*
 - a. *Use supervised study followed by class discussion on the meaning of a mammal and the phases of the female mammal reproductive cycle.*
 - b. *Use supervised study and class discussion to outline the major concepts involved in natural and artificial insemination.*
 - c. *Provide a chart as a handout or in a textbook that lists the gestation lengths for common animals. Review the information and have students determine when breeding should occur in order to have offspring at a particular time, such as the breeding time for February calving.*
 - d. *Use supervised study and class discussion to provide information on the selection of breeding stock to achieve a particular goal with an animal production enterprise.*
 - e. *Demonstrate the process of artificial insemination using educational models.*
 - f. *Demonstrate the use of wet-mount slides for assessing the quality of a semen sample from a local semen service for cattle or swine.*
3. *Examine the reproduction process with poultry.*
 - a. *Use supervised study and class discussion to develop an outline on the writing surface of the general process of reproduction in poultry.*
 - b. *Provide a chart in a handout or textbook that covers incubation conditions for various poultry. Incubate a setting of eggs in the classroom or laboratory. Keep a log of dates and times, temperature, and other conditions in the incubator.*
 - c. *Develop a daily and weekly schedule to follow in caring for newly-hatched poultry. Demonstrate the correct practices with the poultry that hatch from the setting of eggs.*
4. *Examine the reproduction process with finfish.*
 - a. *Use supervised study and class discussion to organize a summary of the processes involved in the reproduction of finfish, including natural spawning and artificial fertilization.*
 - b. *Use a locally-available species and spawn the fish in the laboratory.*
 - c. *Form cooperative learning groups with each group investigating and reporting on spawning methods with various species of finfish. Use appropriate hatchery methods for the species that was spawned in the laboratory.*
 - d. *Using spawns that hatch in the laboratory, properly care for the fry.*

Suggested Assessment Strategies:

1. *Assess the importance of reproduction in animal production.*
 - a. *Use a written or oral unit test to cover objectives a-e.*
 - b. *Students will demonstrate knowledge of animal reproduction efficiency with animal enterprises in SAE.*
2. *Examine the reproduction process with mammals.*
 - a. *Use a written or oral unit test to cover objectives a-g.*
 - b. *Students will demonstrate knowledge of mammal reproduction in the practices used in SAE.*
3. *Examine the reproduction process with poultry.*
 - a. *Use a written or oral unit test to cover objectives a-c.*
 - b. *Student participation in activities involving the reproduction of poultry.*
4. *Examine the reproduction process with finfish.*
 - a. *Use a written or oral unit test to cover objectives a-d.*
 - b. *Oral reports by student cooperative groups of spawning processes with selected species of fish.*

Suggested Resources:

Ensminger, M. E. (1992). Poultry science. Danville, IL: Interstate Publishers, Inc.

Gillespie, J. R. (2002). Modern livestock and poultry production (6th ed.). Albany, NY: Delmar Publishers.

Gillespie, J. (1998). Animal science. Albany, NY: Delmar Publishers.

Herman, H. A., Mitchell, J. R., & Doak, G. A. (1994). The artificial insemination and embryo transfer of dairy and beef cattle. Danville, IL: Interstate Publishers, Inc.

Lee, J. S., Embry, C., Hutter, J., Pollok, J., Rudd, R., Westrom, L., & Bull, A. (2000). Introduction to livestock and companion animals. (2nd ed.). Danville, IL: Interstate Publishers, Inc.

Lee, J. S., & Newman, M. E. (1997). Aquaculture: An introduction. Danville, IL: Interstate Publishers, Inc.

THE SCIENCE OF AGRICULTURAL ANIMALS
UNIT 9: ANIMAL EVALUATION

(12 hours)

Competencies and Suggested Objectives:

1. Investigate the selection of market animals.
 - a. Explain the importance of animal selection.
 - b. Identify the high quality meat cuts on a market animal.
 - c. List the main points to consider when evaluating a market class (type, muscle, finish, carcass merit, yield, quality, balance, and style).
 - d. Evaluate classes of market animals and present reasons for each class.
 - e. Demonstrate the proper fitting procedures to prepare an animal for show.

Related Academic Topics (See Appendix A): C1, C2, C4, S3, S7
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
2. Investigate the selection of breeding animals.
 - a. Explain the points to consider when selecting a breeding animal (structural soundness, growth, capacity, breed, and sex character).
 - b. Use performance records in selecting breeding animals.
 - c. Evaluate classes of breeding animals and present reasons for each class.
 - d. Demonstrate the proper fitting procedures to prepare an animal for show.

Related Academic Topics (See Appendix A): C1, C2, C4, S3, S7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
3. Evaluate non-mammal species on the basis of productive efficiency.
 - a. Assess the role of feed conversion in animal efficiency.
 - b. Examine reproductive capability in productive efficiency.
 - c. Determine the role of disease in productive efficiency.

Related Academic Topics (See Appendix A): C1, C2, C4, S3, S7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Investigate the selection of market animals.*
 - a. *Use supervised study followed with class discussion to outline major concepts in the selection of animals.*
 - b. *Use charts that show wholesale and retail meat cuts for species of animals in the local area.*
 - c. *Form cooperative learning groups for students to identify meat animal evaluation criteria. Provide reference materials for their use in preparing oral reports to be given to the class.*
 - d. *Set up sample classes of animals for students to evaluate. Follow procedures of the FFA livestock judging event.*

- e. *Organize a clinic on grooming and training animals for show. Give demonstrations with live animals. Use community resource persons or livestock specialists to assist.*
- f. *Demonstrate acceptable ethical practices in grooming and showing livestock.*
- 2. *Investigate the selection of breeding animals.*
 - a. *Use supervised study followed by class discussion on the selection of breeding animals.*
 - b. *Provide samples of performance records for students to practice selecting animals with such information.*
 - c. *Use specimen classes of breeding animals for students to evaluate. Follow procedures of the FFA judging event.*
 - d. *Demonstrate the fitting and training of breeding animals for showing.*
- 3. *Evaluate non-mammal species on the basis of productive efficiency.*
 - a. *Form cooperative learning groups for students to investigate the productive efficiency of non-mammal species. Each group should produce a chart that compares common species on the basis of feed conversion, reproductive capability, and disease resistance.*

Suggested Assessment Strategies:

- 1. *Investigate the selection of market animals.*
 - a. *Use a written or oral test for objectives a-e.*
 - b. *Prepare a rubric for assessment of student performance in fitting and training animals for showing.*
 - c. *Use results of judging specimen classes following FFA judging event procedures.*
 - d. *Skill in correctly using ultrasound equipment to make accurate backfat measurements.*
- 2. *Investigate the selection of breeding animals.*
 - a. *Use a written or oral test for objectives a-d.*
 - b. *Prepare a rubric for assessment of student performance in fitting and training breeding animals for showing.*
 - c. *Use results of judging specimen classes of breeding animals following FFA judging event procedures.*
- 3. *Evaluate non-mammal species on the basis of productive efficiency.*
 - a. *Assessment of student performance in cooperative learning groups preparing a chart that compares the efficiency of common non-mammal species.*

Suggested Resources:

Ensminger, M. E. (1991). Animal science digest. Danville, IL: Interstate Publishers, Inc.

Ensminger, M. E. (1992). Poultry science. Danville, IL: Interstate Publishers, Inc.

Gillespie, J. R. (2002). Modern livestock and poultry production (6th ed.). Albany, NY:

Delmar Publishers.

Gillespie, J. (1998). Animal science. Albany, NY: Delmar Publishers.

Herren, R. V. (2000). The science of animal agriculture. (2nd ed.). Albany, NY: Delmar Publishers.

Lee, J. S., Embry, C., Hutter, J., Pollok, J., Rudd, R., Westrom, L., & Bull, A. (2000). Introduction to livestock and companion animals. (2nd ed.). Danville, IL: Interstate Publishers, Inc.

Taylor, R. E. (1995). Scientific farm animal production. Englewood Cliffs, NJ: Prentice-Hall, Inc.

THE SCIENCE OF AGRICULTURAL ANIMALS
UNIT 10: ANIMAL HEALTH

(12 hours)

Competencies and Suggested Objectives:

1. Examine the effects of disease on livestock, companion, and laboratory animals.
 - a. Explain health and the importance of promoting animal health through disease prevention.
 - b. Define disease and list the major causes of disease.
 - c. Assess animal losses due to poor health.
 - d. Explain practices that promote good health.
 - e. List the signs of good health in animals.

Related Academic Topics (See Appendix A): C1, C2, C4, S1, S2, S3
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
2. Examine the effects of environment on animal health.
 - a. Identify environmental conditions that affect animal health.
 - b. Explain the importance of animal housing.
 - c. Assess the role of nutrition in animal health.
 - d. Assess the importance of quality water in animal health.
 - e. Investigate how population density is related to health.
 - f. Explain the role of air quality in animal health.

Related Academic Topics (See Appendix A): C1, C2, C4, S1, S2, S3, S7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
3. Examine the role of the host animal as related to health.
 - a. Describe how age, gender, breed, stocking density, and immunity affect host health.
 - b. Explain the functions of red blood cells and white blood cells.
 - c. Identify the role of immunity in disease control.
 - d. Describe how vaccines work.
 - e. Explain how antigens enter the body.

Related Academic Topics (See Appendix A): C1, C2, C4, S1, S2, S3, S7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
4. Examine the role of pathogens in animal health.
 - a. List and describe the types of disease organisms.
 - b. Discuss how pathogens enter the body.
 - c. Classify common diseases of domesticated animals.
 - d. Identify ways medicines are delivered to animals.

Related Academic Topics (See Appendix A): C1, C4, S1, S2, S3, S7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
5. Examine the role of parasites and plant toxins in animal health.
 - a. Discuss how parasites cause harm to host animals.
 - b. Classify internal parasites.
 - c. Explain the effects of external parasites.
 - d. Discuss the control of external and internal parasites.
 - e. Explain plant toxins and how they affect animal health.

Related Academic Topics (See Appendix A): C1, C2, C4, S1, S2, S3, S7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Examine the effects of disease on livestock, companion, and laboratory animals.*
 - a. *Use supervised study followed by class discussion to develop a definition of disease and a list of the major causes.*
 - b. *Form cooperative learning groups to investigate animal losses due to disease and practices that promote good health. Have each group provide a report.*
 - c. *Use supervised study followed by class discussion and listing of signs of good health and disease in animals. Observe animals for these signs.*
2. *Examine the effects of environment on animal health.*
 - a. *Use supervised study and class discussion to summarize the environmental conditions that affect animal health. Relate health to animal housing needs.*
 - b. *Form cooperative learning groups for students to determine the role of feed and water as environmental conditions affecting health.*
 - c. *Use class discussion to explain the meaning of population density and the influence it has on health. Include the role of air quality in animal health.*
3. *Examine the role of the host animal as related to health.*
 - a. *Have students prepare short written reports on the meaning and importance of host animals, including age, gender, breed, stocking density, and immunity.*
 - b. *Have students investigate the role of red and white blood cells and in disease.*
 - c. *Relate immunity to the use of vaccines. Demonstrate the correct procedure in giving various injections, and have students practice using chicken legs.*
 - d. *Explain the role of antigens and how they are important in animal health.*
4. *Examine the role of pathogens in animal health.*
 - a. *Use supervised study for students to investigate the types of disease organisms.*
 - b. *Describe the meaning of pathogens and ways they enter the body.*
 - c. *Use supervised study for students to determine the classification of diseases.*
5. *Examine the role of parasites and plant toxins in animal health.*
 - a. *Use supervised study followed by class discussion to develop an outline of the ways parasites harm animals. Classify parasites as internal or external. Identify local examples in each classification.*
 - b. *Form cooperative learning groups for students to investigate the effects of external parasites on animals. Include controlling external and internal parasites.*
 - c. *Present the meaning of plant toxins and how they effect animal health. Have specimen plants that produce such toxins available for class observation but use caution to assure that no students are harmed.*

Suggested Assessment Strategies:

1. *Examine the effects of disease on livestock, companion, and laboratory animals.*

- a. *Use a unit test on objectives a-e.*
 - b. *Student participation in cooperative learning groups and in reporting to the class.*
 - c. *Practices followed by students with animals in assuring good animal health.*
2. *Examine the effects of environment on animal health.*
 - a. *Use a unit test on objectives a-f.*
 - b. *Practices followed by students with animals in assuring a good environment that promotes health.*
 - c. *Demonstrated ability to select and provide proper feed and water for animals based on age, condition, and other factors.*
 - d. *Demonstrated ability to place the proper number of animals in a given environment to promote health.*
3. *Examine the role of the host animal as related to health.*
 - a. *Use a unit test on objectives a-e.*
 - b. *Student participation with groups and in reporting in class.*
 - c. *Practices students follow with animals that promote health.*
4. *Examine the role of pathogens in animal health.*
 - a. *Use a unit test on objectives a-d.*
 - b. *Student participation in class groups, discussion, and other activities.*
 - c. *Practices students follow with animals under their supervision.*
5. *Examine the role of parasites and plant toxins in animal health.*
 - a. *Use a unit test on objectives a-e.*
 - b. *Student participation in class discussions and group activities.*
 - c. *Practices followed by students with their animal projects.*
 - d. *Ability to identify toxic plants and develop a plan for eliminating such plants from the environments of animals.*

Suggested Resources:

Cheeke, P. R. (1998). Natural toxicants in feeds, forages and poisonous plants (2nd ed.). Danville, IL: Interstate Publishers, Inc.

Ensminger, M. E. (1991). Animal science digest. Danville, IL: Interstate Publishers, Inc.

Greer, W. J., & Baker, J. (1992). Animal health. Danville, IL: Interstate Publishers, Inc.

Herren, R. (1994). The science of animal agriculture. Albany, NY: Delmar Publishers.

Lee, J. S., Embry, C., Hutter, J., Pollok, J., Rudd, R., Westrom, L., & Bull, A. (2000). Introduction to livestock and companion animals. (2nd ed.). Danville, IL: Interstate Publishers, Inc.

THE SCIENCE OF AGRICULTURAL ANIMALS
UNIT 11: FACILITIES AND EQUIPMENT

(7 hours)

Competencies and Suggested Objectives:

1. Identify the facility and equipment needs with various animal production enterprises.
 - a. Discuss facility and equipment needs based on species and breed of animal.
 - b. Explain climate and weather conditions related to species requirements.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, S2, S3
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
2. Explore the design and construction features of facilities and equipment in the animal industry.
 - a. List the factors to consider when planning a facility.
 - b. List the factors to consider when selecting equipment for a selected facility.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, S2, S3
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Identify the facility and equipment needs with various animal production enterprises.*
 - a. *Use supervised study and class discussion to outline the major facility and equipment needs based on species and breed of animal.*
 - b. *Have students investigate the facilities needed for animal species as related to climate and weather.*
2. *Explore the design and construction features of facilities and equipment in the animal industry.*
 - a. *Use supervised study for students to investigate facility design.*
 - b. *Form cooperative learning groups for students to prepare plans of facilities for animals in the local area. Include a sketch of the layout and a list of the features of the facility. Have each group present a report on their work to the class.*

Suggested Assessment Strategies:

1. *Identify the facility and equipment needs with various animal production enterprises.*
 - a. *Use a unit test on objectives a and b.*
 - b. *Demonstrated practices of students in providing facilities and equipment for their animals in SAE.*
2. *Explore the design and construction features of facilities and equipment in the animal industry.*
 - a. *Use a unit test on objectives a and b.*

- b. Participation of students in cooperative learning groups and reports presented by each group to the class.*

Suggested Resources:

Boyd, J. S., & Reynolds, C. L. (1996). Buildings for small acreages: Farm, ranch and recreation (2nd ed.). Danville, IL: Interstate Publishers, Inc.

Ensminger, M. E. (1991). Animal science digest. Danville, IL: Interstate Publishers, Inc.

Gillespie, J. R. (2002). Modern livestock and poultry production (6th ed.). Albany, NY: Delmar Publishers.

Gillespie, J. (1998). Animal science. Albany, NY: Delmar Publishers.

Lee, J. S., Embry, C., Hutter, J., Pollok, J., Rudd, R., Westrom, L., & Bull, A. (2000). Introduction to livestock and companion animals. (2nd ed.). Danville, IL: Interstate Publishers, Inc.

THE SCIENCE OF AGRICULTURAL ANIMALS
UNIT 12: MANAGEMENT AND MARKETING

(13 hours)

Competencies and Suggested Objectives:

1. Investigate the approved practices for managing animal enterprises.
 - a. Identify management practices with cow-calf and farrowing operations.
 - b. Describe pre-conditioning and backgrounding calves and hogs.
 - c. Describe approved practices in caring for weaning age animals.
 - d. Explain the purpose of castration and spaying.
 - e. Observe dehorning, tattooing, and branding.
 - f. Develop an enterprise budget for animal production.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, S3, S7, S8
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
2. Analyze the approved practices in marketing animals.
 - a. Assess marketing alternatives for meat animals.
 - b. Assess marketing alternatives for dairy products.
 - c. Assess marketing alternatives for aquaculture.
 - d. Assess marketing alternatives for companion animals.
 - e. Assess marketing alternatives for laboratory animals.

Related Academic Topics (See Appendix A): C1, C2, C4, S3
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
3. Investigate new and emerging technologies in managing and marketing animals.
 - a. Discuss examples of new and emerging trends and practices in managing and marketing animals.

Related Academic Topics (See Appendix A): C1, C4
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
4. Examine small business management in animal agriculture.
 - a. Determine the important practices in managing a small business.
 - b. Use spreadsheets to keep records.
 - c. Describe the procedures to follow in gaining and succeeding in employment in a small business.

Related Academic Topics (See Appendix A): C1, C2, C4
Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Investigate the approved practices for managing animal enterprises.*
 - a. *Use supervised study followed by discussion to identify important management practices in cow-calf and farrowing operations. Implement these practices, as appropriate, with supervised experience activities in animal agriculture.*
 - b. *Use cooperative learning groups for students to obtain and analyze information on preconditioning and backgrounding calves and pigs. Use a local producer or animal specialist as a resource person to describe local area practices.*
 - c. *Form students into cooperative learning groups to investigate practices in*

- caring for weaning age animals. Have each group use a different species and provide an oral report to the class.
- d. Observe approved practices in castrating and spaying animals.
 - e. Observe approved practices in dehorning, tattooing, and branding.
 - f. Provide examples of enterprise budgets for animal production enterprises. Review the examples and have students prepare an example for animals they own or that are owned by another individual.
2. Analyze the approved practices in marketing animals.
 - a. Use supervised study and class discussion to identify and list the meaning of marketing alternatives for various animals and animal products produced in the local area.
 - b. Use market reports from the local newspaper or web site. Have students keep a 10-day record and prepare a graph that depicts price fluctuations.
 - c. Use a resource person on animal marketing to provide current information.
 - d. Form students into cooperative learning groups and have them prepare the pros and cons of integrators in agricultural marketing.
 3. Investigate new and emerging technologies in managing and marketing animals.
 - a. Provide resource materials on new and emerging technologies in managing and marketing animals for supervised study by students. Follow this with discussion and developing a summary outline on the chalkboard.
 4. Examine small business management in animal agriculture.
 - a. Form cooperative learning groups for students to investigate important areas of business management in animal agriculture. Follow this with class discussion and developing an outline on the writing surface.
 - b. Provide students with examples of spreadsheets and instruct them in how to prepare such sheets using microcomputers. Students should use spreadsheets to keep records on their supervised experience program.
 - c. Use a resource person to discuss how to get a job in animal agriculture or start your own business and how to be successful.

Suggested Assessment Strategies:

1. Investigate the approved practices for managing animal enterprises.
 - a. Use a written or oral test on objectives a-f.
 - b. Participation of individuals in cooperative group learning.
 - c. Practices followed by students who own animals or who are working with other individuals in managing animal enterprises.
 - d. Skill of students in performing livestock animal management practices.
2. Analyze the approved practices in marketing animals.
 - a. Use a written or oral test for objectives a-e.
 - b. Participation by individuals in identifying markets and using market information.
3. Investigate new and emerging technologies in managing and marketing animals.
 - a. Use a written or oral test.
4. Examine small business management in animal agriculture.
 - a. Use a written or oral test for objectives a-c.
 - b. Skill of student in printing out an accurate spreadsheet for an animal

- enterprise.*
- c. *Demonstrated ability in interviewing for a job, gaining employment, and advancing in a job.*

Suggested Resources:

Ensminger, M. E. (1991). Animal science digest. Danville, IL: Interstate Publishers, Inc.

Gillespie, J. R. (2002). Modern livestock and poultry production (6th ed.). Albany, NY: Delmar Publishers.

Gillespie, J. (1998). Animal science. Albany, NY: Delmar Publishers.

Herren, R. V. (2000). The science of animal agriculture. (2nd ed.). Albany, NY: Delmar Publishers.

Lee, J. S., Embry, C., Hutter, J., Pollok, J., Rudd, R., Westrom, L., & Bull, A. (2000). Introduction to livestock and companion animals. (2nd ed.). Danville, IL: Interstate Publishers, Inc.

THE SCIENCE OF AGRICULTURAL ANIMALS

UNIT 13: COMPANION ANIMAL CARE AND MANAGEMENT

(5 hours)

Competencies and Suggested Objectives:

1. Determine the types, uses, care, and management of companion animals.
 - a. Describe the domestication and history of companion animals.
 - b. Determine the economic impact of various classes of companion animals.
 - c. Identify the types and uses of various classes of companion animals.
 - d. Describe the approved practices in feeding and caring for companion animals.
- Related Academic Topics (See Appendix A): C1, C2, C4*
Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Determine the types, uses, care, and management of companion animals.*
 - a. *Oral and written assignment to describe the domestication and history of companion animals.*
 - b. *Oral and written assignment to determine the economic impact of various classes of companion animals.*
 - c. *Oral and written assignment to identify the types and uses of various classes of companion animals.*
 - d. *Oral and written assignment to describe the approved practices in feeding and caring for companion animals.*

Suggested Assessment Strategies:

1. *Determine the types, uses, care, and management of companion animals.*
 - a. *Oral and/ written report - Describe the domestication and history of companion animals.*
 - b. *Oral and/ written report - Determine the economic impact of various classes of companion animals.*
 - c. *Oral and/ written report - Identify the types and uses of various classes of companion animals.*
 - d. *Oral and/ written report - Describe the approved practices in feeding and caring for companion animals.*

Suggested Resources:

Ensminger, M. E. (1991). Animal science digest. Danville, IL: Interstate Publishers, Inc.

Gillespie, J. R. (2002). Modern livestock and poultry production (6th ed.). Albany, NY: Delmar Publishers.

Gillespie, J. (1998). Animal science. Albany, NY: Delmar Publishers.

Herren, R. V. (2000). The science of animal agriculture. (2nd ed.). Albany, NY: Delmar Publishers.

Lee, J. S., Embry, C., Hutter, J., Pollok, J., Rudd, R., Westrom, L., & Bull, A. (2000). Introduction to livestock and companion animals. (2nd ed.). Danville, IL: Interstate Publishers, Inc.

June 21, 2002

June 21, 2002

SECTION IV:
CURRICULUM GUIDE
FOR
THE SCIENCE OF AGRICULTURAL ENVIRONMENT

June 21, 2002

**THE SCIENCE OF AGRICULTURAL ENVIRONMENT
COURSE DESCRIPTION
(CIP: 03.0102)**

The Science of Agricultural Environment is a course to introduce and develop skills in environmental areas related to the use and management of natural resources in the food and fiber systems. New technologies being used to enhance human capabilities to monitor and protect the environment are introduced. The overall focus is on maintaining and protecting resources to assure quality human life. Important relationships of living organisms to land and soil, water, the atmosphere, waste management, forestry, and energy management are included. Stress is on understanding global environmental issues and developing appropriate attitudes of environmental stewardship.
(Prerequisite: Concepts of Agriscience Technology or Biology; Grades 10-12; 1 year, 1 Carnegie Unit)

**THE SCIENCE OF AGRICULTURAL ENVIRONMENT
COURSE OUTLINE**

<u>Unit No.</u>	<u>Title</u>	<u>No. of Hours</u>
Unit 1	The Environment and Quality of Life	7
Unit 2	Supervised Experience in Agricultural Environment	5
Unit 3	Living Organisms and the Environment	10
Unit 4	Ecology and the Environment	10
Unit 5	Land and Soil Management	10
Unit 6	Water Quality Management	12
Unit 7	The Atmosphere and Environmental Quality	8
Unit 8	Bioremediation and Waste Management	7
Unit 9	Forestry and the Environment	10
Unit 10	Wildlife and the Environment	11
Unit 11	Energy Management	5
Unit 12	Environmental Stewardship	7
Unit 13	Issues in a Global Environment	3
Unit 14	Future Environments and Occupational Opportunities	7

**THE SCIENCE OF AGRICULTURAL ENVIRONMENT
UNIT 1: THE ENVIRONMENT AND QUALITY OF LIFE**

(7 hours)

Competencies and Suggested Objectives:

1. Examine the environment and how human and agricultural activities create environmental change.
 - a. Describe environmental resources and distinguish between renewable and nonrenewable resources.
 - b. Explain sustainability in the environment.
 - c. Examine relationships of the ecosystem to energy transfer and food chains.
 - d. Explain the relationship of agriculture to the quality of the environment.

Related Academic Topics (See Appendix A): C1, C4, C6, S4
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
2. Analyze issues affecting the global environment and how these relate to agriculture.
 - a. Explain human population trends and factors influencing population changes.
 - b. Investigate the demands of human population on the environment and how these relate to agriculture.
 - c. Describe the effect of landscape degradation on the environment.
 - d. Examine natural resource conservation and interdependency.
 - e. Explain the decline of the world's natural fisheries.

Related Academic Topics (See Appendix A): C1, C4, S4
Workplace Skills (Appendix B): WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Examine the environment and how human and agricultural activities create environmental change.*
 - a. *Develop a definition of environment using student experiences and input. Use student descriptions to develop the concept of landscape and landscape change. Involve students in identifying natural resources and classifying these resources as renewable and nonrenewable.*
 - b. *Use student input to define the concept of sustainability. Relate sustainability to the use of natural resources and quality of life. Show how the use of resources is tied to meeting life needs for food, water, air, space, and shelter and protection.*
 - c. *Develop the concept of the environment as the "home" for humans and other living organisms using student input to define ecosystems and habitat. Use student input to define the concept of energy transfer and food chains and food webs.*

2. *Analyze issues affecting the global environment and how these relate to agriculture.*
 - a. *Use student input to develop a definition of “population.” Relate population to demography and current population data. Use graphs and tables for students to analyze and state long-term population trends. Investigate factors influencing population changes.*
 - b. *Have students identify the demands that humans place on the environment, including the use of renewable and nonrenewable resources. Discuss how the use of resources also results in wastes. Use student suggestions to identify major wastes created by humans. Relate demands and wastes to human population endangerment and to agriculture.*
 - c. *Use student responses to explain the concept of landscape degradation. Identify areas in the local community that have undergone development and relate the changes in the environment to the landscape.*
 - d. *Explain the decline of the world’s natural fisheries.*

Suggested Assessment Strategies:

1. *Examine the environment and how human and agricultural activities create environmental change.*
 - a. *Written test covering objectives a-d.*
 - b. *Mastery of concepts as evidenced by ability of students to identify and discuss the effects of human activities on the environment.*
2. *Analyze issues affecting the global environment and how these relate to agriculture.*
 - a. *Written test covering objectives a-d.*
 - b. *Observed ability of students to use environmental issues in communicating information.*
 - c. *Explain the decline of the world’s natural fisheries.*

Suggested Resources:

Holt. (2000). Environmental science. Austin, TX: Holt, Rinehart, and Winston.

Camp, W. G., & Donahue, R. L. (1997). Environmental science for agriculture and the life sciences. Albany, NY: Delmar Publishers.

Gulf of Mexico citizen’s pollution prevention program. (1992). Mississippi State, MS: Mississippi Cooperative Extension Service.

Introduction to environmental science. (1996). Alexandria, VA: National Council for Agricultural Education.

Porter, L., Lee, J. S., Turner, D. L., & Hillan, M. (1997). Environmental science and technology. Danville, IL: Interstate Publishers, Inc.

Turner, D. L. (1997). Environmental science and technology activity manual. Danville, IL: Interstate Publishers, Inc.

THE SCIENCE OF AGRICULTURAL ENVIRONMENT
UNIT 2: SUPERVISED EXPERIENCE IN
AGRICULTURAL ENVIRONMENT

(5 hours)

Competencies and Suggested Objectives:

1. Plan, implement, and expand supervised experience in agricultural environment.
 - a. Explain the purpose, kinds, and nature of supervised experience.
 - b. Explain how supervised experience is part of a carefully planned and long-term supervised agricultural experience program (SAE).
 - c. Describe how supervised experience relates to achievement of FFA proficiency awards and other activities.
 - d. Identify appropriate experiences for a supervised agricultural experience program.
 - e. Develop short-term, intermediate, and long-term SAE goals.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, S3, S8
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP6, WP7, WP8
2. Prepare and keep appropriate written documentation on supervised experiences.
 - a. Develop a training plan.
 - b. Develop a training agreement.
 - c. Keep records of competencies developed, inventory, income, and expenses.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, S3, S8
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Plan, implement, and expand supervised experience in agricultural environment.*
 - a. *Use class presentations and discussion to explain SAE, including its purpose, nature of the experiences, and how a program is planned and carried out.*
 - b. *Use materials published by the National FFA Organization that provide information on Career Development Events, Proficiency Awards, and other programs.*
 - c. *Use regular supervision and observation of student performance with supervised experience.*
 - d. *Provide a form to make goal setting easier and use individual counseling with each student on the goals that are made.*
2. *Prepare and keep appropriate written documentation on supervised experience.*
 - a. *Provide examples of training plans and training plan forms. In consultation with parents, employers, and others, complete a training plan.*
 - b. *Provide examples of training agreements and a sample training agreement form. Use presentations and discussions to develop students' skills in developing a training agreement. Have students prepare a training agreement and provide feedback on their work.*

- c. *Provide presentations on keeping records of personal experiences, inventory, and income and expense. Use sample forms and have students complete forms and explain what they have done.*

Suggested Assessment Strategies:

1. *Plan, implement, and expand supervised experience in agricultural environment.*
 - a. *Written or oral test on the purpose, kinds, and nature of SAE.*
 - b. *Initiating and progressing in appropriate supervised experience in agricultural environment by students, including advancing with degrees of FFA membership.*
 - c. *Observations made during supervision of student while engaged in experience program.*
 - d. *Developing and revising, as needed, of goals.*
2. *Prepare and keep appropriate written documentation on supervised experience.*
 - a. *Assessment of a completed SAE training agreement.*
 - b. *Accuracy and neatness of records kept of competencies developed, inventory, income, and expenses from supervised experience.*

Suggested Resources:

A guide to local program success. (1997). Indianapolis, IN: National FFA Organization.

Advisor's guide to the FFA student handbook. (Current ed.). Indianapolis, IN: National FFA Organization.

Career development events. (Current ed.). Indianapolis, IN: National FFA Organization.

Hunter, S., Stewart, M., Scheil, B., Terry, R., Jr., & Frazee, S. D. (1997). Developing leadership and personal skills. Danville, IL: Interstate Publishers, Inc.

Official FFA manual. (Current ed.). Indianapolis, IN: National FFA Organization.

SAE best practices. (1997). Indianapolis, IN: National FFA Organization.

**THE SCIENCE OF AGRICULTURAL ENVIRONMENT
UNIT 3: LIVING ORGANISMS AND THE ENVIRONMENT**

(10 hours)

Competencies and Suggested Objectives:

1. Investigate living organisms in the environment.
 - a. Classify living organisms in the environment.
 - b. Examine the roles of living organisms in the environment.
 - c. Demonstrate microbiology applications in environmental study.
Related Academic Topics (See Appendix A): C1, C4, S2, S3, S4
Workplace Skills (See Appendix B): WP2, WP7, WP8
2. Examine relationships of living organisms and the environment.
 - a. Explain life span and the stages of life.
 - b. Investigate the life processes essential for the living condition.
 - c. Examine the anatomy and physiology of living organisms as related to the environment.
 - d. Describe the role of biodiversity.
Related Academic Topics (See Appendix A): C1, C4, S2, S4
Workplace Skills (See Appendix B): WP2, WP7, WP8
3. Identify agricultural pests as they relate to the environment.
 - a. Explain the economic impact of agricultural pests on the environment.
 - b. Relate methods of controlling agricultural pests to impact on the environment.
Related Academic Topics (See Appendix A): C, C4, S3
Workplace Skills (See Appendix B): WP2, WP7, WP8

Suggested Teaching Strategies:

1. *Investigate living organisms in the environment.*
 - a. *Use student input to identify living organisms in the local area. Describe how these organisms are classified using a scientific classification system. Bring examples of organisms for student examination into the classroom or use a tour around the school grounds to identify living organisms found on it.*
 - b. *Have students offer examples of the roles of different organisms in the environment, with emphasis on producers, consumers, and decomposers.*
 - c. *Use student-collected samples from the environment to illustrate the importance of microbiology in environmental study. The focus is on plants and microbes, such as fungi and bacteria. Demonstrate proper protocol in preparing temporary wet-mount slides. Follow this with a demonstration on proper use of a microscope and student practice in using microscopes to identify microbes, such as those found in decaying wood or leaves.*
2. *Examine relationships of living organisms and the environment.*
 - a. *Use student input to explain life span and identify the five stages of life of organisms. Relate these to the environment. Have students explain how this is related to the life of trees in a forest or small plants along the side of a road.*
 - b. *Involve students in defining "life processes." Use their input to develop and*

- explain the essential life processes of organisms. Ask students to explain what happens if the organism fails to carry out these processes. Have students suggest local wildlife species and identify how the life processes occur with these organisms.*
- c. Have students distinguish between unicellular and multicellular organisms. Use student input in describing cell specialization and the structure of tissues, organs, and organ systems. Use student comparisons in distinguishing between plant and animal species.*
 - d. Use student input to define heredity and genetics. Relate these to biodiversity and associated areas of genetic diversity, species diversity, and ecological diversity. Have students identify diversity among species found in the local terrestrial and aquatic ecosystems, including forests, meadows, streams, and lakes. Insects can be collected for study from terrestrial environments or plankton from aquatic environments.*
- 3. *Identify agricultural pests as they relate to the environment.***
- a. Use a class presentation and outline of content to explain the economic impact of agricultural pests on the environment.*
 - b. Use supervised study followed by class discussion on methods of controlling agricultural pests as related to impact on the environment. Bulletins of the Cooperative Extension Service can be used to enhance relevance to the local area based on the crops produced and the pest problems that exist. A crop pest consultant can be used as a resource person.*

Suggested Assessment Strategies:

- 1. *Investigate living organisms in the environment.***
 - a. Written test covering objectives a-c.*
 - b. Student skill in collecting and examining microbial specimens from the environment.*
- 2. *Examine relationships of living organisms and the environment.***
 - a. Written test covering objectives a-d.*
 - b. Observed ability of students to orally communicate information about living organisms in the environment.*
 - c. Develop and use rubrics to assess student participation in studying habitat, collecting specimens; and examining plants, animals, and other species from the local environment.*
 - d. Demonstrated understanding of biodiversity as manifested in class discussion, supervised experience, and class projects.*
- 3. *Identify agricultural pests as they relate to the environment.***
 - a. Written or oral test on objectives a and b.*
 - b. Participation of individuals in discussion following supervised study session.*

Suggested Resources:

Holt. (2000). Environmental science. Austin, TX: Holt, Rinehart, and Winston.

Chiras, D. D. Environmental Science: Action for a sustainable future (3rd ed.). Redwood City, CA: The Benjamin/Cummings Publishing Company, Inc.

Porter, L., Lee, J. S., Turner, D. L., & Hillan, M. (1997). Environmental science and technology. Danville, IL: Interstate Publishers, Inc.

Turner, D. L. (1997). Environmental science and technology activity manual. Danville, IL: Interstate Publishers, Inc.

THE SCIENCE OF AGRICULTURAL ENVIRONMENT
UNIT 4: ECOLOGY AND THE ENVIRONMENT

(10 hours)

Competencies and Suggested Objectives:

1. Examine the principles of ecology as related to environmental quality.
 - a. Develop a working definition of ecology.
 - b. Describe agricultural and wildlife ecosystems and identify factors in those ecosystems.
 - c. Explain community organization and structure.
 - d. Diagram the food chain and web for organisms in a local agricultural or wildlife ecosystem.
 - e. Identify the roles of natural selection and succession.

Related Academic Topics (See Appendix A): C1, C4, S3
Workplace Skills (See Appendix B): WP2, WP7, WP8
2. Identify ecological diversity in agricultural and wildlife ecosystems.
 - a. Distinguish between terrestrial and aquatic biomes and give examples of each.
 - b. Explain the importance of homeostasis in the survival of organisms.
 - c. Describe population ecology, including natality and mortality.

Related Academic Topics (See Appendix A): C1, C4, S1, S2, S3, S4
Workplace Skills (See Appendix B): WP2, WP7, WP8

Suggested Teaching Strategies:

1. *Examine the principles of ecology as related to environmental quality.*
 - a. *Use supervised study followed by class discussion to define ecology and explain the organization of nature.*
 - b. *Use supervised study and discussion to determine the nature of economic systems. Form cooperative learning groups for students to describe ecosystems in the local area and identify biotic and abiotic factors in the ecosystems. Each group should provide an oral or visual report to the class.*
 - c. *Use supervised study followed by discussion to explain community and how habitats, niche, and structures are formed.*
 - d. *Describe the concepts of food chains and food webs. Examine the food web of a local species. Dissect laboratory-prepared owl pellets and prepare a diagram that illustrates the food chain and web of the owl.*
 - e. *Explain the terms natural selection and succession. Use local examples of animals or plants that adapt to their environment to survive, such as a toad that changes color based on its background or a plant that grows roots around rocks in order to obtain water. Examine an area in the local community in terms of succession. Determine the sequence of succession that is underway. Prepare a diagram that illustrates succession.*
 - f. *Arrange for the class to learn about programs for adopting a stream or other nature area. Have a local conservation district officer describe such efforts and assist the class in making a selection, preparing a plan and implementing a*

- course of action. (This can be an activity carried out throughout the course.)
2. *Identify ecological diversity in agricultural and wildlife ecosystems.*
 - a. *Use supervised study followed by discussion to cover types of biomes. Distinguish between terrestrial and aquatic biomes and describe examples of each. Use student input to describe biomes found in the local area.*
 - b. *Define homeostasis and describe factors that occur at intervals (periodicity) and provide adaptations based on temperature.*
 - c. *Use supervised study followed by class discussion to organize an outline on the writing surface that explains population ecology and related attributes including density, age, distribution, and population growth. Relate the role of competition and predation in population ecology.*

Suggested Assessment Strategies:

1. *Examine the principles of ecology as related to environmental quality.*
 - a. *Written or oral test covering objectives a-e.*
 - b. *Observed student ability to communicate information about ecology in the environment.*
2. *Identify ecological diversity in agricultural and wildlife ecosystems.*
 - a. *Written or oral test covering objectives a-c.*
 - b. *Observed student ability to describe biomes found in the local area.*

Suggested Resources:

Holt. (2000). Environmental science. Austin, TX: Holt, Rinehart, and Winston.

Porter, L., Lee, J. S., Turner, D. L., & Hillan, M. (1997). Environmental science and technology. Danville, IL: Interstate Publishers, Inc.

Turner, D. L. (1997). Environmental science and technology activity manual. Danville, IL: Interstate Publishers, Inc.

THE SCIENCE OF AGRICULTURAL ENVIRONMENT
UNIT 5: LAND AND SOIL MANAGEMENT

(10 hours)

Competencies and Suggested Objectives:

1. Identify the process of planning for urban and rural land use.
 - a. Explain the concepts of land and land use.
 - b. Describe land-use planning and zoning.

Related Academic Topics (See Appendix A): C1, C2, C4, S4
Workplace Skills (See Appendix B): WP2, WP7, WP8
2. Explain the importance of soil and proper soil management.
 - a. Identify the materials in soil and growing media.
 - b. Demonstrate how soil is formed.
 - c. Investigate the physical and chemical nature of soil using appropriate analyses.
 - d. Identify soil degradation and ways degradation occurs.
 - e. Explain the importance of soil conservation and relate conservation to management practices.
 - f. Describe how soil erosion impacts the water in streams, lakes, and oceans.

Related Academic Topics (See Appendix A): C1, C4, S4
Workplace Skills (See Appendix B): WP2, WP7, WP8
3. Assess the impact of agricultural, horticultural, and forestry practices on land and soil.
 - a. Identify tillage practices that promote and prevent soil erosion.
 - b. Illustrate the importance of protecting the soil from degradation.
 - c. Demonstrate principal elements of land surveying including measuring horizontal distances, slope chaining, direction measurements, elevation measurements, area measurements, and boundary surveys.

Related Academic Topics (See Appendix A): C1, C4, S4
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Identify the process of planning for urban and rural land use.*
 - a. *Define land and explain how land is classified based on capability. Describe management practices that result in the best use of land. Assess land areas in the local area in terms of suitable use and identify factors that determine the suitability of the use.*
 - b. *Describe land use and the important role of planning. Include the role of local governments in zoning.*
2. *Explain the importance of soil and proper soil management.*
 - a. *Have students develop a definition of soil and growing media and identify the constituent materials in local soil samples and media.*
 - b. *Demonstrate soil formation including weathering and parent materials. Relate the formation process to climate, topography, presence of living organisms, and time required for the process to occur.*

- c. *Identify the characteristics that determine the physical and chemical nature of soil. Explain the use of a soil triangle in showing relationships between proportions of soil constituents. Have students classify local soils on the basis of physical characteristics. Describe the chemical characteristics of soils, including pH and nutrient content. Have students conduct tests on collected samples of soil for pH and nutrient analysis using a soil test kit.*
- d. *Define soil degradation and explain major ways it occurs. Identify examples of areas in the local community where degradation has occurred. Assess how the soil has been affected and what can be done to prevent further degradation and restore the soil.*
- e. *List and explain practices that can be used in properly managing soil. Implement at least one of the practices in an area on the school grounds or elsewhere in the community.*
3. *Assess the impact of agricultural, horticultural, and forestry practices on land and soil.*
 - a. *Use supervised study followed by class discussion on traditional and reduced tillage practices as well as protection steps that can be taken. Invite a local farmer or soil conservationist to serve as a resource person to describe the impacts of no-till farming on the conservation of soil and level of crop production from the land.*
 - b. *Describe how soil is lost and the amount per acre that is lost from unprotected areas. Explain how soil loss is one way it is degraded; pollution, compaction, and other activities also degrade soil. Form cooperative learning groups for students identify areas in the local community where land and soil have been degraded and develop practices that prevent soil degradation and help restore soil productivity.*
 - c. *Practical exercise to demonstrate principal elements of land surveying including measuring horizontal distances, slope chaining, direction measurements, elevation measurements, area measurements, and boundary surveys.*

Suggested Assessment Strategies:

1. *Identify the process of planning for urban and rural land use.*
 - a. *Written or oral test covering objectives a and b.*
 - b. *Assess student discussion for evidence of knowledge of meaning and importance of zoning.*
2. *Explain the importance of soil and proper soil management.*
 - a. *Written or oral test covering objectives a-f.*
 - b. *Observation of student performance in carrying out activities in assessing soil physical and chemical properties, including following proper safety procedures.*
3. *Assess the impact of agricultural, horticultural, and forestry practices on land and soil.*
 - a. *Oral or written test on objectives a and b.*
 - b. *Reports prepared by cooperative groups on preventing land degradation and restoring damaged land and soil.*

c. Demonstrate principal elements of land surveying.

Suggested Resources:

Holt. (2000). Environmental science. Austin, TX: Holt, Rinehart, and Winston.

Biondo, R. J., & Lee, J. S. (1997). Introduction to plant and soil science and technology. Danville, IL: Interstate Publishers, Inc.

Camp, W. G., & Donahue, R. L. (1997). Environmental science for agriculture and the life sciences. Albany, NY: Delmar Publishers.

Porter, L., Lee, J. S., Turner, D. L., & Hillan, M. (1997). Environmental science and technology. Danville, IL: Interstate Publishers, Inc.

THE SCIENCE OF AGRICULTURAL ENVIRONMENT
UNIT 6: WATER QUALITY MANAGEMENT

(12 hours)

Competencies and Suggested Objectives:

1. Explain water uses and quality.
 - a. Describe the nature and states of water.
 - b. Identify important uses of water.
 - c. Identify sources of water.
 - d. Demonstrate the qualities of potable water.

Related Academic Topics (See Appendix A): C, C4, S4
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
2. Describe important water management practices.
 - a. Diagram and explain the water cycle.
 - b. Explain natural water supplies in flowing and non-flowing sources.
 - c. Identify common causes of water pollution and distinguish between point and nonpoint sources of pollution.
 - d. Explain the role of water quality monitoring and monitor the water in a stream.

Related Academic Topics (See Appendix A): C1, C2, S2, S4
Workplace Skills (See Appendix B): WP2, WP7, WP8
3. Describe how wastewater is treated to maintain water quality.
 - a. Explain the classes and sources of wastewater.
 - b. Identify hazards that may be present in wastewater.
 - c. Explain methods and processes in wastewater treatment.

Related Academic Topics (See Appendix A): C1, C2, S2, S4
Workplace Skills (See Appendix B): WP2, WP7, WP8

Suggested Teaching Strategies:

1. *Explain water uses and quality.*
 - a. *Use supervised study followed by discussion to outline information on the nature and states of water. Demonstrate the three states of water: solid, liquid, and gas. Articulate instruction with physical science, chemistry, or physics classes.*
 - b. *Use student input to develop a list of uses of water. Have students prepare posters, bulletin boards, or other materials that depict various water uses. Have students prepare a log listing the ways they use water each day and an estimate of the quantity used in the various ways.*
 - c. *Develop a descriptive list of the major sources of water, with particular application to the local area. Determine the sources of the water students use in their homes. Have students investigate the advantages and disadvantages of the various sources by interviewing people in the community or collecting information in other ways.*
 - d. *Define the term potable water. Emphasize the importance of potable water and the amount used per person each day. Describe the qualities of potable water.*

Conduct common tests (pH, salinity, odor and taste, color, alkalinity, hardness, dissolved solids and turbidity, presence of heavy metals, chemical residues, and coliform bacteria) on various local water sources to determine potability. Use water test kits to analyze samples for the presence of pollution, including coliform bacteria. Explain needed treatments to make water potable. Use a resource person from a local water treatment facility to discuss the processes used with the local municipal or community system. Make a field trip to the water treatment plant to study the methods used in water treatment.

2. Describe important water management practices.
 - a. Explain the water cycle. Use a transparency, line art drawing, or sketch to illustrate the water cycle.
 - b. Use supervised study for students to investigate supplies of flowing and nonflowing surface water. Diagram stream and lake structure, including the food webs found in the water. Make a field trip to a local stream or lake and collect samples of water for analysis.
 - c. Define water pollution and describe common kinds of water pollution. Have students identify bodies of water in the local area and assess the extent of pollution. Identify sources of possible pollution in the water, including point and nonpoint sources.
 - d. Monitor the water in a stream. Regularly take samples and perform tests. Keep data on your findings. Describe water quality monitoring and the physical monitoring and testing procedures that are followed. Conduct laboratory tests on various water samples, including tap water, water that collects on a parking lot following a rain, stream water, and lake water.
3. Describe how wastewater is treated to maintain water quality.
 - a. Define wastewater, explain the kinds of wastewater that are produced, and propose ways the amount of wastewater can be reduced. Distinguish between the sources of wastewater and how the qualities of the sources vary. Have students list the ways they are involved in producing wastewater. Identify sources of wastewater from agricultural and horticultural activities, including production and processing. Assess ways of reducing the amount of wastewater produced.
 - b. Use supervised study for students to investigate the hazards in wastewater. They should identify infectious agents, such as bacteria, protozoa, and parasitic worms, as well as toxic substances, organic matter, and thermal hazards.
 - c. List and explain the different ways wastewater is treated. Have students identify the objectives of wastewater treatment. Describe home wastewater systems as well as municipal, agricultural, and commercial systems. Identify the uses of sludge from the systems. Explain the role of biological processes in wastewater treatment. Illustrate the nitrogen, phosphorus, and sulfur cycles in wastewater.

Suggested Assessment Strategies:

1. Explain water uses and quality.

- a. *Written or oral unit test on objectives a-d.*
 - b. *Diagram the structure of a water molecule.*
 - c. *Log of water uses by individual students.*
 - d. *List of sources of water by each student for the community in which he/she lives.*
2. *Describe important water management practices.*
 - a. *Written or oral unit test on objectives a-d.*
 - b. *Student diagrams of the water cycle.*
 - c. *Student lists of sources of surface water in the local community.*
 - d. *Student descriptions of sources of water pollution in the local area distinguishing between point and nonpoint sources.*
3. *Describe how wastewater is treated to maintain water quality.*
 - a. *Written or oral unit test on objectives a-c.*
 - b. *Student descriptions of methods used in wastewater treatment in the community, including residential, commercial, agricultural, and horticultural wastewater.*

Suggested Resources:

Holt. (2000). Environmental science. Austin, TX: Holt, Rinehart, and Winston.

Chiras, D. D. (1991). Environmental science: Action for a sustainable future (3rd ed.). Redwood City, CA: The Benjamin/Cummings Publishing Company, Inc.

DeZuane, J. (1990). Handbook of drinking water quality. New York, NY: Van Nostrand Reinhold.

Mississippi Department of Environmental Quality. "Adopt a Stream Program."

NOAA. "Globe Program."

Porter, L., Lee, J. S., Turner, D. L., & Hillan, M. (1997). Environmental science and technology. Danville, IL: Interstate Publishers, Inc.

THE SCIENCE OF AGRICULTURAL ENVIRONMENT
UNIT 7: THE ATMOSPHERE AND ENVIRONMENTAL QUALITY

(8 hours)

Competencies and Suggested Objectives:

1. Examine the relationship of the atmosphere to the Earth's environment.
 - a. Define atmosphere and describe its contents.
 - b. Explain the structure of the atmosphere.

Related Academic Skills (See Appendix A): C1, C2, C4, S4
Workplace Skills (See Appendix B): WP2, WP7, WP8
2. Use weather and climate information in making decisions about the environment.
 - a. Define and distinguish between weather and environment.
 - b. Describe climate types and differences.
 - c. Make and interpret weather measurements.
 - d. Illustrate weather fronts, clouds, and storms and how these affect the environment.

Related Academic Topics (See Appendix A): C1, C2, C4, S4
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
3. Assess air quality and identify sources of air pollution.
 - a. Define air quality and relate quality to pollution and air quality standards.
 - b. Explain the movement of air and global pollution.
 - c. Describe the major kinds and sources of air pollution.
 - d. Identify the effects of air pollution on the Earth's environment.
 - e. Make air quality measurements.

Related Academic Topics (See Appendix A): C1, C2, S4
Workplace Skills (See Appendix B): WP2, WP5, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Examine the relationship of the atmosphere to the Earth's environment.*
 - a. *Use supervised study followed by class discussion to develop an outline on the writing surface of information to define atmosphere and describe its major constituents. Include the importance of the atmosphere to the well-being of living organisms.*
 - b. *Describe the structure of the atmosphere in terms of layers based on distance from the Earth's surface.*
2. *Use weather and climate information in making decisions about the environment.*
 - a. *Explain the meaning of weather and climate, including how climate is a result of long-term weather conditions. Use the Weatherlink Software Kit for students to analyze information relevant to weather conditions.*
 - b. *Provide information that explains climate differences based on latitude, longitude, and altitude. Interpret this information using a map or globe for the local area.*
 - c. *Demonstrate how weather measurements are made and used. Have students use devices to measure temperature, humidity, atmospheric pressure, and*

- wind.
- d. *Use published local weather reports to depict weather fronts, clouds, and storms. Have students assess current weather conditions based on the presence of fronts, clouds, and storms.*
- 3. *Assess air quality and identify sources of air pollution.*
 - a. *Use supervised study followed by discussion to outline information that explains air quality, air pollution, and air quality standards.*
 - b. *Illustrate how air moves globally and forms airsheds.*
 - c. *Describe how the air is continually changing as gases and particulate are released into it. Provide information on the kinds of gases and particulate that cause air pollution and pose threats to air quality.*
 - d. *Use supervised study and discussion on the effects of air pollution on human health and the health of other living organisms. Have students observe the local atmosphere for the presence of gases and particulate.*
 - e. *Demonstrate how air quality is tested and have students make air quality measurements using air sampling pumps and other approaches. (Note: Actual testing may require sending samples to a laboratory with the capability of making such tests.) A simple test for the presence of particulate is to suspend sections of masking tape in the area for several days and examine afterward with a hand lens for the presence of particulate on the tape.*

Suggested Assessment Strategies:

- 1. *Examine the relationship of the atmosphere to the Earth's environment.*
 - a. *Written or oral unit test for objectives a and b.*
 - b. *Students prepare posters or other materials that illustrate layers in the Earth's atmosphere and describe the impacts of these layers on the environment.*
- 2. *Use weather and climate information in making decisions about the environment.*
 - a. *Written or oral unit test for objectives a-d.*
 - b. *Skill in using instruments to measure weather information and compile weather data.*
 - c. *Skill in interpreting weather maps and other weather information.*
- 3. *Assess air quality and identify sources of air pollution.*
 - a. *Written or oral unit test for objectives a-e.*
 - b. *Skill in using instruments to collect air samples and assess air quality data.*
 - c. *Skill in identifying sources of air pollution and environmental effects of air pollution.*

Suggested Resources:

Holt. (2000). Environmental science. Austin, TX: Holt, Rinehart, and Winston.

Bitton, G. (1994). Wastewater microbiology. New York, NY: Wiley-Liss, Inc.

Chiras, D. D. Environmental science: Action for a sustainable future (Latest ed.). Redwood City, CA: The Benjamin/Cummings Publishing Company, Inc.

NOAA. "Globe Program."

Porter, L., Lee, J. S., Turner, D. L., & Hillan, M. (1997). Environmental science and technology. Danville, IL: Interstate Publishers, Inc.

Turner, D. L. (1997). Environmental science and technology activity manual. Danville, IL: Interstate Publishers, Inc.

**THE SCIENCE OF AGRICULTURAL ENVIRONMENT
UNIT 8: BIOREMEDIATION AND WASTE MANAGEMENT**

(7 hours)

Competencies and Suggested Objectives:

1. Use appropriate procedures in managing solid waste.
 - a. Explain the kinds of solid waste materials.
 - b. Identify sources of solid waste.
 - c. Identify hazards associated with improperly managed waste.
 - d. Explain how solid waste materials should be managed.
 - e. Select recycling processes and identify materials that are recycled.
 - f. Explain the use of residential, agricultural, and industrial composting.

Related Academic Topics (See Appendix A): C1, C4, S2, S4
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
2. Select appropriate procedures for managing hazardous waste.
 - a. Explain the meaning of hazardous waste.
 - b. Classify hazardous waste materials.
 - c. Identify the environmental problems created by hazardous waste.
 - d. Explain methods of disposing of hazardous waste.
 - e. Select appropriate procedures to follow with spills or accidents involving hazardous waste.

Related Academic Topics (See Appendix A): C1, C4, S4
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Use appropriate procedures in managing solid waste.*
 - a. *Provide information that explains solid waste, including waste produced by agricultural activities.*
 - b. *Describe the major sources of solid waste including the kinds of waste materials that are produced. Help students develop skills in distinguishing between biodegradable and nonbiodegradable solid wastes.*
 - c. *Provide information about the hazards that solid waste materials pose in the environment, to human health, and to the health of all living organisms.*
 - d. *Describe the proper management of solid waste materials. Assess the advantages and disadvantages of incineration, landfills, and recycling. Have students investigate how solid wastes are managed by the school, homes, farms, and commercial sources in the local community.*
 - e. *Provide information on the meaning of recycling and the different methods used in recycling. Have students investigate the availability of recycling for different materials in the local community.*
 - f. *Explain composting and how it is used in home, agricultural, municipal, and industrial uses. Students may design a compost bin for use at their home, school, or other location.*
2. *Select appropriate procedures for managing hazardous waste.*

- a. *Provide information that explains hazardous wastes. Identify local sources of hazardous waste materials.*
- b. *Provide information that explains how hazardous waste materials are classified. Assess the potential dangers in the materials, including characteristics hazards, health hazards, and other hazards.*
- c. *Explain the dangers that hazardous materials pose in habitat destruction, disease, and other areas.*
- d. *Describe methods used to dispose of hazardous waste, with emphasis on methods used with such materials produced in the local community.*
- e. *Explain the procedures to follow with spills or accidents involving hazardous waste materials. Use resources from a local Haz-Mat emergency response agency, including color and numerical coding systems developed by the U.S. Department of Transportation.*

Suggested Assessment Strategies:

1. *Use appropriate procedures in managing solid waste.*
 - a. *Written or oral unit test for objectives a-f.*
 - b. *Student participation in developing a solid waste management program for the school, their homes, or local farms or commercial establishments.*
2. *Select appropriate procedures for managing hazardous waste.*
 - a. *Written or oral unit test for objectives a-e.*

Suggested Resources:

DOT Guidebook.

HAZWOPer Program.

Porter, L., Lee, J. S., Turner, D. L., & Hillan, M. (1997). Environmental science and technology. Danville, IL: Interstate Publishers, Inc.

Recyclers handbook. (Latest ed.). Berkeley, CA: Earthworks Press.

THE SCIENCE OF AGRICULTURAL ENVIRONMENT
UNIT 9: FORESTRY AND THE ENVIRONMENT

(10 hours)

Competencies and Suggested Objectives:

1. Examine the relationship of forests to the environment.
 - a. Examine the layered structure of forests and how these layers provide habitat for various wildlife species.
 - b. Identify locally important tree species by common names, scientific names, and physical characteristics.
 - c. Determine the age of a tree using an increment borer and counting annual rings in a tree cross-section.
 - d. Demonstrate procedures used in timber cruising, including standing timber estimation of tree volume using a tree scale stick, determining stand density, measuring tree height, and measuring diameter at breast height (DBH).
 - e. Demonstrate proper procedures for planting trees.

Related Academic Topics (See Appendix A): C1, C2, C4, S2, S4
Workplace Skills (See Appendix B): WP2, WP7, WP8
2. Explain the contributions made by forests to the economy and environmental quality.
 - a. Identify consumer goods derived from forest locally, statewide, and nationally.
 - b. Describe the relationships of biodiversity and old growth forests.
 - c. Recommend ways of preventing forest fires.
 - d. Explain damage caused by forest fires.
 - e. Explain the importance of reforestation.

Related Academic Topics (See Appendix A): C1, C4, S4
Workplace Skills (See Appendix B): WP2, WP7, WP8

Suggested Teaching Strategies:

1. *Examine the relationship of forests to the environment.*
 - a. *Practical exercise to examine the layered structure of forests and how these layers provide habitat for various wildlife species.*
 - b. *Practical exercise to identify locally important tree species by common names, scientific names, and physical characteristics.*
 - c. *Practical exercise to determine the age of a tree using an increment borer and counting annual rings in a tree cross-section.*
 - d. *Practical exercise to demonstrate procedures used in timber cruising, including standing timber estimation of tree volume using a tree scale stick, determining stand density, measuring tree height, and measuring diameter at breast height (DBH).*
 - e. *Practical exercise to demonstrate proper procedures for planting trees.*

2. *Explain the contributions made by forests to the economy and environmental quality.*
 - a. *Use supervised study and class presentations to identify the products from forests, including those produced locally, statewide, and nationally.*
 - b. *Use supervised study followed by class discussion to outline the roles of forests in environmental quality such as reducing soil erosion, air quality, and temperature control in urban areas.*
 - c. *Use supervised study followed by the use of student input to develop an outline that explains the meaning of biodiversity as related to the forest species and the living organisms that use old growth forests as habitat.*
 - d. *Use supervised study and class discussion to examine the meaning and importance of forest fires. Include the prevention of forest fires.*
 - e. *Oral and written assignment to explain the importance of reforestation.*

Suggested Assessment Strategies:

1. *Examine the relationships of forests to the environment.*
 - a. *Practical activity - Examine the layered structure of forests and how these layers provide habitat for various wildlife species.*
 - b. *Practical activity - Identify locally important tree species by common names, scientific names, and physical characteristics.*
 - c. *Practical activity - Determine the age of a tree using an increment borer and counting annual rings in a tree cross-section.*
 - d. *Practical activity - Demonstrate procedures used in timber cruising, including standing timber estimation of tree volume using a tree scale stick, determining stand density, measuring tree height, and measuring diameter at breast height (DBH).*
 - e. *Practical activity - Demonstrate proper procedures for planting trees.*
2. *Explain the contributions made by forests to the economy and environmental quality.*
 - a. *Oral or written test on objectives a-e.*
 - b. *Assessment of student participation in discussion on consumer products from forests that are produced locally, statewide, and nationally.*
 - c. *Assessment of student participation in class discussion about forest fires.*
 - d. *Practical exercise - Demonstrate proper procedures for planting trees.*

Suggested Resources:

Camp, W. G., & Donahue, R. L. (1997). Environmental science for agriculture and the life sciences. Albany, NY: Delmar Publishers.

Holland, I. I., & Rolfe, G. L. (1997). Forests and forestry (5th ed.). Danville, IL: Interstate Publishers, Inc.

Porter, L., Lee, J. S., Turner, D. L., & Hillan, M. (1997). Environmental science and technology. Danville, IL: Interstate Publishers, Inc.

Turner, D. L. (1997). Environmental science and technology activity manual. Danville, IL: Interstate Publishers, Inc.

THE SCIENCE OF AGRICULTURAL ENVIRONMENT
UNIT 10: WILDLIFE AND THE ENVIRONMENT

(11 hours)

Competencies and Suggested Objectives:

1. Examine the relationships of wildlife well-being and environmental quality.
 - a. Identify the wildlife species found in the local area and classify as terrestrial or aquatic.
 - b. Identify the habitat requirements of various wildlife species and assess habitat found locally.
 - c. Investigate the role of the environment on the health and population status of wildlife using local situations.
 - d. Explain the importance of wildlife to the environment and human well-being.
 - e. Recommend procedures for improving environmental quality for wildlife.

Related Academic Topics (See Appendix A): C1, C2, C4, S2, S3, S4
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
2. Investigate approaches in protecting wildlife species.
 - a. Explain the need for wildlife protection and conservation and how species are lost from the Earth.
 - b. Classify wildlife species based on threats to their continued existence.
 - c. Implement practices that can be used to protect and conserve wildlife species.
 - d. Explain practices in using and enjoying wildlife that conserve wildlife populations.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, S3, S4
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Examine the relationships of wildlife well-being and environmental quality.*
 - a. *Provide information on the terrestrial and aquatic wildlife species found in the local area. Identify those which are game species.*
 - b. *Use supervised study followed by class discussion and participation in developing an outline of information on the meaning of habitat and the requirements of various wildlife species. Select wildlife species found in the local area and have students develop descriptions of habitat requirements and provide oral reports to the class on their findings.*
 - c. *Use supervised study and class discussion to identify the impacts that the environment has on wildlife. Identify areas in the local community where the environment has impacted wildlife and develop plans to improve environmental quality.*
 - d. *Describe how wildlife contributes to environmental quality and human well-being.*
 - e. *Provide information on wildlife habitat improvement, including recommended practices in managing land areas to enhance habitat for target species.*
2. *Investigate approaches in protecting wildlife species.*

- a. *Provide information that explains the need for protecting wildlife species, including how species become rare, threatened, endangered, and extinct.*
- b. *Explain natural and human-caused endangerments to wildlife species.*
- c. *Discuss practices that can be used to protect wildlife species. Have students identify practices used in the local area, such as captive breeding, reserves and refuges, and habitat development.*
- d. *Use supervised study, discussion, and first-hand observations through field trips to develop skills and appreciations in enjoying wildlife. For those that are hunters, a hunter education class may be arranged.*

Suggested Assessment Strategies:

1. *Examine the relationships of wildlife well-being and environmental quality.*
 - a. *Written or oral unit test for objectives a-e.*
 - b. *Quality of oral report prepared by students on wildlife species habitat requirements.*
 - c. *Preparation of a written report on improving habitat to promote wildlife species in the local area.*
2. *Investigate approaches in protecting wildlife species.*
 - a. *Written or oral unit test for objectives a-d.*
 - b. *Student performance in identifying practices used in the local area to promote wildlife well-being.*

Suggested Resources:

Burton, D. (1995). Ecology of fish and wildlife. Albany, NY: Delmar Publishers.

Camp, W. G., & Donahue, R. L. (1997). Environmental science for agriculture and the life sciences. Albany, NY: Delmar Publishers.

DNFP. "Hunter Education Course."

Porter, L., Lee, J. S., Turner, D. L., & Hillan, M. (1997). Environmental science and technology. Danville, IL: Interstate Publishers, Inc.

Stutzenbaker, C. D., Scheil, B. J., Swan, M. K., Lee, J. S., & Mattics, J. D. (1998). Wildlife management. Danville, IL: Interstate Publishers, Inc.

Introduction to environmental science. (1996). Alexandria, VA: National Council for Agricultural Education.

THE SCIENCE OF AGRICULTURAL ENVIRONMENT
UNIT 11: ENERGY MANAGEMENT

(5 hours)

Competencies and Suggested Objectives:

1. Examine how energy is classified and used.
 - a. Identify energy in the environment, including renewable and nonrenewable forms.
 - b. Describe the sources of energy, including fuel, nonfuel, and alternative energy sources.
 - c. Explain the production and use of fuel from agricultural crops.
Related Academic Topics (See Appendix A): C1, C2, C4, S4, S6
Workplace Skills (See Appendix B): WP2, WP7, WP8
2. Implement practices that conserve energy.
 - a. Explain the importance of efficiently using energy.
 - b. Select practices that can be used to increase energy efficiency.
 - c. Describe alternative energy sources and the possibilities such sources provide in energy conservation.
Related Academic Topics (See Appendix A): C1, C4, S6, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Examine how energy is classified and used.*
 - a. *Direct student supervised study using printed or computer-based materials to identify energy forms and classifications. Have students provide oral reports in class on their findings.*
 - b. *Provide information on the major sources of energy. Organize the sources by fuel and nonfuel energy. Have students assess the advantages and disadvantages of each source. Students should also identify uses of energy from the alternative sources.*
 - c. *Identify agricultural crops produced in the local area that can be used to make fuel. Use independent study of the World Wide Web to identify information and have each student prepare a short written report.*
2. *Implement practices that conserve energy.*
 - a. *Use supervised study followed by discussion to identify and outline important information on the meaning and importance of efficiently using energy. Pose the question, "What would happen in our daily living if all fuel energy was suddenly no longer available?" Have students suggest how this action would impact their lives. Allow students to propose local alternatives to fuel energy, such as wind and water.*
 - b. *Provide information on practices that would increase energy efficiency. Have students assess the merits of the various practices and identify those with greatest potential in agriculture, daily living, and commercial applications.*
 - c. *Discuss the meaning of alternative energy. Provide examples of alternative*

energy sources. Have students assess the merits of such sources in their local communities.

Suggested Assessment Strategies:

1. *Examine how energy is classified and used.*
 - a. *Written or oral unit test on objectives a-c.*
 - b. *Have students provide short oral reports on fuel, including both renewable and nonrenewable fuels.*
2. *Implement practices that conserve energy.*
 - a. *Written or oral unit test on objectives a-c.*
 - b. *Observe student participation in class discussion of energy availability.*
 - c. *Student participation in assessing the merits of energy conservation practices in agriculture, industry, and daily living.*
 - d. *Student participation in identifying alternative sources of energy and assessing the merits of these sources.*

Suggested Resources:

Camp, W. G., & Donahue, R. L. (1997). Environmental science for agriculture and the life sciences. Albany, NY: Delmar Publishers.

Introduction to environmental science. (1996). Alexandria, VA: National Council for Agricultural Education.

Porter, L., Lee, J. S., Turner, D. L., & Hillan, M. (1997). Environmental science and technology. Danville, IL: Interstate Publishers, Inc.

Turner, D. L. (1997). Environmental science and technology activity manual. Danville, IL: Interstate Publishers, Inc.

THE SCIENCE OF AGRICULTURAL ENVIRONMENT
UNIT 12: ENVIRONMENTAL STEWARDSHIP

(7 hours)

Competencies and Suggested Objectives:

1. Explain sustainable agriculture.
 - a. Describe the importance of sustainable agriculture.
 - b. Identify sustainable agriculture practices.
 - c. Describe the role of agriculture precision technologies in environmental stewardship.

Related Academic Topics (See Appendix A): C1, C4, S2, S4
Workplace Skills (See Appendix B): WP2, WP7, WP8
2. Use the services of agricultural agencies and organizations in maintaining the environment.
 - a. Name government agencies concerned with environmental quality and explain the general role of each agency. Include information on the EPA, DEQ, and OSHA regulations and fines.
 - b. Name organizations concerned with environmental quality and explain the general role of each organization.

Related Academic Topics (See Appendix A): C1, C4
Workplace Skills (See Appendix B): WP1, WP2, WP7, WP8

Suggested Teaching Strategies:

1. *Explain sustainable agriculture.*
 - a. *Use supervised study followed by discussion and student participation in developing an outline that provides information on the meaning and importance of sustainable agriculture.*
 - b. *Identify sustainable agriculture practices used in the local community and those that have potential for use considering the nature of the agriculture. The results of demonstration activities and experiments on farms in the local area will enhance the relevance of learning. Have students investigate local practices in sustainable agriculture, prepare written reports on their findings, and provide oral reports in class.*
 - c. *Discuss the meaning and use of precision technology systems with crop production. Describe the components of such systems. Demonstrate the use of global positioning systems, sensors, and other technology used in precision crop production.*
2. *Use the services of agricultural agencies and organizations in maintaining the environment.*
 - a. *Discuss agricultural agencies and their missions in environmental quality. Students can investigate and prepare reports on various agencies using Internet web sites, local interviews, and printed materials.*
 - b. *Discuss agricultural organizations and how they are involved in maintaining a quality environment. Representatives of the organizations can be used as*

resource persons in class. Students can prepare written and oral reports on the different organizations in the local area.

Suggested Assessment Strategies:

1. *Explain sustainable agriculture.*
 - a. *Written or oral unit test on objectives a-c.*
 - b. *Quality of student written and/or oral reports on sustainable agriculture in the local area.*
2. *Use the services of agricultural agencies and organizations in maintaining the environment.*
 - a. *Written or oral unit test on objectives a and b.*
 - b. *Quality of student written and/or oral reports on agencies and organizations that serve agriculture in the local area.*

Suggested Resources:

Burton, D. (1995). Ecology of fish and wildlife. Albany, NY: Delmar Publishers.

Introduction to environmental science. (1996). Alexandria, VA: National Council for Agricultural Education.

Porter, L., Lee, J. S., Turner, D. L., & Hillan, M. (1997). Environmental science and technology. Danville, IL: Interstate Publishers, Inc.

Turner, D. L. (1997). Environmental science and technology activity manual. Danville, IL: Interstate Publishers, Inc.

THE SCIENCE OF AGRICULTURAL ENVIRONMENT
UNIT 13: ISSUES IN A GLOBAL ENVIRONMENT

(3 hours)

Competencies and Suggested Objectives:

1. Analyze issues related to the global environment.
 - a. Explain how issues are identified.
 - b. Describe the procedures used in solving environmental problems.

Related Academic Topics (See Appendix A): C1, C4, S4
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
2. Identify trends that affect the global environment.
 - a. Investigate the effect of landscape defacement on the environment.
 - b. Evaluate the effect of acid rain deposition on the environment.
 - c. Evaluate the effect of tropical rain forest destruction on the environment.
 - d. Investigate the meaning and importance of ozone destruction on the environment.
 - e. Investigate alternative agricultural crops used in producing food, fiber, and energy.

Related Academic Topics (See Appendix A): C1, C4, S4, S5
Workplace Skills (See Appendix B): WP2, WP7, WP8
3. Describe the effect of agricultural, horticultural, and forestry activities on the environment.
 - a. Identify ways agricultural, horticultural, and forestry activities alter the environment.
 - b. Explain water depletion, degradation, and conservation.
 - c. List and explain causes of soil degradation and conservation.

Related Academic Topics (See Appendix A): C1, S4
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Analyze issues related to the global environment.*
 - a. *Discuss the meaning of "issue" and how issues are related to problems that are found in the local community as well as the global environment.*
 - b. *Present various approaches in solving environmental problems. Have students assess the potential of the various sources and identify others that may have potential.*
2. *Identify trends that affect the global environment.*
 - a. *Explain the meaning of landscape defacement and identify examples of how it occurs. Have students relate landscape defacement to the local community and identify examples where it has occurred to such an extent that the quality of the environment has been degraded.*
 - b. *Discuss the meaning of acid rain and how it is formed. Describe how acid rain affects the quality of the environment. Relate acid rain to the local area.*

- c. *Discuss the meaning and importance of tropical rain forests in the global environment. Provide information on how rain forests contribute to biodiversity and why it is important.*
- d. *Discuss the meaning of ozone destruction and how its destruction causes problems. Have students investigate various areas of ozone destruction such as the greenhouse effect and global warming. Students can prepare written reports and provide oral reports in class.*
- e. *Explain the meaning of alternative crops and list examples and their uses. Students may do independent study using the World Wide Web on selected crops to determine the nature of the crop and needed cultural practices.*
- 3. *Describe the effect of agricultural, horticultural, and forestry activities on the environment.*
 - a. *Use supervised study followed by discussion to outline the human activities and natural events that affect the environment both positively and negatively in terms of sustaining life as we know it today.*
 - b. *Use supervised study followed by discussion and presentation to outline water depletion, degradation, and conservation. Have students identify streams and lakes that have been damaged and suggest corrective actions to alleviate the problems.*
 - c. *Use supervised study and class participation to outline the causes of soil degradation and approaches to conservation.*

Suggested Assessment Strategies:

- 1. *Analyze issues related to the global environment.*
 - a. *Written or oral unit test on objectives a and b.*
 - b. *Student participation in identifying and discussing global environmental issues and proposing solutions to problems.*
- 2. *Identify trends that affect the global environment.*
 - a. *Written or oral unit test on objectives a-e.*
 - b. *Quality of student participation and reports on areas impacting the global environment.*
 - c. *Student reporting on various alternative crops.*
- 3. *Describe the effect of agricultural, horticultural, and forestry activities on the environment.*
 - a. *Written or oral test on objectives a-c.*
 - b. *Observation of student participation in supervised study and class discussion to outline information.*

Suggested Resources:

Holt. (2000). Environmental science. Austin, TX: Holt, Rinehart, and Winston.

Camp, W. G., & Donahue, R. L. (1997). Environmental science for agriculture and the life sciences. Albany, NY: Delmar Publishers.

Chiras, D. D. Environmental science: Action for a sustainable future (Latest ed.). Redwood City, CA: The Benjamin/Cummings Publishing Company, Inc.

Introduction to environmental science. (1996). Alexandria, VA: National Council for Agricultural Education.

Porter, L., Lee, J. S., Turner, D. L., & Hillan, M. (1997). Environmental science and technology. Danville, IL: Interstate Publishers, Inc.

Turner, D. L. (1997). Environmental science and technology activity manual. Danville, IL: Interstate Publishers, Inc.

**THE SCIENCE OF AGRICULTURAL ENVIRONMENT
UNIT 14: FUTURE ENVIRONMENTS AND
OCCUPATIONAL OPPORTUNITIES**

(7 hours)

Competencies and Suggested Objectives:

1. Participate in designing alternative futures.
 - a. Explain the role of forecasting in the environment.
 - b. Describe how futuring is used to assure a desired environment.
 - c. Identify major environmental trends.
 - d. Demonstrate the role of environmental planning.

Related Academic Topics (See Appendix A): C1, C2, C4, S4, S8
Workplace Skills (See Appendix B): WP2, WP7, WP8
2. Assess personal interests in environmental careers.
 - a. Identify career areas in environmental science and technology.
 - b. Describe the education and experience needed for environmental careers.
 - c. Identify important traits for success in environmental careers.

Related Academic Topics (See Appendix A): C1, C4, S8
Workplace Skills (Appendix B): WP1, WP6, WP7, WP8
3. Evaluate availability of environmental occupations in agricultural, horticultural, and forestry areas.
 - a. Determine working conditions in the occupations.
 - b. Identify education and training requirements.
 - c. Locate potential employers.

Related Academic Topics (See Appendix A): C1, C4, S8
Workplace Skills (See Appendix B): WP1, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Participate in designing alternative futures.*
 - a. *Provide written or computer-based information for student supervised study to investigate the role of forecasting in the environment. Use class discussion to summarize the major points on a writing surface.*
 - b. *Discuss the meaning and role of futuring in helping assure the kind of future environment that humankind desires. Have students identify possible futures that they would like to have on the Earth. Students should also specify the steps that will need to be taken to help assure that the desired future is reality.*
 - c. *Discuss global and local environmental trends. Have students assess these trends in terms of dangers and the quality of future environments. Students may prepare written and/or oral reports on areas of specific interest and need.*

- d. *Explain how choices about future environments are related to environmental planning. Describe the importance of environmental planning and the major elements in such planning. Have students work in small groups to sketch a desired environmental plan for their community. Representatives of Federal and state agencies can be used as resource persons by the students in developing their plans.*
2. *Assess personal interests in environmental careers.*
 - a. *Direct discussion of environmental careers, including those found in the local area and state. Use individuals in such careers as resource persons to describe the nature of the work, needed education and training, and benefits of the work to the individual and society.*
 - b. *Discuss education and experience needed for entering and advancing in environmental careers. Invite a representative of a local technical school, college, or university to discuss academic preparation programs that are available. The individual should discuss entry requirements, program completion expectations, and opportunities following program completion.*
 - c. *Discuss personal traits needed for success in environmental careers. This should include approaches in goal setting and how goals are achieved. Have students select individual environmental occupation and prepare a one-page written report on the occupation, including an assessment of how their personal traits and aspirations match with requirements for success in the occupation.*
3. *Evaluate availability of environmental occupations in agricultural, horticultural, and forestry areas.*
 - a. *Use supervised study, resource persons, job shadowing, and other means of providing practical orientation and internalization of the working conditions in the occupations.*
 - b. *Use supervised study (including the Chronicle of Agricultural Occupations Guidebook), resource persons, interviews of occupation incumbents, and other means of assisting students in gaining practical information about education and training requirements of the occupations.*
 - c. *Provide access to job listings, personnel office contacts, and other means to identify potential employers in the local area.*

Suggested Assessment Strategies:

1. *Participate in designing alternative futures.*
 - a. *Written or oral unit test for objectives a-d.*
 - b. *Student identification of possible futures and the steps that are needed to help assure the desired future.*
 - c. *Quality of written and/or oral reports on global environmental trends.*
 - d. *Quality of sketches of environmental plans for their communities.*
2. *Assess personal interests in environmental careers.*
 - a. *Written or oral unit test for objectives a-c.*
 - b. *Student investigations of various careers and how their personal traits are evaluated in terms of the careers.*
 - c. *Evaluation of job shadowing and other activities designed to acquaint students*

- with the nature of various environmental careers or relationship of environmental areas in agriculture and horticulture.*
3. *Evaluate availability of environmental occupations in agricultural, horticultural, and forestry areas.*
 - a. *Student participation in activities designed to provide orientation to environmental occupations.*
 - b. *Student investigation and reporting of education and training needed for environmental occupations in agricultural, horticultural, and forestry areas.*

Suggested Resources:

Camp, W. G., & Donahue, R. L. (1997). Environmental science for agriculture and the life sciences. Albany, NY: Delmar Publishers.

Chronicle agricultural occupations guidebook. (1997). Moravia, NY: Chronicle Guidance Publications, Inc.

Introduction to environmental science. (1996). Alexandria, VA: National Council for Agricultural Education.

Porter, L., Lee, J. S., Turner, D. L., & Hillan, M. (1997). Environmental science and technology. Danville, IL: Interstate Publishers, Inc.

June 21, 2002

SECTION V:
CURRICULUM GUIDE
FOR
THE SCIENCE OF AGRICULTURAL MECHANICS

June 21, 2002

**THE SCIENCE OF AGRICULTURAL MECHANICS
COURSE DESCRIPTION
(CIP: 01.0201)**

The Science of Agricultural Mechanics is a course which includes physical science principles and applications in agricultural technology, agricultural mechanics, and agricultural mechanization. Topics of instruction are: safety; physics technology, including work and power, mechanics, heat, light, sound, and magnetism and electricity; concepts of agricultural mechanization; electricity/electronics technology systems; computer technology in agricultural mechanization; hydraulics and pneumatics systems; internal combustion engines; and preventive maintenance and diagnostics. (Prerequisite: Concepts of Agriscience Technology; Grades 10-12; 1 year, 1 Carnegie Unit)

**THE SCIENCE OF AGRICULTURAL MECHANICS
COURSE OUTLINE**

<u>Unit No.</u>	<u>Title</u>	<u>No. of Hours</u>
Unit 1	Using Physical and Mechanical Technology in Agriculture	7
Unit 2	Supervised Experience in Physical and Mechanical Technology	5
Unit 3	Practicing Safety in Physical and Mechanical Technology	7
Unit 4	Applying Physical and Mechanical Technology in Agricultural Mechanization and Careers	5
Unit 5	Applying Physical and Mechanical Technology in Agricultural Enterprises	5
Unit 6	Using Computer Applications in Agriculture	10
Unit 7	Analyzing Electricity/Electronics Systems	14
Unit 8	Using Hydraulic and Pneumatic Systems	10
Unit 9	Applying Principles of Internal Combustion Engines	15
Unit 10	Performing Preventive Maintenance	10
Unit 11	Applying Principles of Diagnostics	8
Unit 12	Basic Welding	8
Unit 13	Basic Gas Cutting and Welding and Cutting	8

THE SCIENCE OF AGRICULTURAL MECHANICS
UNIT 1: USING PHYSICAL AND MECHANICAL TECHNOLOGY
IN AGRICULTURE

(7 hours)

Competencies and Suggested Objectives:

1. Investigate the role of physical and mechanical technology in agriculture.
 - a. Explain how technology has changed how food and fiber are produced.
 - b. Describe the role of power technology in agriculture.
 - c. Describe emerging technologies in site-specific crop management.

Related Academic Topics (See Appendix A): C1, C2, C3, S6
Workplace Skills (See Appendix B): WP1, WP2, WP7, WP8
2. Identify science applications in agriculture technology.
 - a. Explain how the science of mathematics is used in agriculture.
 - b. Explain how physical science is used in agriculture.
 - c. Identify and describe areas of physics in agriculture technology.
 - d. Name and distinguish between the simple machines used in agricultural implements.
 - e. Explain relationship of machines and efficiency in agriculture.
 - f. Identify common tools that apply mechanical advantage by their correct names and demonstrate their correct uses.

Related Academic Topics (See Appendix A): C1, C2, C3, M1, M7, S6, S8
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Investigate the role of physical and mechanical technology in agriculture.*
 - a. *Provide student-based learning materials for supervised study followed by class discussion. Use student input to summarize the major points.*
 - b. *Form students into cooperative learning groups to explore how technology has changed agricultural practices. Have each group place the items in priority and provide an oral report to the class.*
 - c. *Use supervised study and Internet access for students to explore site-specific crop management. Have each student prepare a short written report on their observations.*
2. *Identify science applications in agriculture technology.*
 - a. *Use supervised study followed by class discussion to develop a summary of the major areas.*
 - b. *Provide a modern farm implement and have students work in cooperative groups to identify the uses of physical science in the operation of the implement.*
 - c. *Collaborate, as appropriate, with the physics and physical science teachers on areas of physics used in agriculture technology.*
 - d. *Following supervised study, have examples of common hand tools that apply the simple machines. Have students demonstrate how the tool is used so that it*

- is a simple machine.*
- e. Form students into cooperative learning groups to investigate the relationship of machines and efficiency, with each group providing a report to the class.*
 - f. Provide specimens of several common hand tools. Have students identify each by its correct name and use the tools correctly in performing various laboratory activities throughout the course.*

Suggested Assessment Strategies:

- 1. Investigate the role of physical and mechanical technology in agriculture.*
 - a. Use a written or oral test on objectives a-c.*
 - b. Observe student performance in cooperative learning groups and oral reporting to the class.*
 - c. Assessment of written report prepared on site-specific crop management.*
- 2. Identify science applications in agriculture technology.*
 - a. Use a written or oral test on objectives a-f.*
 - b. Individual participation in cooperative learning groups.*
 - c. Application by students who are enrolled in physics or physical science classes.*
 - d. Demonstrations by students on the uses of various hand tools as simple machines.*
 - e. Participation of individual students in preparing and providing an oral report on group activities.*
 - f. Ability of students to correctly identify common hand tools.*

Suggested Resources:

Cooper, E. L. (1997). Agricultural mechanics. Albany, NY: Delmar Publishers.

Goering, C. E. Engine and tractor power (Latest ed.). St. Joseph, MI: American Society of Agricultural Engineers.

Johnson, D. M., Harper, J., Lawver, D. E., & Buriak, P. (2001). Mechanical technology in agriculture. Danville, IL: Interstate Publishers, Inc.

Phipps, L. J. & Miller, G. M. (1998). AgriScience mechanics. Danville, IL: Interstate Publishers, Inc.

THE SCIENCE OF AGRICULTURAL MECHANICS

UNIT 2: SUPERVISED EXPERIENCE IN PHYSICAL AND MECHANICAL TECHNOLOGY

(5 hours)

Competencies and Suggested Objectives:

1. Plan, implement, and expand supervised experience in physical and mechanical technology.
 - a. Explain the purpose, kinds, and nature of supervised experience.
 - b. Explain how supervised experience is part of a carefully planned and long-term supervised agricultural experience program (SAE).
 - c. Describe how supervised experience relates to achievement of FFA proficiency awards and other activities.
 - d. Identify appropriate experiences for a supervised agricultural experience program.
 - e. Develop short-term, intermediate, and long-term SAE goals.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, S3, S8
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP6, WP7, WP8
2. Prepare and keep appropriate written documentation on supervised experience.
 - a. Develop a training plan.
 - b. Develop a training agreement.
 - c. Keep records of competencies developed, inventory, income, and expenses.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, S3, S8
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Plan, implement, and expand supervised experience in physical and mechanical technology.*
 - a. *Use class presentations and discussion to explain SAE, including its purpose, nature of the experiences, and how a program is planned and carried out.*
 - b. *Use materials published by the National FFA Organization that provide information on Career Development Events, Proficiency Awards, and other programs.*
 - c. *Use regular supervision and observation of student performance with supervised experience.*
 - d. *Provide a form to make goal setting easier and use individual counseling with each student on the goals that are made.*
2. *Prepare and keep appropriate written documentation on supervised experience.*
 - a. *Provide examples of training plans and training plan forms. In consultation with parents, employers, and others, complete a training plan.*
 - b. *Provide examples of training agreements and a sample training agreement form. Use presentations and discussions to develop students' skills in developing a training agreement. Have students prepare a training agreement and provide feedback on their work.*

- c. *Provide presentations on keeping records of personal experiences, inventory, and income and expense. Use sample forms and have students complete forms and explain what they have done.*

Suggested Assessment Strategies:

1. *Plan, implement, and expand supervised experience in physical and mechanical technology.*
 - a. *Written or oral test on the purpose, kinds, and nature of SAE.*
 - b. *Initiating and progressing in appropriate supervised experience in physical and mechanical technology by students, including advancing with degrees of FFA membership.*
 - c. *Observations made during supervision of student while engaged in experience program.*
 - d. *Developing and revising, as needed, of goals.*
2. *Prepare and keep appropriate written documentation on supervised experience.*
 - a. *Assessment of a completed SAE training agreement.*
 - b. *Accuracy and neatness of records kept of competencies developed, inventory, income, and expenses from supervised experience.*

Suggested Resources:

A guide to local program success. (1997). Indianapolis, IN: National FFA Organization.

Advisor's guide to the FFA student handbook. (Current ed.). Indianapolis, IN: National FFA Organization.

Career development events. (Current ed.). Indianapolis, IN: National FFA Organization.

Hunter, S., Stewart, M., Scheil, B., Terry, R., Jr., & Frazee, S. D. (1997). Developing leadership and personal skills. Danville, IL: Interstate Publishers, Inc.

Official FFA manual. (Current ed.). Indianapolis, IN: National FFA Organization.

SAE best practices. (1997). Indianapolis, IN: National FFA Organization.

**THE SCIENCE OF AGRICULTURAL MECHANICS
UNIT 3: PRACTICING SAFETY IN PHYSICAL AND
MECHANICAL TECHNOLOGY**

(7 hours)

Competencies and Suggested Objectives:

1. Identify general safety precautions for the work site and laboratory.
 - a. Describe procedures for maintaining a clean and orderly work site.
 - b. Describe personal behavior and personal safety requirements.
 - c. Describe work site and laboratory organization.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6, S8
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
2. Apply personal behavior and safety procedures required at the work site.
 - a. Demonstrate appropriate personal manners, cooperation, work attitude, and goal setting.
 - b. Demonstrate safe use of head, eye, hearing, body, hand, and foot protective devices.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6, S8
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP8
3. Apply general safety rules pertaining to hand and stationary power tools.
 - a. Demonstrate rules for hand tools including use, danger points, and observer safety.
 - b. Demonstrate rules for power tools including basic operation, safeguards in place, danger points, observer safety, and electrical safety.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6, S8
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
4. Apply rules of safety and first aid measures relating to different situations at the work site or in the laboratory.
 - a. Demonstrate rules of safety with fire prevention, oil and grease, lifting and hoisting, electricity, compressed air equipment, and batteries.
 - b. Demonstrate safe storage, use, and disposal of hazardous waste.
 - c. Demonstrate procedures to clear airway passages, stop bleeding, protect a wound, and prevent shock.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6, S8
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8

Suggested Teaching Strategies:

1. *Identify general safety precautions for the work site and laboratory.*
 - a. *Present information on general safety for a work site and laboratory.*
 - b. *Use cooperative learning groups to identify and place in priority personal behavior and safety requirements. Have each group provide an oral report.*
 - c. *Tour the school laboratory or a work site and explain how it is organized.*
2. *Apply personal behavior and safety procedures required at the work site.*
 - a. *Present important areas in work site behavior and have students give*

- examples of acceptable and unacceptable behavior.*
- b. Use examples of all appropriate personal safety protection devices, demonstrate their use, and have students demonstrate that they know how to use them.*
- 3. *Apply general safety rules pertaining to hand and stationary power tools.*
 - a. Use specimens of common hand tools and demonstrate their proper use. Have students show that they know how to use them properly.*
 - b. Demonstrate the proper use of power tools and have students show that they know how to use them properly.*
- 4. *Apply rules of safety and first aid measures relating to different situations at the work site or in the laboratory.*
 - a. Demonstrate the proper use of equipment and processes that may pose hazards.*
 - b. Tour a work site or laboratory and identify storage and disposal areas for wastes. Have students prepare sketches of areas identifying important features for safety.*
 - c. Demonstrate basic first aid procedures and have students explain how they would respond in case of accidents.*

Suggested Assessment Strategies:

- 1. *Identify general safety precautions for the work site and laboratory.*
 - a. Use a written test for objectives a-c. Re-teach until all students score 100% on the test. Keep copies of the tests on file.*
 - b. Observe individual contributions within cooperative learning groups and reports that are given in class.*
 - c. Observe student participation in studying the work site or laboratory.*
- 2. *Apply personal behavior and safety procedures required at the work site.*
 - a. Use a written test for objectives a and b.*
 - b. Demonstrated behavior by individuals that they know how to properly use personal protection equipment.*
- 3. *Apply general safety rules pertaining to hand and stationary power tools.*
 - a. Demonstrated ability by individual students that they know how to properly use hand tools.*
 - b. Demonstrated ability by individual students that they know how to properly use power tools.*
- 4. *Apply rules of safety and first aid measures relating to different situations at the work site or in the laboratory.*
 - a. Ability of individual students in performing activities that may pose safety hazards.*
 - b. Accuracy of sketch of work site or laboratory area showing features related to safety.*
 - c. Use a written test that covers basic first aid procedures. Re-teach to assure student mastery. Keep a copy of each student's test on file.*

Suggested Resources:

Anthony, S. Farm and ranch safety management (Latest ed.). Albany, NY: Delmar Publishers.

Butterfield, F. Developing shop safety skills: Teacher guide (Latest ed.). Athens, GA: American Association for Vocational Instructional Materials.

Cooper, E. L. (1997). Agricultural mechanics: Fundamentals and applications (3rd ed.). Albany, NY: Delmar.

Johnson, D. M., Harper, J., Lawver, D. E., & Buriak, P. (2001). Mechanical technology in agriculture. Danville, IL: Interstate Publishers, Inc.

Phipps, L. J., & Miller, G. M. (1998). AgriScience mechanics. Danville, IL: Interstate Publishers, Inc.

Wren, J. E., & Smith, W. G. Safety color coding for the shop (Latest ed.). Winterville, GA: American Association for Vocational Instructional Materials.

THE SCIENCE OF AGRICULTURAL MECHANICS
UNIT 4: APPLYING PHYSICAL AND MECHANICAL TECHNOLOGY IN
AGRICULTURAL MECHANICS AND CAREERS

(5 hours)

Competencies and Suggested Objectives:

1. Explain concepts of management and maintenance systems.
 - a. Describe concepts of management of agricultural mechanization.
 - b. Describe concepts of maintenance of agricultural mechanics systems.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
2. Describe economics of agricultural mechanization.
 - a. Determine cost-benefit of new technology in agricultural mechanization.
 - b. Determine cost of machinery replacement.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
3. Explore career concepts associated with agricultural mechanization.
 - a. Identify career opportunities in agricultural mechanization.
 - b. Describe educational requirements for participation in careers in agricultural mechanization.
 - c. Identify emerging technology in agricultural mechanization.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
4. Develop related workplace skills required in agricultural mechanization.
 - a. Demonstrate human relations skills required for employees in agricultural mechanization.
 - b. Identify concepts of quality assurance related to agricultural mechanization.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
5. Develop leadership and citizenship skills necessary for employment and successful performance in agricultural mechanization.
 - a. Participate in FFA leadership and citizenship development activities.
 - b. Develop a supervised agricultural experience program (SAE).

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8

Suggested Teaching Strategies:

1. *Explain concepts of management and maintenance systems.*
 - a. *Oral/written assignment to describe concepts of management of agricultural mechanization.*
 - b. *Oral/written assignment to describe concepts of maintenance of agricultural mechanics systems.*
2. *Describe economics of agricultural mechanization.*
 - a. *Use an exercise to determine cost-benefit of new technology in agricultural*

- mechanization.
- b. Use an exercise to determine cost of machinery replacement.
- 3. Explore career concepts associated with agricultural mechanization.
 - a. Oral/written assignment to identify career opportunities in agricultural mechanization.
 - b. Oral/written assignment to describe educational requirements for participation in careers in agricultural mechanization.
 - c. Guest speakers to present opportunities to identify new and emerging technology in agricultural mechanization.
- 4. Develop related workplace skills required in agricultural mechanization.
 - a. Use an exercise to demonstrate human relations skills required for employees in agricultural mechanization, which may include role playing various human relations situations.
 - b. Use a practical exercise to identify concepts of quality assurance.
- 5. Develop leadership and citizenship skills necessary for employment and successful performance in agricultural mechanization.
 - a. Promote membership and participation in FFA leadership and citizenship development activities and career development events related to agricultural mechanization.
 - b. Have each student plan and carry out an SAE program.

Suggested Assessment Strategies:

- 1. Explain concepts of management and maintenance systems.
 - a. Use oral and/or written report in which students describe concepts of management of agricultural mechanization.
 - b. Use oral and/or written reports in which students describe concepts of maintenance of agricultural mechanics systems.
- 2. Describe economics of agricultural mechanization.
 - a. Use a written or oral test on objectives a and b.
 - b. Use a practical activity in which students are to determine the cost-benefit of new technology in agricultural mechanization.
 - c. Use a practical activity for students to determine the cost of machinery replacement.
- 3. Explore career concepts associated with agricultural mechanization.
 - a. Use oral and/or written reports in which students describe career opportunities in agricultural mechanization.
 - b. Use oral and/or written reports in which students describe the educational requirements for participation in careers in agricultural mechanization.
 - c. Use an activity in which students identify emerging technology in agricultural mechanization.
- 4. Develop related workplace skills required in agricultural mechanization.
 - a. Use an oral or written test on objectives a and b.
 - b. Use a practical activity in which students demonstrate human relations skills required for employees in agricultural mechanization.
 - c. Oral or written reports that identify and explain important concepts of quality

- assurance.*
5. *Develop leadership and citizenship skills necessary for employment and successful performance in agricultural mechanization.*
 - a. *Participation in FFA leadership and citizenship development activities and career development events related to agricultural mechanization.*
 - b. *Individual student initiative in planning and carrying out an SAE in an appropriate area.*

Suggested Resources:

FFA proficiency award and degree software. (Current ed.). Indianapolis, IN: National FFA Organization.

FFA student handbook. (Current ed.). Indianapolis, IN: National FFA Organization.

Machinery management. (Latest ed.). Moline, IL: John Deere Publishing.

Machinery replacement strategies. (1994). Moline, IL: John Deere Publishing.

National FFA contests (Bulletin No. 4). (Current ed.). Indianapolis, IN: National FFA Organization.

Official FFA manual. (Current ed.). Indianapolis, IN: National FFA Organization.

THE SCIENCE OF AGRICULTURAL MECHANICS

UNIT 5: APPLYING PHYSICAL AND MECHANICAL TECHNOLOGY IN AGRICULTURAL ENTERPRISES

(5 hours)

Competencies and Suggested Objectives:

1. Demonstrate applications of physical and mechanical technology in agricultural enterprises.
 - a. Identify applications of physical and mechanical technology in the local area.
 - b. Interpret information in operators' manuals in the use of equipment.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
2. Apply physical and mechanical technology in operating equipment.
 - a. Identify equipment function controls.
 - b. Demonstrate safe operation of equipment and machinery.
 - c. Select and use materials handling equipment, including augers, conveyors, pumps, and blowers.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8

Suggested Teaching Strategies:

1. *Demonstrate applications of physical and mechanical technology in agricultural enterprises.*
 - a. *Provide resource materials for supervised study followed by class discussion.*
 - b. *Use a resource person to describe the applications of physical and mechanical technology in mechanization in the local area.*
 - c. *Provide examples of operators' manuals for supervised study followed by demonstrations and hands-on experience operating field and/or stationary equipment safely.*
2. *Apply physical and mechanical technology in operating equipment.*
 - a. *Form students into cooperative learning groups and use operators' manuals and other resource materials for groups of students to identify equipment function controls on tractors and/or implements. Have students place paper labels on each control indicating its name and function. (Controls to be identified include throttles, clutches, brakes, switches, speed controls, and hydraulic and power take-off controls.)*
 - b. *Using cooperative learning groups, have students identify and label all safety features on a tractor or implement, such as guards, shields, roll bars, and slow moving vehicle emblems.*
 - c. *Each student should individually, as appropriate, operate equipment used in the local area in agriculture, including pre-inspecting, starting, operating, and stopping equipment.*
 - d. *Each student should select and appropriately use materials handling equipment.*

Suggested Assessment Strategies:

1. *Demonstrate applications of physical and mechanical technology in agricultural enterprises.*
 - a. *Written reports by individual students that identify applications of physical and mechanical technology in the local area.*
 - b. *Observation of the ability of individual students to interpret an operator's manual in using tractors and/or implements.*
2. *Apply physical and mechanical technology in operating equipment.*
 - a. *Orally "check out" each student's knowledge on the identification of equipment function controls.*
 - b. *Orally "check out" each student's knowledge on the identification and use of safety features on a tractor and/or implement.*
 - c. *Have each student demonstrate the ability to safely operate appropriate equipment.*
 - d. *Have each student demonstrate the ability to select and use materials handling equipment.*

Suggested Resources:

Operators' manuals for tractors and implements in the local area that are to be operated in the class.

Anthony, S. Farm and ranch safety management. Albany, NY: Delmar Publishers.

Burke, S. R., & Wakeman, T. J. (1992). Modern agricultural mechanics (3rd ed.). Danville, IL: Interstate Publishers, Inc.

Goering, C. E. (1992). Engine and tractor power (3rd ed.). St. Joseph, MI: American Society of Agricultural Engineers.

Johnson, D. M., Harper, J., Lawver, D. E., & Buriak, P. (2001). Mechanical technology in agriculture. Danville, IL: Interstate Publishers, Inc.

Phipps, L. J., & Miller, G. M. (1998). AgriScience mechanics. Danville, IL: Interstate Publishers, Inc.

THE SCIENCE OF AGRICULTURAL MECHANICS

UNIT 6: USING COMPUTER APPLICATIONS IN AGRICULTURE

(10 hours)

Competencies and Suggested Objectives:

1. Identify computer applications related to physical and mechanical technology.
 - a. Discuss the uses of the computer for information management.
 - b. Demonstrate the use of computers in record keeping, including inventory, service records, and financial records.
 - c. Demonstrate the use of computers in remote sensing.
 - d. Demonstrate the application of computers in monitoring and controlling operations.
 - e. Demonstrate the use of test instruments that involve computer applications.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
2. Acquire technical information.
 - a. Demonstrate how to search a database on CD-ROM.
 - b. Demonstrate how to use the Internet in obtaining information, such as equipment service data.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
3. Prepare and send information using electronic technology.
 - a. Use a computer to prepare reports and spreadsheets.
 - b. Use e-mail to send and receive information.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8

Suggested Teaching Strategies:

1. *Identify computer applications related to physical and mechanical technology.*
 - a. *Use presentations or supervised study to provide information on the uses of computers for information management.*
 - b. *Use supervised study or presentations followed with practice exercises on computer applications in record keeping. Such activity can be tied to the SAE.*
 - c. *Have a resource person provide a demonstration and discussion on the use of computers in remote sensing and controlling operations. Emphasis may be on geographic information systems as part of precision crop management technologies.*
 - d. *Invite a local equipment dealer or other individual to serve as a resource person and discuss the role of computers on tractors and implements.*
2. *Acquire technical information.*
 - a. *Provide exercises to utilize basic principles of data acquisition using on-line and CD-ROM resources.*
 - b. *Provide practical exercises related to physical and mechanical technology with keyword searches using search engines to identify sources of information.*

Examples of key words include precision farming, variable rate technology, remote sensing, and geographic information systems.

- c. Provide a practical exercise to conduct a reference search and prepare a short written report on the findings.*
- 3. Prepare and send information using electronic technology.*
 - a. Provide a presentation and demonstration on how to prepare and send information using e-mail.*
 - b. Have students prepare and send a sample e-mail message that deals with a topic in physical and mechanical technology. In some cases, contacting manufacturers to obtain information or service date may be appropriate.*

Suggested Assessment Strategies:

- 1. Identify computer applications related to physical and mechanical technology.*
 - a. Use a written or oral test to assess student comprehension of objectives a-e.*
 - b. Observation of student performance in using computers.*
- 2. Acquire technical information.*
 - a. Use a written or oral test on objectives a and b.*
 - b. Evidence of a search of a CD-ROM database.*
 - c. Evidence of a search of the Internet and the retrieval of a report on a topic in physical and mechanical technology.*
- 3. Prepare and send information using electronic technology.*
 - a. The receipt of an appropriate e-mail message by the instructor from the student.*
 - b. Receiving an e-mail message from another member of the class and printing it out on paper for submission to the instructor.*

Suggested Resources:

Hitch up a computer for your farm. (1996). Moline, IL: John Deere Publishing.

The Internet guide for agriculturists. (1997). Moline, IL: John Deere Publishing.

The precision farming guide for agriculturists. (1997). Moline, IL: John Deere Publishing.

THE SCIENCE OF AGRICULTURAL MECHANICS

UNIT 7: ANALYZING ELECTRICITY/ELECTRONICS SYSTEMS

(14 hours)

Competencies and Suggested Objectives:

1. Identify electrical/electronics systems used in agriculture.
 - a. Demonstrate uses of sensors and monitoring systems.
 - b. Demonstrate uses of controllers.
 - c. Explain the role of integrated systems.
 - d. Select and use electric motors.
 - e. List applications of electrical/electronics systems in plant and animal production.

Related Academic Skills (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
2. Investigate electrical/electronics systems used on tractors and implements and with stationary systems.
 - a. Interpret symbols, schematics, and blueprints.
 - b. Identify components of electrical systems.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
3. Identify parts and functions of charging systems on internal combustion engines.
 - a. Operate charging circuit.
 - b. Test charging circuit operation according to specifications.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
4. Identify components and functions of starting systems on internal combustion engines.
 - a. Operate a starting system.
 - b. Test and service components of a starting system according to specifications.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8

Suggested Teaching Strategies:

1. *Identify electrical/electronics systems used in agriculture.*
 - a. *Use supervised study with student discussions and the development of an outline that summarizes the information.*
 - b. *Present information and use models to explain the uses of sensors and monitoring systems as well as controllers.*
 - c. *Use stationary or mobile equipment as models for identifying the electrical/electronics systems and describe the roles of these systems.*
 - d. *Form cooperative learning groups for students to investigate and prepare a report on the applications of electrical/electronics systems in plant and animal production.*
2. *Investigate electrical/electronics systems used on tractors and implements and*

with stationary equipment.

- a. *Use an electrical/electronics trainer (module) to accomplish the objectives for this competency.*
- b. *Use an exercise to interpret symbols, schematics, and blueprints.*
- c. *Use simulations or models to identify components of electrical systems.*
3. *Identify parts and functions of charging systems on internal combustion engines.*
 - a. *Use supervised study followed by class discussion and the development of an outline of the information.*
 - b. *Use a model charging circuit to identify components, functions, and operation.*
 - c. *Use a model for test charging circuit operation according to specifications.*
4. *Identify components and functions of starting systems on internal combustion engines.*
 - a. *Use student learning materials for supervised study followed by class discussion and use of a demonstration model.*
 - b. *Use a model starting system to identify components and test operation.*
 - c. *Form students into cooperative groups to test and service components of starting systems according to specifications.*

Suggested Assessment Strategies:

1. *Identify electrical/electronics systems used in agriculture.*
 - a. *Use a written or an oral test on objectives a-e to determine student cognitive mastery.*
 - b. *Participation of individuals in cooperative learning groups and quality of reports provided by the groups.*
2. *Investigate electrical/electronics systems used on tractors and implements and with stationary equipment.*
 - a. *Demonstrated ability by individual students to use symbols, schematics, and blueprints to interpret and install electrical/electronics systems.*
 - b. *Oral questioning and reporting by individuals on systems used with tractors and implements as well as stationary equipment.*
3. *Identify parts and functions of charging systems on internal combustion engines.*
 - a. *Demonstrated ability by individuals in operating a charging circuit.*
 - b. *Demonstrated ability by individual students to test the operation of a charging circuit according to specifications.*
4. *Identify components and functions of starting systems on internal combustion engines.*
 - a. *Use oral or written test to assess knowledge of individuals about starting systems.*
 - b. *Demonstrated ability by individual students to operate a starting system properly.*
 - c. *Demonstrated ability to test and service components of starting systems according to specifications.*

Suggested Resources:

Fundamentals of service: Electronic and electrical systems. Moline, IL: John Deere Publishing.

Johnson, D. M., Harper, J., Lawver, D. E., & Buriak, P. (2001). Mechanical technology in agriculture. Danville, IL: Interstate Publishers, Inc.

THE SCIENCE OF AGRICULTURAL MECHANICS
UNIT 8: USING HYDRAULIC AND PNEUMATIC SYSTEMS

(10 hours)

Competencies and Suggested Objectives:

1. Describe how hydraulic and pneumatic systems are used in agriculture.
 - a. Compare and contrast the operation of hydraulic and pneumatic systems.
 - b. Identify the components and functions of hydraulic and pneumatic systems.
 - c. Read and interpret flow charts depicting hydraulic and pneumatic systems.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
2. Apply safe practices in servicing and using hydraulic and pneumatic systems.
 - a. Inspect system components and assess and correct unsafe conditions.
 - b. Service hydraulic and pneumatic systems according to operators' manual specifications following safe practices.
 - c. Operate hydraulic and pneumatic systems safely.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8

Suggested Teaching Strategies:

1. *Describe how hydraulic and pneumatic systems are used in agriculture.*
 - a. *Provide textbook or reference materials for supervised study followed by class discussion and the development of a summary of the information.*
 - b. *Demonstrate the use of flow charts in understanding hydraulic and pneumatic system.*
 - c. *Provide flow charts of hydraulic and pneumatic systems and have students interpret the information.*
2. *Apply safe practices in servicing and using hydraulic and pneumatic systems.*
 - a. *Provide textbook or reference materials for supervised study followed by class discussion on safety with hydraulic and pneumatic systems.*
 - b. *Use model hydraulic and pneumatic systems for students to develop skill in servicing according to operators' manual specifications.*
 - c. *Use model systems for cooperative learning groups to identify potential sources of danger and operate the system properly.*

Suggested Assessment Strategies:

1. *Describe how hydraulic and pneumatic systems are used in agriculture.*
 - a. *Use an oral or a written test over objectives a-c.*
 - b. *Use models on which students demonstrate their knowledge and skill in identifying the components and functions of hydraulic and pneumatic systems.*
 - c. *Use charts for individuals to read and interpret flow chart information on hydraulic and pneumatic systems.*
2. *Apply safe practices in servicing and using hydraulic and pneumatic systems.*

- a. *Provide textbook or reference materials that describe hydraulic and pneumatic systems, their components, and safe operation.*
- b. *Use models of a hydraulic system and a pneumatic system for students to demonstrate their skills in servicing and assessing for safety.*
- c. *Use models of hydraulic and pneumatic systems for cooperative learning groups to use in assessing sources of danger and operating the systems properly.*

Suggested Resources:

Goering, C. E. Engine and tractor power (Latest ed.). St. Joseph, MI: American Society of Agricultural Engineers.

Hydraulics. (Latest ed.). Moline, IL: John Deere Publishing.

Hydraulic system diagnostics. (1997). Moline, IL: John Deere Publishing.

Johnson, D. M., Harper, J., Lawver, D. E., & Buriak, P. (2001). Mechanical technology in agriculture. Danville, IL: Interstate Publishers, Inc.

THE SCIENCE OF AGRICULTURAL MECHANICS
UNIT 9: APPLYING PRINCIPLES OF INTERNAL
COMBUSTION ENGINES

(15 hours)

Competencies and Suggested Objectives:

1. Describe the importance and uses of internal combustion engines.
 - a. Explain the meaning of “internal combustion engine” and relate its operation to the combustion triangle.
 - b. Explain and distinguish between the kinds of internal combustion engines, including 2-cycle and 4-cycle gasoline engines and diesel engines.
 - c. List important principles in the safe and efficient operation of internal combustion engines.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6

Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8

2. Identify parts and functions of internal combustion engine systems.
 - a. Demonstrate lubrication system parts and functions and the kinds of lubricants used.
 - b. Demonstrate cooling system parts and functions.
 - c. Demonstrate fuel system components and functions.
 - d. Demonstrate ignition system components and functions.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6

Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8

3. Disassemble and inspect internal combustion systems.

- a. Disassemble an internal combustion engine.
- b. Inspect internal combustion engine parts to specifications.
- c. Identify failed component parts and obtain replacement parts.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6

Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8

4. Assemble, operate, and test an internal combustion engine following safe and approved procedures.

- a. Assemble an internal combustion engine according to manufacturer's specifications.
- b. Operate an assembled engine.
- c. Test an engine for performance according to manufacturer's specifications.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6, M7

Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8

Suggested Teaching Strategies:

1. *Describe the importance and uses of internal combustion engines.*
 - a. *Provide student learning and reference materials for supervised study. Follow with discussion to summarize the information.*
 - b. *Use class presentations enriched with visuals that explain and distinguish between the kinds of internal combustion engines.*

- c. *Use supervised study and class discussion to cover the safe and efficient operation of internal combustion engines.*
2. *Identify parts and functions of internal combustion engine systems.*
 - a. *Provide student learning and/ or reference materials for supervised study. Use class discussion, visuals, and models to demonstrate the engine systems and summarize the functions of the major parts.*
 - b. *Present the routine service and/or checking that the systems may need to be sure that fluid levels and adjustments are appropriate.*
3. *Disassemble and inspect internal combustion systems.*
 - a. *Organize students into cooperative learning groups of two individuals. Provide each group with a small internal combustion engine without fluids in the crankcase, fuel tanks, or other location. Provide the tools necessary for the disassembly of the engine. Provide diagrams that label the major parts. Have students learn the identity of the parts.*
 - b. *Present information on the characteristics of parts that are in good condition and do not show wear so that replacement is needed.*
 - c. *Be sure students follow all safety rules in engine work, including eye protection.*
4. *Assemble, operate, and test an internal combustion engine following safe and approved practices.*
 - a. *Properly assemble the engine that was disassembled in the previous competency. Replace any defective or worn parts.*
 - b. *Move assembled engines to a safe location, add appropriate fluids, and start the engines.*
 - c. *Use test procedures in operator's manuals for the engines, such as a dynamometer for horsepower or a compression gauge for testing compression within a cylinder.*

Suggested Assessment Strategies:

1. *Describe the importance and uses of internal combustion engines.*
 - a. *Use a written or oral test on objectives a-c.*
 - b. *When given different kinds of engines, the ability of individuals to distinguish one type of engine from another.*
2. *Identify parts and functions of internal combustion engine systems.*
 - a. *Use a written or oral test on objectives a-d.*
 - b. *Demonstrated ability of students to use concepts related to the various engine systems when otherwise using, repairing, or servicing a small engine.*
3. *Disassemble and inspect internal combustion systems.*
 - a. *Demonstrated ability of individuals to safely disassemble, inspect, and identify failed parts of an internal combustion engine.*
 - b. *Demonstrated ability of individuals to use information to identify parts and correctly obtain a replacement.*
4. *Assemble, operate, and test an internal combustion engine following safe and approved procedures.*
 - a. *Demonstrated ability of students to use manufacturer's materials in assembling an engine properly.*

- b. Demonstrated ability of individuals to service and otherwise prepare an engine for operation.*
- c. Engine starts and runs properly.*
- d. Demonstrated ability to use various test equipment on small engines.*

Suggested Resources:

Goering, C. E. Engine and tractor power (Latest ed.). St. Joseph, MI: American Society of Agricultural Engineers.

Johnson, D. M., Harper, J., Lawver, D. E., & Buriak, P. (2001). Mechanical technology in agriculture. Danville, IL: Interstate Publishers, Inc.

Various operators' manuals and assembly instructions for the engines used in the laboratory work.

THE SCIENCE OF AGRICULTURAL MECHANICS
UNIT 10: PERFORMING PREVENTIVE MAINTENANCE

(10 hours)

Competencies and Suggested Objectives:

1. Identify the importance of preventive maintenance.
 - a. Explain the meaning of preventive maintenance.
 - b. Describe the use of an operator's manual in identifying needed maintenance.
 - c. List general preventive maintenance practices.
 - d. Describe the meaning and importance of "maintenance intervals."

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
2. Identify components and systems on small engines requiring preventive maintenance.
 - a. Use manufacturers' manuals to identify preventive maintenance recommendations.
 - b. Explain the importance of routine maintenance based on manufacturer's recommendations.
 - c. Identify safety practices while performing preventive maintenance activities.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
3. Perform basic preventive maintenance service on a small engine.
 - a. Service the air filter on an engine.
 - b. Service the fuel system on an engine.
 - c. Service the lubrication system on an engine.
 - d. Service the cooling system on an engine.
 - e. Service the exhaust system on an engine.
 - f. Service the starting system on an engine.
 - g. Service the ignition system on an engine.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8

Suggested Teaching Strategies:

1. *Identify the importance of preventive maintenance.*
 - a. *Provide student learning materials for supervised study. Follow supervised study with class discussion and development of an outline that summarizes the information. Use examples of failures from poorly maintained engines.*
 - b. *Provide each individual an example of an operator's or manufacturer's manual. Have each student review the manual and provide an oral report on the major areas of content in the manual. Have the class identify similarities and differences in manual content.*
 - c. *Present information on general preventive maintenance practices.*
 - d. *Have students use the operators' manuals to identify recommended maintenance intervals on engines.*

2. *Identify components and systems on small engines requiring preventive maintenance.*
 - a. *Provide individuals with operators' manuals and have each student present a short oral report to the class on the preventive maintenance recommendations.*
 - b. *Use student discussion to identify areas of safety practices in engine work. As needed, demonstrate the use of personal safety equipment.*
3. *Perform basic preventive maintenance service on a small engine.*
 - a. *Form students into cooperative learning groups of two individuals each and assign each group a small internal combustion engine. Have each group perform the recommended service activities.*
 - b. *Following servicing an engine, start and operate the engine for a short time.*

Suggested Assessment Strategies:

1. *Identify the importance of preventive maintenance.*
 - a. *Use a written or oral test on objectives a-d.*
 - b. *Observe the ability of individuals to locate and interpret information in an operator's (manufacturer's) manual on the maintenance intervals for the engine.*
2. *Identify components and systems on small engines requiring preventive maintenance.*
 - a. *Provide an oral report on information in an operator's manual on preventive maintenance recommendations.*
 - b. *Use a written or oral test to assess student comprehension of safety practices in working on internal combustion engines.*
3. *Perform basic preventive maintenance service on a small engine.*
 - a. *Observe the procedures followed by each student in performing the preventive maintenance activities.*
 - b. *Visually inspect each student's work before an engine is operated.*
 - c. *Operate an engine to determine if the work has been performed properly.*

Suggested Resources:

Engines. (Latest ed.). Moline, IL: John Deere Publishing.

Fuels, lubricants, and coolants. (Latest ed.). Moline, IL: John Deere Publishing.

Goering, C. E. Engine and tractor power (Latest ed.). St. Joseph, MI: American Society of Agricultural Engineers.

Johnson, D. M., Harper, J., Lawver, D. E., & Buriak, P. (2001). Mechanical technology in agriculture. Danville, IL: Interstate Publishers, Inc.

Machinery maintenance. (Latest ed.). Moline, IL: John Deere Publishing.

Preventive maintenance. (Latest ed.). Moline, IL: John Deere Publishing.

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THE SCIENCE OF AGRICULTURAL MECHANICS
UNIT 11: APPLYING PRINCIPLES OF DIAGNOSTICS

(8 hours)

Competencies and Suggested Objectives:

1. Identify principles of diagnostics.
 - a. Explain the meaning and importance of diagnostics.
 - b. Describe the processes used in diagnostics, including equipment.
 - c. Demonstrate how to identify a problem that is preventing proper function of equipment.
 - d. Demonstrate how to identify the system where a problem is occurring.
 - e. Demonstrate how to identify the probable cause of a problem.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
2. Apply diagnostic procedures in solving a problem.
 - a. Operate the equipment as best possible to assess a problem.
 - b. Explain how to isolate a problem.
 - c. Select and use the proper diagnostic equipment and service data.
 - d. Perform the needed work and repairs according to manufacturer's specifications.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6,
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8

Suggested Teaching Strategies:

1. *Identify principles of diagnostics.*
 - a. *Provide textbooks or reference materials on diagnostics for supervised study. Follow with class discussion and the development of a summary of the information.*
 - b. *Demonstrate how to use diagnostics on an engine that has one problem that is preventing the correction function. (Probably this engine will need to be disabled by the instructor to assure that the teaching strategy is efficient.)*
2. *Apply diagnostic procedures in solving a problem.*
 - a. *Demonstrate the careful operation of equipment to diagnose a possible problem.*
 - b. *Organize class into cooperative learning groups of two individuals each and provide each group an engine for diagnostic work. Have students perform diagnostic activities related to identifying a problem, identifying possible cause of the problem, isolating the problem, selecting diagnostic equipment and service data, and performing the needed repairs according to manufacturer's specifications to correct problems.*

Suggested Assessment Strategies:

1. *Identify principles of diagnostics.*
 - a. *Use a written or oral test on objectives a-e to determine student mastery of the information.*
 - b. *Performance of students in laboratory work in diagnostics.*
2. *Apply diagnostic procedures in solving a problem.*
 - a. *Observe the procedures individuals and groups follow in operating equipment to aid in diagnosis.*
 - b. *Demonstrated performance by student in correctly diagnosing a problem.*
 - c. *Observation of student performance of needed repairs following safe and proper procedures based on the manufacturer's specifications.*

Suggested Resources:

Engines. (Latest ed.). Moline, IL: John Deere Publishing.

Fundamentals of service: Electronic and electrical systems. (Latest ed.). Moline, IL: John Deere Publishing.

Goering, C. E. Engine and tractor power (Latest ed.). St. Joseph, MI: American Society of Agricultural Engineers.

Hydraulic system diagnostics. (1997). Moline, IL: John Deere Publishing.

Johnson, D. M., Harper, J., Lawver, D. E., & Buriak, P. (2001). Mechanical technology in agriculture. Danville, IL: Interstate Publishers, Inc.

THE SCIENCE OF AGRICULTURAL MECHANICS
UNIT 12: BASIC WELDING

(8 hours)

Competencies and Suggested Objectives:

1. Identify common equipment and tools used in welding.
 - a. Describe major types of welders including electric arc and metal inert gas (MIG).
 - b. Describe tools used with each type of welding.

Related Academic Topics (See Appendix A): C1, C2, C3, C4
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
2. Apply safety precautions used in welding.
 - a. Use eye protection and proper apparel.
 - b. Use ventilation and materials handling procedures.

Related Academic Topics (See Appendix A): C1, C2, C3, C4
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
3. Describe different welding supplies used in welding.
 - a. Identify low hydrogen, mild steel, and alloy welding electrodes.
 - b. Identify the different types of gases involved in the shielded arc welding process.

Related Academic Topics (See Appendix A): C1, C2, C3, C4
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
4. Explain the meanings of the numbers in the electrode classification system.
 - a. Identify electrodes based upon tensile strength, position, and special characteristics.
 - b. Identify different types of wire and wire sizes (e.g., flux cored wire).
 - c. Describe the function of welding flux.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, M1, M8
Workplace Skills (See Appendix B): WP1, WP2, WP7, WP8
5. Compare the different types of welds.
 - a. Identify bead, groove, and fillet welds.
 - b. Identify the types of weld joints including T, lap, corner, edge, and butt.

Related Academic Topics (See Appendix A): C1, C2, C3, C4
Workplace Skills (See Appendix B): WP1, WP2, WP7, WP8
6. Perform various welding techniques.
 - a. Perform welding techniques including start, stop and re-start, pad construction, flat butt construction, and flat fillet.
 - b. Utilize various welding equipment including electric arc and MIG.

Related Academic Topics (See Appendix A): C1, C2, C3, C4
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8

Suggested Teaching Strategies:

1. *Identify common equipment and tools used in welding.*
 - a. *Discussion and media on major types of welders, including electric arc and metal inert gas (MIG).*
 - b. *Discussion and media on tools used with each type of welding.*
2. *Apply safety precautions used in welding.*
 - a. *Use eye protection and proper apparel.*
 - b. *Use ventilation and materials handling procedures.*
3. *Describe different welding supplies used in welding.*
 - a. *Performance exercise to demonstrate low hydrogen, mild steel, and alloy welding electrodes.*
 - b. *Written report on the different types of gases involved in the shielded arc welding process.*
4. *Explain the meanings of the numbers in the electrode classification system.*
 - a. *Performance exercise to demonstrate electrodes based upon tensile strength, position, and special characteristics.*
 - b. *Performance exercise to demonstrate different types of wire and wire sizes (e.g., flux cored wire).*
 - c. *Written report on the function of welding flux.*
5. *Compare the different types of welds.*
 - a. *Performance exercise to demonstrate bead, groove, and fillet welds.*
 - b. *Performance exercise to demonstrate the types of weld joints including T, lap, corner, edge, and butt.*
6. *Perform various welding techniques.*
 - a. *Performance exercise to demonstrate welding techniques including start, stop and re-start, pad construction, flat butt construction, and flat fillet.*
 - b. *Performance exercise to demonstrate various welding equipment including electric arc and MIG.*

Suggested Assessment Strategies:

1. *Identify common equipment and tools used in welding.*
 - a. *Test - Describe major types of welders including electric arc and metal inert gas (MIG).*
 - b. *Test - Describe tools used with each type of welding.*
2. *Apply safety precautions used in welding.*
 - a. *Practical Activity - Use eye protection and proper apparel.*
 - b. *Practical Activity - Use ventilation and materials handling procedures.*
3. *Describe different welding supplies used in welding.*
 - a. *Performance Activity - Identify low hydrogen, mild steel, and alloy welding electrodes.*
 - b. *Assignment - Identify the different types of gases involved in the shielded arc welding process.*
4. *Explain the meanings of the numbers in the electrode classification system.*
 - a. *Performance Activity - Identify electrodes based upon tensile strength, position,*

- and special characteristics.*
- b. Performance Activity - Identify different types of wire and wire sizes (e.g., flux cored wire).*
 - c. Assignment - Describe the function of welding flux.*
5. *Compare the different types of welds.*
- a. Performance Activity - Identify bead, groove, and fillet welds.*
 - b. Performance Activity - Identify the types of weld joints including T, lap, corner, edge, and butt.*
6. *Perform various welding techniques.*
- a. Performance Activity - Perform welding techniques including start, stop and re-start, pad construction, flat butt construction, and flat fillet.*
 - b. Performance Activity - Utilize various welding equipment including electric arc and MIG.*

Suggested Resources:

Cooper, E. L. (1997). Agricultural mechanics: Fundamentals and applications (3rd ed.). Albany, NY: Delmar.

Phipps, L. J., & Reynolds, C. L. (1992). Mechanics in agriculture (4th ed.). Danville, IL: Interstate.

THE SCIENCE OF AGRICULTURAL MECHANICS
UNIT 13: BASIC GAS CUTTING AND WELDING

(8 hours)

Competencies and Suggested Objectives:

1. Identify parts of the oxyacetylene welding equipment.
 - a. Assemble cutting attachment with regulator and gauges.
 - b. Assemble welding attachments with regulators and gauges.

Related Academic Topics (See Appendix A): C1, C2, C3, C4
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
2. Apply safety procedures for using oxyacetylene equipment.
 - a. Demonstrate removal of flammable materials.
 - b. Demonstrate lighting, adjustment, and operations.

Related Academic Topics (See Appendix A): C1, C2, C3, C4
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
3. Identify the different types of oxyacetylene flames.
 - a. Compare neutral, oxidizing, and carburizing flames.
 - b. Demonstrate proper adjustment of flames.

Related Academic Topics (See Appendix A): C2, C3, C4
Workplace Skills (See Appendix B): WP4, WP7, WP8
4. Operate oxyacetylene equipment.
 - a. Set up and adjust oxyacetylene equipment.
 - b. Make a cut in mild steel.

Related Academic Topics (See Appendix A): C2, C3
Workplace Skills (See Appendix B): WP1, WP2, WP4, WP7, WP8

Suggested Teaching Strategies:

1. *Identify parts of the oxyacetylene welding equipment.*
 - a. *Practical exercise to assemble cutting attachment with regulator and gauges.*
 - b. *Practical exercise to assemble welding attachments with regulators and gauges.*
2. *Apply safety procedures for using oxyacetylene equipment.*
 - a. *Practical exercise to demonstrate removal of flammable materials.*
 - b. *Practical exercise to demonstrate lighting, adjustment, and operations.*
3. *Identify the different types of oxyacetylene flames.*
 - a. *Practical exercise to compare neutral, oxidizing, and carburizing flames.*
 - b. *Practical exercise to demonstrate proper adjustment of flames.*
4. *Operate oxyacetylene equipment.*
 - a. *Practical exercise to set up and adjust oxyacetylene equipment.*
 - b. *Practical exercise to make a cut in mild steel.*

Suggested Assessment Strategies:

1. *Identify parts of the oxyacetylene welding equipment.*
 - a. *Practical Activity - Assemble cutting attachment with regulator and gauges.*
 - b. *Practical Activity - Assemble welding attachments with regulators and gauges.*
2. *Apply safety procedures for using oxyacetylene equipment.*
 - a. *Practical Activity - Demonstrate removal of flammable materials.*
 - b. *Practical Activity - Demonstrate lighting, adjustment, and operations.*
3. *Identify the different types of oxyacetylene flames.*
 - a. *Practical Activity - Compare neutral, oxidizing, and carburizing flames.*
 - b. *Practical Activity - Demonstrate proper adjustment of flames.*
4. *Operate oxyacetylene equipment.*
 - a. *Practical Activity - Set up and adjust oxyacetylene equipment.*
 - b. *Practical Activity - Make a cut in mild steel.*

Suggested Resources:

Cooper, E. L. (1997). Agricultural mechanics: Fundamentals and applications (3rd ed.). Albany, NY: Delmar.

Phipps, L. J., & Reynolds, C. L. Mechanics in agriculture (Latest ed.). Danville, IL: Interstate.

June 21, 2002

SECTION VI:
CURRICULUM GUIDE
FOR
THE SCIENCE OF AGRICULTURAL PLANTS

June 21, 2002

**THE SCIENCE OF AGRICULTURAL PLANTS
COURSE DESCRIPTION
(CIP: 02.0401)**

The Science of Agricultural Plants is a course which develops competencies related to the production of plants for food, fiber, ornamental, and other purposes. It includes instruction in the basic principles of plant science as well as cultural practices and the use of technology to efficiently and effectively meet consumer needs. Plant growing structures, plant classification, growth, propagation, culture, pests, harvesting, and marketing are included. (Prerequisite: Concepts of Agriscience Technology or Biology; Grades 10-12; 1 year, 1 Carnegie Unit)

**THE SCIENCE OF AGRICULTURAL PLANTS
COURSE OUTLINE**

<u>Unit No.</u>	<u>Title</u>	<u>No. of Hours</u>
Unit 1	Introduction to Agricultural Plants	9
Unit 2	Supervised Experience in Agricultural Plants	5
Unit 3	Plant Enterprises and Systems	6
Unit 4	Plant Growth	12
Unit 5	Plant Classification and Physiology	5
Unit 6	Reproduction and Propagation	12
Unit 7	Plant Growing Structures	9
Unit 8	Cultural and Harvesting Practices	19
Unit 9	Pest Management	16
Unit 10	Management and Marketing in Plant Production	9
Unit 11	Environmental Concerns for Sustainable Agriculture	5
Unit 12	New Technologies in Plant Production	5

THE SCIENCE OF AGRICULTURAL PLANTS
UNIT 1: INTRODUCTION TO AGRICULTURAL PLANTS

(9 hours)

Competencies and Suggested Objectives:

1. Investigate student organizations in the plant agriculture industry.
 - a. Identify student organizations related to agriculture.
 - b. List the requirements for Chapter, State, and American FFA Degrees.
 - c. Prepare for student development on the local, state, and national level.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
2. Demonstrate communication skills for employment in the plant agriculture industry.
 - a. Identify skills required by employers.
 - b. Explain the importance of responding to authority.
 - c. Explain the importance of ethics in the workplace.
 - d. Demonstrate the proper use of a business telephone.
 - e. Write a business letter using accepted procedures.
 - f. Complete a resume, letter of application, and job application form.
 - g. Role play a job interview in the classroom.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP2, WP3, WP6, WP7, WP8
3. Use the Internet to discover emerging technologies.
 - a. Investigate topics in plant agriculture and make an oral presentation to the class.
 - b. Investigate careers in plant agriculture.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP2, WP3, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Investigate student organizations in the plant agriculture industry.*
 - a. *Identify student organizations related to agriculture by researching agricultural student organizations on the Internet and producing a report.*
 - b. *Explain the requirements for Chapter, State, and American FFA Degrees.*
 - c. *Take part in the opportunities available to FFA members.*
2. *Demonstrate communication skills for employment in the plant agriculture industry.*
 - a. *Invite the guidance counselor to address the class to identify skills required by employers. Have each student to complete an interest survey with Choices.TM*
 - b. *Demonstrate how to respond to authority through class role playing exercises.*
 - c. *Explain the importance of ethics in the workplace and have students to relate experiences they have encountered.*
 - d. *Demonstrate the proper use of a business telephone.*
 - e. *Have each student write a business letter following accepted procedures using the business education teacher as a resource for computer word processing.*
 - f. *Have each student complete a resume and letter of application using the*

- computer.
- g. *Provide instruction in how to do a job interview and organize the class so that each student role plays an interview.*
- 3. *Use the Internet to discover emerging technologies.*
 - a. *Have each student research a topic on plant agriculture and make an oral presentation to the class.*
 - b. *Have each student research plant agriculture careers and prepare a short written report.*

Suggested Assessment Strategies:

1. *Investigate student organizations in the plant agriculture industry.*
 - a. *Unit test on objectives a-c.*
 - b. *Students identify and review student organizations related to agriculture.*
 - c. *Students describe the requirements for Chapter, State, and American FFA Degrees of Membership.*
 - d. *Students join the FFA and take part in local, state, and national level activities.*
2. *Demonstrate communication skills for employment in the plant agriculture industry.*
 - a. *Unit test on objectives a-f.*
 - b. *Students orally name and explain the skills required by employers.*
 - c. *Students orally explain the importance of responding to authority.*
 - d. *Students orally explain the importance of ethics in the workplace.*
 - e. *Each student will demonstrate the proper use of a business telephone.*
 - f. *Each student will use a computer to write a business letter.*
 - g. *Each student will prepare a resume and letter of application on the computer.*
 - h. *Each student will role play a job interview.*
3. *Use the Internet to discover emerging technologies.*
 - a. *Evidence of information will be in oral class presentations.*
 - b. *Evidence will be in written reports about plant agriculture careers.*

Suggested Resources:

FFA manual. (Current ed.). Indianapolis, IN: National FFA Organization.

FFA student handbook. (Latest ed.). Indianapolis, IN: National FFA Organization.

Hunter, S., Stewart, M., Scheil, B., Terry, R., Jr., & Frazee, S. D. (1997). Developing leadership and personal skills. Danville, IL: Interstate Publishers, Inc.

Ricketts, C. (1997). Leadership development and career success. Albany, NY: Delmar Publishers.

Videotape: Taking science from school to work. Source: Carolina Biological Supply Company, Burlington, North Carolina.

THE SCIENCE OF AGRICULTURAL PLANTS

UNIT 2: SUPERVISED EXPERIENCE IN AGRICULTURAL PLANTS

(5 hours)

Competencies and Suggested Objectives:

1. Plan, implement, and expand supervised experience in plant agriculture.
 - a. Explain the purpose, kinds, and nature of supervised experience.
 - b. Explain how supervised experience is part of a carefully planned and long-term supervised agricultural experience program (SAE).
 - c. Describe how supervised experience relates to achievement of FFA proficiency awards and other activities.
 - d. Identify appropriate experiences for a supervised agricultural experience program.
 - e. Develop short-term, intermediate, and long-term SAE goals.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, S3, S8
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP6, WP7, WP8
2. Prepare and keep appropriate written documentation on supervised experience.
 - a. Develop a training plan.
 - b. Develop a training agreement.
 - c. Keep records of competencies developed, inventory, income, and expenses.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, S3, S8
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Plan, implement, and expand supervised experience in plant agriculture.*
 - a. *Use class presentations and discussion to explain SAE, including its purpose, nature of the experience, and how a program is planned and carried out.*
 - b. *Use materials published by the National FFA Organization that provide information on Career Development Events, Proficiency Awards, and other programs.*
 - c. *Use regular supervision and observation of student performance with supervised experience.*
 - d. *Provide a form to make goal setting easier and use individual counseling with each student on the goals that are made.*
2. *Prepare and keep appropriate written documentation on supervised experience.*
 - a. *Provide examples of training plans and training plan forms. In consultation with parents, employers, and others, complete a training plan.*
 - b. *Provide examples of training agreements and a sample training agreement form. Use presentations and discussions to develop students' skills in developing a training agreement. Have students prepare a training agreement and provide feedback on their work.*
 - c. *Provide presentations on keeping records of personal experiences, inventory, income, and expenses. Use sample forms and have students complete forms and explain what they have done.*

Suggested Assessment Strategies:

1. *Plan, implement, and expand supervised experience in plant agriculture.*
 - a. *Written or oral test on the purpose, kinds, and nature of SAE.*
 - b. *Initiating and progressing in appropriate supervised experience in agricultural plants by students, including advancing with degrees of FFA membership.*
 - c. *Observations made during supervision of student while engaged in experience program.*
 - d. *Developing and revising, as needed, of goals.*
2. *Prepare and keep appropriate written documentation on supervised experience.*
 - a. *Assessment of a completed SAE training agreement.*
 - b. *Accuracy and neatness of records kept of competencies developed, inventory, income, and expenses from supervised experience.*

Suggested Resources:

A guide to local program success. (1997). Indianapolis, IN: National FFA Organization.

Advisor's guide to the FFA student handbook. (Current ed.). Indianapolis, IN: National FFA Organization.

Career development events. (Current ed.). Indianapolis, IN: National FFA Organization.

Hunter, S., Stewart, M., Scheil, B., Terry, R., Jr., & Frazee, S. D. (1997). Developing leadership and personal skills. Danville, IL: Interstate Publishers, Inc.

Official FFA manual. (Current ed.). Indianapolis, IN: National FFA Organization.

SAE best practices. (1997). Indianapolis, IN: National FFA Organization.

THE SCIENCE OF AGRICULTURAL PLANTS
UNIT 3: PLANT ENTERPRISES AND SYSTEMS

(6 hours)

Competencies and Suggested Objectives:

1. Examine how plants are used to meet human needs.
 - a. Explain the importance of plants in meeting human food needs.
 - b. Explain how plants are used as a source of clothing material.
 - c. Identify how wood and wood products are used in construction.

Related Academic Topics (See Appendix A): C1, C2, C4, C6, S2, S8
Workplace Skills (See Appendix B): WP2, WP4, WP6, WP7, WP8
2. Examine plant production enterprises.
 - a. Identify different types of field crops used for food and fiber production.
 - b. Identify the different types of horticulture crops grown including ornamental horticulture, floriculture, landscape horticulture, etc.
 - c. Define forestry and the products made from trees.
 - d. Identify important plants and their uses including grain crops, sugar and oil crops, fiber crops, vegetable, fruit, and nut crops.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M1, M4, M7, S8
Workplace Skills (See Appendix B): WP2, WP4, WP6, WPP7, WP8
3. Assess the functions and importance of plants.
 - a. Explain why plants are essential for life.
 - b. Identify the parts of plants that are used to meet human needs.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M1, S2, S5, S8
Workplace Skills (See Appendix B): WP2, WP4, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Examine how plants are used to meet human needs.*
 - a. *Explain the importance of human food needs by reviewing the nutrient requirements of humans.*
 - b. *Explain how plants are used as a source of clothing material and the importance of cotton imports and exports. Relate the use of cotton varieties to their use and how biotechnology has produced new varieties.*
 - c. *Describe how wood and wood products are used in construction. Have students prepare reports on the forestry industry and the source of local lumber supplies.*
2. *Examine plant production enterprises.*
 - a. *Explain how field crops are grown and used including seedbed preparation, pest management, and reasons wheat, corn, and rice lands are prepared differently.*
 - b. *Describe the different types of horticulture crops grown including ornamental horticulture, floriculture, landscape horticulture, etc. Conduct a field trip to a local nursery.*
 - c. *Define forestry and the products made from trees.*

- d. *Have students research by electronic means one of the important plants and its use (either grain crops, sugar and oil crops, fiber crops, vegetable, fruit, or nut crops).*
3. *Assess the functions and importance of plants.*
 - a. *Explain the food chain and why plants are essential for life.*
 - b. *Provide examples of common foods and have students identify the parts of plants that produced the food item.*

Suggested Assessment Strategies:

1. *Examine how plants are used to meet human needs.*
 - a. *Unit test on objectives a-c.*
 - b. *Student oral explanations of the importance of plants in meeting food, fiber, and wood needs.*
2. *Examine plant production enterprises.*
 - a. *Unit test on objectives a-d.*
 - b. *Student explanations of ways plant products are produced.*
3. *Assess the functions and importance of plants.*
 - a. *Unit test on objectives a and b.*
 - b. *Explain why plants are essential for life.*
 - c. *Identification of food items from various parts of plants.*

Suggested Resources:

Biondo, R. J., & Lee, J. S. (1997). Introduction to plant and soil science and technology. Danville, IL: Interstate Publishers, Inc.

Herren, R. V. (2002). The science of agriculture: A biological approach. (2nd ed.). Albany, NY: Delmar Publishers.

Janick, J., & Simon, J. E. New crops (Latest ed.). New York, NY: John Wiley & Sons, Inc.

Lampkin, N. (1994). Organic farming. Alexandria Bay, NY: Diamond Farm Enterprises.

Maynard, D. N., & Hochmuth, G. J. (1997). Handbook for vegetable growers. New York, NY: John Wiley & Sons, Inc.

Schroeder, C. B., Seagle, E. D., Felton, L. M., Ruter, J. M., Kelley, W. T., & Krewer, G. (1997). Introduction to horticulture: Science and technology (2nd ed.). Danville, IL: Interstate Publishers, Inc.

Smith, C. W. Crop production, evolution, history, and technology. (Latest ed.). New York, NY: John Wiley & Sons, Inc.

THE SCIENCE OF AGRICULTURAL PLANTS
UNIT 4: PLANT GROWTH

(12 hours)

Competencies and Suggested Objectives:

1. Examine the principles of plant growth.
 - a. Discuss the principles of cell division, including both mitosis and meiosis.
 - b. Demonstrate the use of growth retardants and stimulants.
 - c. List and explain types of tropism.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7, S2, S5, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
2. Describe nutrients necessary for plant growth.
 - a. Explain macro and micro nutrients.
 - b. Discuss the Law of Limiting Factors.
 - c. Describe the effect of excesses and deficiencies of plant nutrients.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M1, M7, S2, S5
Workplace Skills (See Appendix B): WP2, WP4, WP6, WP7, WP8
3. Identify the pH of soil and its effect on plant nutrition and growth.
 - a. Discuss soil pH.
 - b. Predict the effect various pH levels will have on plant nutrition and growth.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M1, S2, S5, S8
Workplace Skills (See Appendix B): WP2, WP4, WP6, WP7, WP8
4. Use soil test results to calculate application rates of fertilizer on a selected crop.
 - a. Demonstrate the proper way of taking a soil sample.
 - b. Analyze a soil sample for nutrient deficiencies.
 - c. Calculate fertilizer application rates to meet nutritional requirements of a crop.
 - d. Select fertilizer application methods for different plant enterprises.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M1, M4, M7, S2
Workplace Skills (See Appendix B): WP2, WP4, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Examine the principles of plant growth.*
 - a. *Demonstrate the process of cell division in mitosis and meiosis. Use videotape or laser disk information for animated views.*
 - b. *Demonstrate the use of growth retardants and stimulants.*
 - c. *Demonstrate tropisms with plants in the greenhouse.*
2. *Describe nutrients necessary for plant growth.*
 - a. *Explain macro and micro nutrients and show examples of how their absence causes growth problems.*
 - b. *Discuss the Law of Limiting Factors through over-fertilization of plants in the greenhouse and their reactions.*
 - c. *Oral and written assignment to describe the effect of excesses and deficiencies of plant nutrients.*
3. *Identify the pH of soil and its effect on plant nutrition and growth.*

- a. *Demonstrate how soil pH is derived. Each student should conduct a soil test of soil from their home. Also send a soil sample to the state lab to be analyzed and compare the results from the lab with those students obtain.*
- b. *Predict the effect various pH levels will have on plant nutrition and growth.*
4. *Use soil test results to calculate application rates of fertilizer on a selected crop.*
 - a. *Describe how soil samples are collected and have students devise and implement a plan for collecting samples from a field or lawn area.*
 - b. *Have students use a soil test kit to analyze a soil sample.*
 - c. *Calculate fertilizer application rates to meet nutritional requirements of a specific crop based on the results of the soil test.*
 - d. *Discuss fertilizer application methods for different plant enterprises.*

Suggested Assessment Strategies:

1. *Examine the principles of plant growth.*
 - a. *Unit test on objectives a-d.*
 - b. *Have students describe the principles of cell division, including mitosis and meiosis.*
 - c. *Have students name and explain plant tropisms and how they are manifested.*
2. *Describe nutrients necessary for plant growth.*
 - a. *Unit test on objectives a and b.*
 - b. *Have students explain how macro and micro nutrients effect plant growth.*
 - c. *Have students define the Law of Limiting Factors.*
 - d. *Oral and/ written report - Describe the effects of excesses and deficiencies of plant nutrients.*
3. *Identify the pH of soil and its effect on plant nutrition and growth.*
 - a. *Unit test on objectives a and b.*
 - b. *Have students define soil pH and explain its relation to plant growth.*
 - c. *Use student input to predict the effects various pH levels will have on plant nutrition and growth.*
4. *Use soil test results to calculate application rates of fertilizer on a selected crop.*
 - a. *Unit test on objectives a-d.*
 - b. *Use of appropriate procedures in collecting and testing soil samples.*
 - c. *Calculation of fertilizer application rates to meet nutritional requirements of a specific crop.*
 - d. *Select fertilizer application methods for different plant enterprises.*

Suggested Resources:

Biondo, R. J., & Lee, J. S. (1997). Introduction to plant and soil science and technology. Danville, IL: Interstate Publishers, Inc.

Herren, R. V. (2002). The science of agriculture: A biological approach. (2nd ed.). Albany, NY: Delmar Publishers.

THE SCIENCE OF AGRICULTURAL PLANTS
UNIT 5: PLANT CLASSIFICATION AND PHYSIOLOGY

(5 hours)

Competencies and Suggested Objectives:

1. Examine the methods by which plants are classified.
 - a. Explain the botanical classification of plants.
 - b. Explain variety and variety selection of various plants.
 - c. Explain how plants are classified according to life cycle.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
2. Examine the anatomy of a plant.
 - a. Identify the types and structures of leaves.
 - b. Draw and label the parts of a leaf.
 - c. Identify different types of stems.
 - d. Draw and label the parts of a stem.
 - e. Identify different types of root systems.
 - f. Draw and label the parts of a root.
 - g. Identify the types and structure of a flower.
 - h. Draw and label the parts of a complete flower.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
3. Assess the physiological principles of a plant (how the plant functions as a system).
 - a. Describe photosynthesis, including the chemical reactions that occur.
 - b. Describe the process of transpiration.
 - c. Describe the process of respiration.
 - d. Explain how each plant part and process is important in the growth and development of a plant.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Examine the methods by which plants are classified.*
 - a. *Oral and written assignment to explain the botanical classification of plants.*
 - b. *Oral and written assignment to explain variety and variety selection of various plants.*
 - c. *Oral and written assignment to explain how plants are classified according to life cycle.*
2. *Examine the anatomy of a plant.*
 - a. *Practical exercise to identify the types and structures of leaves.*
 - b. *Practical exercise to draw and label the parts of a leaf.*
 - c. *Practical exercise to identify different types of stems.*
 - d. *Practical exercise to draw and label the parts of a stem.*

- e. *Practical exercise to identify different types of root systems.*
- f. *Practical exercise to draw and label the parts of a root.*
- g. *Practical exercise to identify the types and structure of a flower.*
- h. *Practical exercise to draw and label the parts of a complete flower.*
- 3. *Assess the physiological principles of a plant (how the plant functions as a system).*
 - a. *Oral and written assignment to describe photosynthesis, including the chemical reactions that occur.*
 - b. *Oral and written assignment to describe the process of transpiration.*
 - c. *Oral and written assignment to describe the process of respiration.*
 - d. *Oral and written assignment to explain how each plant part and process is important in the growth and development of a plant.*

Suggested Assessment Strategies:

- 1. *Examine the methods by which plants are classified.*
 - a. *Oral and/ written report - Explain the botanical classification of plants.*
 - b. *Oral and/ written report - Explain variety and variety selection of various plants.*
 - c. *Oral and/ written report - Explain how plants are classified according to life cycle.*
- 2. *Examine the anatomy of a plant.*
 - a. *Practical activity - Identify the types and structures of leaves.*
 - b. *Practical activity - Draw and label the parts of a leaf.*
 - c. *Practical activity - Identify different types of stems.*
 - d. *Practical activity - Draw and label the parts of a stem.*
 - e. *Practical activity - Identify different types of root systems.*
 - f. *Practical activity - Draw and label the parts of a root.*
 - g. *Practical activity - Identify the types and structure of a flower.*
 - h. *Practical activity - Draw and label the parts of a complete flower.*
- 3. *Assess the physiological principles of a plant (how the plant functions as a system).*
 - a. *Oral and/ written report - Describe photosynthesis, including the chemical reactions that occur.*
 - b. *Oral and/ written report - Describe the process of transpiration.*
 - c. *Oral and/ written report - Describe the process of respiration.*
 - d. *Oral and/ written report - Explain how each plant part and process is important in the growth and development of a plant.*

Suggested Resources:

Biondo, R. J., & Lee, J. S. (1997). Introduction to plant and soil science and technology. Danville, IL: Interstate Publishers, Inc.

Lee, J. S., & Turner, D. L. (1997). Introduction to world agriscience and technology (2nd ed.). Danville, IL: Interstate Publishers, Inc.

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Herren, R. V. (2002). The science of agriculture: A biological approach. (2nd ed.). Albany, NY: Delmar Publishers.

THE SCIENCE OF AGRICULTURAL PLANTS
UNIT 6: REPRODUCTION AND PROPAGATION

(12 hours)

Competencies and Suggested Objectives:

1. Examine the principles of genetics.
 - a. Explain the principles of Mendel's law.
 - b. Identify the makeup of chromosomes in a plant cell.
 - c. Describe the structure of DNA.
 - d. Discuss the use of recombinant DNA in producing new varieties of plants.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M1, M7, S2, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
2. Distinguish between sexual and asexual reproduction.
 - a. Explain and list advantages and disadvantages of sexual reproduction in plants.
 - b. Use seed germination tests.
 - c. Describe the conditions needed for good seed germination.
 - d. Describe the two types of seed leaves.
 - e. Explain the importance of seed quality.
 - f. Explain the methods of asexual reproduction of plants.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M1, M7, S2, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
3. Demonstrate the propagation of plants.
 - a. Use tissue culture, cuttings, layering, budding, and separation and division to propagate plants.
 - b. Demonstrate the use of rooting hormones.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7, S2, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Examine the principles of genetics.*
 - a. *Review the principles of Mendel's law using class discussion and presentation.*
 - b. *Review the makeup of chromosomes in a plant cell using a line drawing.*
 - c. *Extract DNA from wheat germ or onion tissue as a class lab and conduct an electrophoresis lab with the product.*
 - d. *Discuss the use of recombinant DNA in producing new varieties of plants.*
2. *Distinguish between sexual and asexual reproduction.*
 - a. *Demonstrate sexual reproduction of plants with video and laser disc.*
 - b. *Describe the advantage of sexual reproduction as related to crop improvement.*
 - c. *Conduct a germination test in the greenhouse, calculate the percentage of germination, and write a report on the results.*
 - d. *Describe and demonstrate the conditions for seed germination.*
 - e. *Describe the two types of seed leaves.*
 - f. *Explain the importance of seed quality and how to read seed certification*

- tags.
- g. Explain the methods of asexual reproduction of plants.
- 3. Demonstrate the propagation of plants.
 - a. Demonstrate propagation procedures through tissue culture, cuttings, layering, budding, and separation and division as a lab activity in the greenhouse.
 - b. Demonstrate the use of rooting hormones.

Suggested Assessment Strategies:

1. Examine the principles of genetics.
 - a. Unit test on objectives a-d.
 - b. Have student describe the principles of Mendel's law.
 - c. Have students draw and label the makeup of chromosomes in a plant cell.
 - d. Student protocol in extracting DNA and conducting an electrophoresis.
 - e. Have students explain the use of recombinant DNA in producing new plant varieties.
2. Distinguish between sexual and asexual reproduction.
 - a. Unit test on objectives a-f.
 - b. Have students explain and list advantages and disadvantages of sexual reproduction.
 - c. Have cooperative groups of students conduct a germination test in the greenhouse, calculate the percentage of germination, and write a report on the results.
 - d. Have individual students explain the conditions needed for seed germination.
 - e. Have students draw and label the parts of two types of seed leaves.
 - f. Have individual students explain seed quality and how to read seed certification tags.
 - g. Have students explain the methods of asexual reproduction of plants.
3. Demonstrate the propagation of plants.
 - a. Unit test on objectives a and b.
 - b. Student skill in demonstrating propagation procedures through tissue culture, cuttings, layering, budding, and separation and division as a lab activity in the greenhouse.
 - c. Ability to appropriately use rooting hormones.

Suggested Resources:

Biondo, R. J. (1997). Activity manual for introduction to plant and soil science and technology. Danville, IL: Interstate Publishers, Inc.

Biondo, R. J., & Lee, J. S. (1997). Introduction to plant and soil science and technology. Danville, IL: Interstate Publishers, Inc.

Herren, R. V. (2002). The science of agriculture: A biological approach. (2nd ed.). Albany, NY: Delmar Publishers.

June 21, 2002

Raven, P. H., Evert, R. F., & Eichhorn, S. E. Biology of plants (Latest ed.).
New York: NY: Worth Publishers.

THE SCIENCE OF AGRICULTURAL PLANTS UNIT 7: PLANT GROWING STRUCTURES

(9 hours)

Competencies and Suggested Objectives:

1. Describe the various plant growing structures and the environmental controls used by each type.
 - a. Illustrate five different greenhouse structures by drawing the end view.
 - b. Explain the uses of hotbeds and cold frames.
 - c. Discuss the purpose of a lath house and shade house.
 - d. Differentiate between environmental controls including humidistat, thermostat, cooling, watering, and heating.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M4, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
2. Examine plant production in growing structures.
 - a. Distinguish between bedding, ornamental, and seasonal potted plants.
 - b. Identify five common bedding, ornamental, and seasonal potted plants.
 - c. Grow a selection of common bedding plants.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7

Suggested Teaching Strategies:

1. *Describe the various plant growing structures and the environmental controls used by each type.*
 - a. *Use supervised study and class discussion to develop sketches on a writing surface of five different greenhouse structures and to relate the purpose and advantages and disadvantages of each.*
 - b. *Explain the uses of hotbeds and cold frames.*
 - c. *Discuss the purpose of a lath house and shade house.*
 - d. *Differentiate between environmental controls including humidistat, thermostat, cooling, watering, and heating in the greenhouse.*
2. *Examine plant production in growing structures.*
 - a. *Use plant specimens and have students examine and describe differences between bedding, ornamental, and seasonal potted plants that are commercially available or produced in the local area.*
 - b. *Use plant specimens and summarize differences between five common ornamental, bedding, and seasonal potted plants so that students are able to accurately identify the plants.*
 - c. *Grow a selection of common bedding plants. Have students prepare and plant on schedule for a spring sale. Each student should be responsible for a section of plants.*

Suggested Assessment Strategies:

1. *Describe the various plant growing structures and the environmental controls used by each type.*
 - a. *Unit test on objectives a-d.*
 - b. *Have students prepare sketches that illustrate five different greenhouse structures.*
 - c. *Have students explain the uses of hotbeds and cold frames.*
 - d. *Have students discuss the use of lath and shade houses.*
 - e. *Have students differentiate between environmental controls including humidistats, thermostats, cooling, watering and heating.*
2. *Examine plant production in growing structures.*
 - a. *Unit test on objectives a-c.*
 - b. *Have students identify ten common bedding plants.*
 - c. *Have students grow a selection of common bedding plants and be responsible for their maintenance in the green house.*
 - d. *Have students associate five common ornamental plants and their uses.*

Suggested Resources:

Reiley, H. E., & Shry, C. L. Jr. (1996). Introductory horticulture (5th ed.). Albany, NY: Delmar Publishers.

Schroeder, C. B., Seagle, E. D., Felton, L. M., Ruter, J. M., Kelley, W. T., & Krewer, G. (1997). Introduction to horticulture: Science and technology (2nd ed.). Danville, IL: Interstate Publishers, Inc.

THE SCIENCE OF AGRICULTURAL PLANTS
UNIT 8: CULTURAL AND HARVESTING PRACTICES

(19 hours)

Competencies and Suggested Objectives:

1. Examine the types of growing media.
 - a. Explain the contents of soil including minerals, water, organic matter, and other constituents.
 - b. Explain the soil components including sand, silt, clay, and others.
 - c. Explain land classification and use.
 - d. Identify the characteristics of an ideal growing medium.
 - e. Identify different types of soil-less growing media mixes.
 - f. Explain hydroponic plant growth and its advantages and disadvantages.
 - g. Compare and contrast soil, soil-less media, and hydroponics.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2, S4, S8
Workplace Skills (See Appendix B): WP2, WP4, WP6, WP7, WP8
2. Discuss the different soil amendments.
 - a. Explain organic soil amendments including bark, compost, leaf mold, and peat moss.
 - b. Explain inorganic soil amendments including perlite, sand, and vermiculite.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2, S4
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
3. Determine the conditions needed for plant growth in a greenhouse.
 - a. Explain the importance of light in plant growth.
 - b. Explain how plants respond to different light rays.
 - c. Explain how temperature affects the growth of a plant.
 - d. Describe the proper water management in growing plants.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2, S6, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
4. Assess tillage and cultivation practices.
 - a. Explain the different types of tillage practices.
 - b. Name the advantages and disadvantages of plowing and tillage.
 - c. Name the advantages and disadvantages of non-tillage planting.
 - d. Contrast and compare the two major groups of fertilizers.
 - e. Explain the role of moisture management in plant production.
 - f. Define irrigation and the types of irrigation systems.
 - g. Develop an irrigation schedule.
 - h. Determine water quality for irrigation.
 - i. Identify sources of irrigation water.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7, S4
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
5. Explain the meaning and importance of harvesting.
 - a. Define harvesting.
 - b. Describe the importance of harvesting in successful plant production.

Related Academic Topics (See Appendix A): C1, C2

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

6. Explain the different harvesting methods, equipment, and facilities.
 - a. Describe the methods of harvesting.
 - b. Explain the timing of harvest as related to maturity, nutrition, and marketing.
 - c. Discuss the different types of harvesting equipment including containers, combines, pickers, and diggers.
 - d. Discuss the different types of storage facilities.
 - e. Discuss preharvest loss and harvest loss.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M1, M7

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Examine the types of growing media.*
 - a. *Explain the contents of soils including minerals, water, organic matter, etc.*
 - b. *Explain the soil components including sand, silt, clay, and others.*
 - c. *Use supervised study followed by practice to present land classification.*
 - d. *Demonstrate the characteristics of an ideal growing medium by examining the composition of various potting media.*
 - e. *Discuss the different types of soil-less growing media mixes such as vermiculite, perlite, peat moss, coca hulls, ground up tires, etc. and how they are used to condition a growing media.*
 - f. *Explain hydroponic production and its advantages and disadvantages.*
Establish a small hydroponics area in the greenhouse.
 - g. *Compare and contrast soil, soil-less media, and hydroponics.*
2. *Discuss the different soil amendments.*
 - a. *Explain organic soil amendments including bark, compost, leaf mold, and peat moss and their purposes.*
 - b. *Explain the use of inorganic soil amendments including perlite, sand, and vermiculite.*
3. *Determine the conditions needed for plant growth in a greenhouse.*
 - a. *Explain the importance of light in plant growth and its control to force flowering.*
 - b. *Demonstrate how plants respond to different light rays.*
 - c. *Explain how temperature affects the growth of a plant and the role of environmental controls in the green house.*
 - d. *Describe the proper water management in growing plants.*
4. *Assess tillage and cultivation practices.*
 - a. *Explain the different types of tillage practices, including limited till and no till.*
 - b. *Provide information for supervised study on the advantages and disadvantages of plowing and tillage and the relationship to soil compaction.*
 - c. *Use supervised study on advantages and disadvantages of non-tillage planting.*
 - d. *Discuss the two major groups of fertilizers.*
 - e. *Have students explore irrigation and the types of irrigation systems by researching equipment vendors on the Internet and reporting on their products.*
 - f. *Provide examples of irrigation schedules.*

- g. *Test water quality for irrigation and assess nitrate leaching and chemical leaching into the water tables.*
- h. *Discuss sources of irrigation water.*
- 5. *Explain the meaning and importance of harvesting.*
 - a. *Use supervised study followed by discussion to outline the major concepts of harvesting on the writing surface.*
 - b. *Use cooperative learning groups for students to identify and assess the importance of proper harvesting in the economic success of a plant production enterprise.*
- 6. *Explain the different harvesting methods, equipment, and facilities.*
 - a. *Describe the methods of harvesting. Visit a local agricultural implement dealer to examine several harvesting machines.*
 - b. *Explain the timing of harvest as related to ripeness, dryness, and storage concerns.*
 - c. *Discuss the different types of harvesting equipment including containers, combines, pickers, and diggers.*
 - d. *Discuss the different types of storage facilities, both for equipment and for products to be held for later sale.*
 - e. *Discuss preharvest loss and harvest loss. Where is the point that a machine that is losing grain should be replaced with a newer more efficient model?*

Suggested Assessment Strategies:

- 1. *Examine the types of growing media.*
 - a. *Unit test on objectives a-g.*
 - b. *Students explain the contents of soils including minerals, water, organic matter, and other constituents.*
 - c. *Students examine soil components and classify soils based on proportion of constituents.*
 - d. *Students explain land classification based on use and classify one or more tracts or fields based on the agricultural land classification system.*
 - e. *Students describe the characteristics of an ideal growing medium.*
 - f. *Students discuss the different types of soil-less growing media mixes such as vermiculite, perlite, peat moss, coca hulls, and shredded tires.*
 - g. *Students relate the advantages and disadvantages of hydroponics.*
 - h. *Students orally compare and contrast soil, soil-less media, and hydroponics.*
- 2. *Discuss the different soil amendments.*
 - a. *Unit test on objectives a and b.*
 - b. *Students examine organic soil amendments including bark, compost, leaf mold and peat moss and identify such materials.*
 - c. *Students discuss inorganic soil amendments including perlite, sand, and vermiculite.*
- 3. *Determine the conditions needed for plant growth in a greenhouse.*
 - a. *Unit test on objectives a-d.*
 - b. *Students explain the importance of light in plant growth.*
 - c. *Students examine how plants respond to different light rays by designing*

- demonstrations using plants and various levels of light and plant positions.*
- d. Students explain how temperature affects the growth of a plant.*
 - e. Students describe the proper water management in growing plants.*
4. *Assess tillage and cultivation practices.*
- a. Have students orally explain the different types of tillage practices.*
 - b. Have students orally list and explain the advantages and disadvantages of plowing and tillage.*
 - c. Have students prepare a chart that presents the advantages and disadvantages of non-tillage planting.*
 - d. Students describe the two major groups of fertilizers.*
 - e. Student reports on irrigation and the types of irrigation systems.*
 - f. Students prepare an irrigation schedule for a specific crop.*
 - g. Students analyze water quality to determine suitability for use in irrigation.*
 - h. Students examine sources of irrigation water.*
5. *Explain the meaning and importance of harvesting.*
- a. Use a unit test for objectives a and b.*
 - b. Student performance with SAE activities that involve harvesting and with an FFA greenhouse-based fundraising program.*
6. *Explain the different harvesting methods, equipment, and facilities.*
- a. Describe the methods of harvesting related to a specific crop.*
 - b. Explain the timing of harvest.*
 - c. Examine the different types of harvesting equipment including containers, combines, pickers, and diggers.*
 - d. Discuss the different types of storage facilities.*
 - e. Define preharvest loss and harvest loss.*

Suggested Resources:

Agriscience laserdisk series, disk 2: Plant science. (1997). Albany, NY: Delmar Publishers.

Biondo, R. J., & Lee, J. S. (1997). Introduction to plant and soil science and technology. Danville, IL: Interstate Publishers, Inc.

Grozinger, J., & Thompson, B. (1997). The Internet guide for agriculturists. Moline, IL: John Deere Publishing.

Irrigation. (1996). Fairfax, VA: The Irrigation Association.

Keesen, L. (1995). The complete irrigation workbook. Cleveland, OH: G. I. E. Inc., Publishers.

Lee, J. S., & Turner, D. L. (1997). Introduction to world agriscience and technology (2nd ed.). Danville, IL: Interstate Publishers, Inc.

Schroeder, C. B., Seagle, E. D., Felton, L. M., Ruter, J. M., Kelley, W. T., & Krewer, G.

(1997). Introduction to horticulture: Science and technology (2nd ed.). Danville, IL: Interstate Publishers, Inc.

Swiader, J. M., Ware, G. W., & McCollum, J. P. Producing vegetable crops (Latest ed.). Danville, IL: Interstate Publishers, Inc.

THE SCIENCE OF AGRICULTURAL PLANTS
UNIT 9: PEST MANAGEMENT

(16 hours)

Competencies and Suggested Objectives:

1. Assess the effects of pests on plant production.
 - a. Explain plant sanitation as related to production, animal health, and HACCP.
 - b. Explain common pests and how plants resist pests.
 - c. Identify types and causes of disease, including viral, fungal, and bacterial diseases.
 - d. List common diseases in plants such as rot, wilt, blight, etc.
 - e. Identify how diseases are spread.
 - f. Demonstrate how diseases are prevented through sanitation.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
2. Discuss biological control systems.
 - a. List five varieties of plants resistant to disease and insects.
 - b. List five plants that show promise as containing natural pesticides.
 - c. Examine the life cycles of insects as related to methods of biological control.
 - d. Explain how crop rotation can be used as a method of controlling pests and diseases in plants.
 - e. Identify types of beneficial insects and how they are used to control pests.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
3. Describe chemical control with pests.
 - a. Discuss how chemical pesticides work.
 - b. Explain the different types of pesticides.
 - c. Analyze factors in selection of pesticides.
 - d. Interpret safety precautions and mixing formulations on a pesticide label.
 - e. Demonstrate proper method of mixing and using agricultural chemicals.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M1, M4, M7, S2, S5, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
4. Demonstrate different types of mechanical pest control.
 - a. Identify and explain mechanical pest control including plowing, mowing, mulching, and hoeing.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S3
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
5. Examine integrated pest management.
 - a. Discuss integrated pest management.
 - b. Design an integrated pest management system for a designated crop.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Assess the effects of pests on plant production.*
 - a. *Explain plant sanitation and how it is important in plant health as well as the health of animals who consume the plants.*
 - b. *Use diseased plant specimens and identify types and causes of diseases, including viral, fungal, and bacterial diseases. Temporary wet-mount slides can be used with microscopes to demonstrate the size and structure of disease-causing organisms.*
 - c. *Practical exercise to examine the life cycles of insects as related to methods of biological control.*
 - d. *Use supervised study and discussion to determine how plant diseases are spread.*
 - e. *Demonstrate how diseases are prevented by using sanitation practices.*
2. *Discuss biological control systems.*
 - a. *List five varieties of plants resistant to disease and insects and explain how this trait was developed.*
 - b. *List five plants that show promise as containing natural pesticides.*
 - c. *Differentiate between complete and incomplete metamorphosis in insects and how this relates to their control.*
 - d. *Explain how crop rotation can be used as a method of controlling pests and diseases in plants.*
 - e. *List uses of beneficial insects and have students name examples.*
3. *Describe chemical control with pests.*
 - a. *Discuss how chemical pesticides work and how they are entered into the body.*
 - b. *Use supervised study followed by student input to outline the different types of pesticides and have students prepare a collection of labels from pesticide containers.*
 - c. *Use supervised study followed by student input to outline the factors to consider in selecting pesticides on the writing surface.*
 - d. *Practical exercise to interpret safety precautions and mixing formulations on a pesticide label.*
 - e. *Practical exercise to demonstrate proper method of mixing and using agricultural chemicals.*
4. *Demonstrate different types of mechanical pest control.*
 - a. *Use supervised study and discussion to outline mechanical pest control on the writing surface, including plowing, mowing, mulching, and hoeing.*
5. *Explain integrated pest management.*
 - a. *Discuss integrated pest management and present the advantages and disadvantages of this method, summarizing the main points.*
 - b. *Form students into cooperative learning groups to design an integrated pest management system for a designated crop.*

Suggested Assessment Strategies:

1. *Assess the effects of pests on plant production.*
 - a. *Use a unit test on objectives a-f.*
 - b. *Have students orally explain the concept of plant sanitation, including how*

- plants resist disease.*
- c. Have students identify types and causes of diseases including viral, fungal, and bacterial disease.*
 - d. Have students associate common diseases in plants such as rot, wilt, and blight with recommended controls.*
 - e. Have students identify how diseases are spread.*
 - f. Have students explain the meaning of sanitation and the procedures used with plant sanitation.*
- 2. Discuss biological control systems.*
- a. Unit test on objectives a-f.*
 - b. Have students prepare posters or reports that depict five varieties of plants resistant to disease and insects.*
 - c. Practical activity - Examine the life cycles of insects as related to methods of biological control.*
 - d. Have students differentiate between complete and incomplete metamorphosis in insects.*
 - e. Have students relate how crop rotation can be used as a method of controlling pests and diseases in plants.*
- 3. Describe chemical control with pests.*
- a. Unit test on objectives a-f.*
 - b. Have students explain how chemical pesticides work.*
 - c. Have students list and define the different types of pesticides.*
 - d. Have students relate factors in the selection of pesticides.*
 - e. Practical activity - Interpret safety precautions and mixing formulations on a pesticide label.*
 - f. Practical activity - Demonstrate proper method of mixing and using agricultural chemicals.*
- 4. Demonstrate different types of mechanical pest control.*
- a. Practical activity - Identify and explain mechanical pest control including plowing, mowing, mulching, and hoeing.*
- 5. Examine integrated pest management.*
- a. Oral/written report - Discuss integrated pest management.*
 - b. Practical activity - Design an integrated pest management system for a designated crop.*

Suggested Resources:

Biondo, R. J., & Lee, J. S. (1997). Introduction to plant and soil science and technology. Danville, IL: Interstate Publishers, Inc.

Herren, R. V. (2002). The science of agriculture: A biological approach. (2nd ed.). Albany, NY: Delmar Publishers.

Mississippi weed control guidelines. (Latest ed.). Mississippi State, MS: Mississippi Cooperative Extension Service.

Reiley, H. E., & Shry, C. L., Jr. (1996). Introductory horticulture. (5th ed.). Delmar. Albany, NY.

Schroeder, C. B., Seagle, E. D., Felton, L. M., Ruter, J. M., Kelley, W. T., & Krewer, G. (1997). Introduction to horticulture: Science and technology (2nd ed.). Danville, IL: Interstate Publishers, Inc.

THE SCIENCE OF AGRICULTURAL PLANTS

UNIT 10: MANAGEMENT AND MARKETING IN PLANT PRODUCTION (9 hours)

Competencies and Suggested Objectives:

1. Explain the management practices needed in plant production.
 - a. Identify factors to consider in plant selection.
 - b. Determine market availability.
 - c. Describe the importance of the likes and dislikes of growers and customers.
 - d. Identify software available for farm record keeping and management.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
2. Examine marketing in plant production.
 - a. Define marketing in plant production.
 - b. Explain cash markets and futures.
 - c. Explain how to use the Internet in selecting a marketing strategy.
 - d. Discuss the selection of the best marketing alternative.
 - e. Evaluate niches in the market place.
 - f. Identify the importance of timing harvesting in marketing.
 - g. Discuss the importance of inventory control.
 - h. Define wholesale and retail marketing.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Explain the management practices needed in plant production.*
 - a. *Discuss factors to consider in plant variety selection by examining available information on the Internet and make a recommendation.*
 - b. *Use supervised study followed by class discussion to describe market availability, including the role of international markets. Have students collect local newspaper market reports and bring the information to class for discussion.*
 - c. *Discuss likes and dislikes of growers and consumers and the roles they play in making selection.*
 - d. *Demonstrate various computer software packages that are available for record keeping and management of farms. This should include those from the Cooperative Extension Service and commercially available as well.*
2. *Examine marketing in plant production.*
 - a. *Use supervised study followed by class discussion to outline the major areas in successfully marketing plant products.*
 - b. *Discuss cash markets and futures. Invite a member of the Farm Bureau marketing staff, a marketing specialist with the Cooperative Extension Services, or another qualified individual to present information on the important roles of various marketing alternatives.*

- c. *Demonstrate use of the Internet in selecting a marketing strategy. Have students use the Internet to enter the Stewart-Peterson Marketing activity specially designed for high school agricultural education classes.*
- d. *Discuss the selection of the best marketing alternative, be it to hold and sell and or to sell at harvest.*
- e. *Explain the meaning of a niche and provide information to evaluate niches.*
- f. *Discuss the meaning and importance of inventory control.*
- g. *Use supervised study followed by class discussion to outline the meaning and use of wholesale and retail marketing in agriculture.*

Suggested Assessment Strategies:

- 1. *Explain the management practices needed in plant production.*
 - a. *Unit test on objectives a-d.*
 - b. *Have students orally identify the factors to consider in plant variety selection.*
 - c. *Have students determine market availability for a specific product.*
 - d. *Use oral student reporting to examine how likes and dislikes of growers and customers affect marketing.*
 - e. *Have students review various software packages that are available for record keeping and management of farms.*
- 2. *Examine marketing in plant production.*
 - a. *Unit test on objectives a-h.*
 - b. *Use student oral reports to examine the role of marketing in plant production.*
 - c. *Have students define cash markets and futures.*
 - d. *Individual use of the Internet to collect information on a marketing strategy.*
 - e. *Have students identify the factors involving the selection of the best marketing alternative.*
 - f. *Have students identify niches in the marketplace for selected products.*
 - g. *Have students identify the importance of inventory control.*
 - h. *Use cooperative groups for students to define wholesale and retail marketing and design the strategy they would use with a selected local crop.*

Suggested Resources:

Biondo, R. J., & Lee, J. S. (1997). Introduction to plant and soil science and technology. Danville, IL: Interstate Publishers, Inc.

Boone, L. V. Producing farm crops (Latest ed.). Danville, IL: Interstate Publishers, Inc.

Lee, J. S., Leising, J. G., & Lawver, D. E. AgriMarketing technology (Latest ed.). Danville, IL: Interstate Publishers, Inc.

**THE SCIENCE OF AGRICULTURAL PLANTS
UNIT 11: ENVIRONMENTAL CONCERNS FOR
SUSTAINABLE AGRICULTURE**

(5 hours)

Competencies and Suggested Objectives:

1. Examine how agricultural activities can affect the environment.
 - a. Explain sustainable agriculture.
 - b. Distinguish between the ways agricultural activities can potentially pollute the environment including point and non-point source pollution.
 - c. Explain the dangers of water table depletion by agriculture use.
 - d. Explain soil and water conservation methods.
 - e. Explain the relationship between ozone depletion and environmental pollution.
 - f. Explain global warming and the greenhouse effect.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S4, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
2. Discuss disposal methods of agricultural waste.
 - a. Determine reentry time into treated areas after chemical application.
 - b. Discuss the effects of increased carbon dioxide levels on plants.
 - c. Describe the causes of soil contamination.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S4, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Examine how agricultural activities can affect the environment.*
 - a. *Oral and written assignment to explain sustainable agriculture.*
 - b. *Practical exercise to distinguish between the ways agricultural activities can potentially pollute the environment including point and non-point source pollution. Use a soil profile demonstrator to examine leaching.*
 - c. *Explain the dangers of water table depletion by agriculture use and the reason for many reservoirs.*
 - d. *Explain soil and water conservation methods. Use a resource person from the local soil and water office to present to the class.*
 - e. *Explain the relationship between ozone depletion and environmental pollution.*
 - f. *Explain the terms global warming and the greenhouse effect.*
2. *Discuss disposal methods of agricultural waste.*
 - a. *Discuss the reentry to a job area after it has been treated with chemicals.*
 - b. *Discuss the effects of increased carbon dioxide levels on plants.*
 - c. *Describe the causes of soil contamination and its reclamation.*

Suggested Assessment Strategies:

1. *Examine how agricultural activities can affect the environment.*
 - a. *Unit test on objectives a-f.*

- b. Have students orally explain sustainable agriculture.*
- c. Have students list the ways agriculture can potentially pollute the environment including chemicals, soil erosion, fertilizers, animal waste, etc.*
- d. Have students explain the dangers of water table depletion by agriculture use and how it happens.*
- e. Have students list soil and water conservation methods.*
- f. Have students explain the relationship between ozone depletion and environmental pollution.*
- g. Have students examine global warming and the greenhouse effect in small groups and provide an overall group report to the class.*
- 2. *Discuss disposal methods of agricultural waste.*
 - a. Have students identify the reentry time to a job area after it has been treated with chemicals.*
 - b. Have students demonstrate the effects of increased carbon dioxide levels on plants.*
 - c. Have students identify the causes of soil contamination.*

Suggested Resources:

Applied environmental science. (1996). Alexandria, VA: The National Council for Agricultural Education.

Biondo, R. J., & Lee, J. S. (1997). Introduction to plant and soil science and technology. Danville, IL: Interstate Publishers, Inc.

Camp, W. G., & Donahue, R. L. (1997). Environmental science for agriculture and the life sciences. Albany, NY: Delmar Publishers.

Herren, R. V. (2002). The science of agriculture: A biological approach. (2nd ed.). Albany, NY: Delmar Publishers.

Porter, L., Lee, J. S., Turner, D. L., & Hillan, M. (1997). Environmental science and technology. Danville, IL: Interstate Publishers, Inc.

THE SCIENCE OF AGRICULTURAL PLANTS
UNIT 12: NEW TECHNOLOGIES IN PLANT PRODUCTION

(5 hours)

Competencies and Suggested Objectives:

1. Examine precision farming as a new technology in plant production.
 - a. Describe precision farming.
 - b. Identify the use of microcomputers in precision farming.
 - c. Use a global positioning system in plant production.
 - d. Demonstrate geographic information system technology in plant production.
 - e. Demonstrate variable rate application equipment in precision farming.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7, S6, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Examine precision farming as a new technology in plant production.*
 - a. *Describe precision farming and its importance.*
 - b. *Demonstrate the use of microcomputers in precision farming. Have a local dealership demonstrate computer based-technologies on new equipment.*
 - c. *Demonstrate the use of a global positioning system in plant production. Describe how GPS works and demonstrate it with a handheld unit as well as equipment-mounted units.*
 - d. *Demonstrate the use of geographic information system technology in plant production. Secure local GIS information and demonstrate how it is used.*
 - e. *Apply GPS and GIS information to fertilizer application and other crop inputs.*

Suggested Assessment Strategies:

1. *Examine precision farming as a new technology in plant production.*
 - a. *Unit test over objectives a-e.*
 - b. *Have students orally explain precision farming and the use of microcomputers in precision farming.*
 - c. *Have students demonstrate the use of GPS in plant production.*
 - d. *Have students demonstrate the use of GIS technology in plant production.*
 - e. *Have students evaluate GPS and GIS information to fertilizer application and other crop inputs.*

Suggested Resources:

Advanced farming systems materials: Instant yield map, instant survey, instant crops and pocket survey. (1998). Burr Ridge, IL: Case Corporation.

Biondo, R. J., & Lee, J. S. (1997). Introduction to plant and soil science and technology. Danville, IL: Interstate Publishers, Inc.

Hitch up a computer for your farm. (1996). Moline, IL: John Deere Publishing.

The precision farming guide for agriculturists. (1997). Moline, IL: John Deere Publishing.

SECTION VII:
CURRICULUM GUIDE
FOR
AGRIBUSINESS AND ENTREPRENEURSHIP TECHNOLOGY

June 21, 2002

**AGRIBUSINESS AND ENTREPRENEURSHIP TECHNOLOGY
COURSE DESCRIPTION
(CIP: 01.0103)**

This is a course in the role and characteristics of agricultural and related businesses in our economy. The purpose of this course is to: provide a basis for making effective business decisions; setting goals; assessing and solving problems; determining financial progress and success; evaluating the management of resources; and gaining skills useful in everyday life in the diverse fields of agribusiness and entrepreneurship. Students explore principles in the successful organization and management of businesses as owners, managers, and operators. (Grades 11-12; 1 year, 1 Carnegie Unit)

**AGRIBUSINESS AND ENTREPRENEURSHIP TECHNOLOGY
COURSE OUTLINE**

<u>Unit No.</u>	<u>Title</u>	<u>No. of Hours</u>
Unit 1	Introduction to Agribusiness and Entrepreneurship	7
Unit 2	Developing Personal Financial Management	12
Unit 3	Conducting a Business Inventory	7
Unit 4	Using the Balance Sheet	7
Unit 5	Using an Income Statement	7
Unit 6	Preparing a Statement of Cash Flows	7
Unit 7	Preparing a Statement of Owner Equity	7
Unit 8	Analyzing Financial Performance	7
Unit 9	Implementing Planning and Decision Making Procedures	10
Unit 10	Explaining Business Borrowing/Investing Practices	7
Unit 11	Managing Business and Self-Employment Taxes	7
Unit 12	Applying Legal Concepts	7
Unit 13	Using Management Information Systems	10
Unit 14	Planning and Conducting Marketing	10

AGRIBUSINESS AND ENTREPRENEURSHIP TECHNOLOGY
UNIT 1: INTRODUCTION TO AGRIBUSINESS AND
ENTREPRENEURSHIP

(7 hours)

Competencies and Suggested Objectives:

1. Describe terms associated with agribusiness and entrepreneurship.
 - a. Define terms associated with agribusiness.
 - b. Define terms associated with entrepreneurship.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP2, WP3, WP6, WP7, WP8
2. Explain types of business organizations.
 - a. Identify the types of business organizations.
 - b. Identify characteristics of business organizations.
 - c. Describe the advantages and disadvantages of different types of business organizations.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP6, WP7, WP8
3. Describe concepts of entrepreneurship.
 - a. Describe the characteristics of successful entrepreneurs.
 - b. Discuss the advantages and disadvantages of being an entrepreneur.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Describe terms associated with agribusiness and entrepreneurship.*
 - a. *Oral/Written assignment to define terms associated with agribusiness.*
 - b. *Oral/Written assignment to define terms associated with entrepreneurship.*
2. *Explain types of business organizations.*
 - a. *Oral/Written report to identify the types of business organizations.*
 - b. *Oral/Written report to identify characteristics of business organizations.*
 - c. *Oral/Written report to describe the advantages and disadvantages of different types of business organizations.*
3. *Describe concepts of entrepreneurship.*
 - a. *Oral/Written report to describe the characteristics of successful entrepreneurs.*
 - b. *Oral/Written report to discuss the advantages and disadvantages of being an entrepreneur.*

Suggested Assessment Strategies:

1. *Describe terms associated with agribusiness and entrepreneurship.*
 - a. *Test - Define terms associated with agribusiness.*
 - b. *Test - Define terms associated with entrepreneurship.*
2. *Explain types of business organizations.*

- a. *Test - Identify the types of business organizations.*
 - b. *Test - Identify characteristics of business organizations.*
 - c. *Test - Describe the advantages and disadvantages of different types of business organizations.*
- 3. *Describe concepts of entrepreneurship.*
 - a. *Test - Describe the characteristics of successful entrepreneurs.*
 - b. *Test - Discuss the advantages and disadvantages of being an entrepreneur.*

Suggested Resources:

Decisions and dollars. (Latest ed.). Alexandria, VA: The Council on Agricultural Education.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Text). Albany, NY: Delmar.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Electronic Record Book). Albany, NY: Delmar.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Instructor's Guide). Albany, NY: Delmar.

Hamilton, W. H., Connelly, D.F., & Doster, H. D. Agribusiness: An entrepreneurial approach (Latest ed.). New York: Delmar.

Moorman, J. W., & Halloran, J. W. Entrepreneurship (Latest ed.). Cincinnati: Southwestern.

Newman, M. E., & Wills, W. J. Agribusiness management and entrepreneurship (Latest ed.). Danville, IL: Interstate.

Stewart, J., & Jobes, R. Farm and ranch business management: An introduction to sound management practices (Latest ed.). Moline, IL: Deere & Co.

The Agricultural Educator. (Software). Brighton, IL: AgriSolutions.

AGRIBUSINESS AND ENTREPRENEURSHIP TECHNOLOGY
UNIT 2: DEVELOPING PERSONAL FINANCIAL MANAGEMENT

(12 hours)

Competencies and Suggested Objectives:

1. Explain personal financial management.
 - a. Describe the importance of personal financial management.
 - b. Oral/written assignment to categorize personal income and expenses.
 - c. Practical exercise to prepare a personal budget.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
2. Describe how to manage a personal checking and savings account.
 - a. Identify types of checking and savings accounts.
 - b. Maintain a checking and savings register.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
3. Describe personal investment opportunities.
 - a. Identify types of investments with reasons for each.
 - b. Explain the concepts of simple and compound interest.
 - c. Calculate the future value of money.
 - d. Establish personal goals for savings and investments.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
4. Explain procedures for use of personal credit.
 - a. Identify the types and sources of credit.
 - b. Describe procedures for obtaining credit.
 - c. Demonstrate procedures for wise use of personal credit.
 - d. Relate personal financial management skills to supervised experience and business.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
5. Describe use of personal insurance.
 - a. Identify types of medical insurance.
 - b. Identify types of life insurance.
 - c. Identify types of property and casualty insurance.
 - d. Develop a proposed personal insurance portfolio.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Explain personal financial management.*
 - a. *Oral/Written assignment to describe the importance of personal financial management.*
 - b. *Practical exercise to categorize personal income and expenses.*
 - c. *Practical exercise to prepare a personal budget.*
2. *Describe how to manage a personal checking and savings account.*
 - a. *Oral/Written assignment to identify types of checking and savings accounts.*
 - b. *Practical exercise to maintain a checking and savings register.*
3. *Describe personal investment opportunities.*
 - a. *Oral/Written assignment to identify types of investments with reasons for each.*
 - b. *Oral/Written assignment to explain the concepts of simple and compound interest.*
 - c. *Practical exercise to calculate the future value of money.*
 - d. *Establish personal goals for savings and investments.*
4. *Explain procedures for use of personal credit.*
 - a. *Oral/Written assignment to identify the types and sources of credit.*
 - b. *Oral/Written assignment to describe procedures for obtaining credit.*
 - c. *Practical exercise to demonstrate procedures for wise use of personal credit.*
 - d. *Practical exercise to relate personal financial management skills to supervised experience and business.*
5. *Describe use of personal insurance.*
 - a. *Oral/Written assignment to identify types of medical insurance.*
 - b. *Oral/Written assignment to identify types of life insurance.*
 - c. *Oral/Written assignment to identify types of property and casualty insurance.*
 - d. *Practical exercise to develop a proposed personal insurance portfolio.*

Suggested Assessment Strategies:

1. *Explain personal financial management.*
 - a. *Oral/Written Report - Explain the importance of personal financial management.*
 - b. *Oral/Written Report - Categorize personal income and expenses.*
 - c. *Practical Activity - Prepare a personal budget.*
2. *Describe how to manage a personal checking and savings account.*
 - a. *Oral/Written Report - Identify types of checking and savings accounts.*
 - b. *Practical Activity - Maintain a checking and savings register.*
3. *Describe personal investment opportunities.*
 - a. *Oral/Written Report - Identify types of investments with reasons for each.*
 - b. *Oral/written Report - Explain the concepts of simple and compound interest.*
 - c. *Practical Activity - Calculate the future value of money.*
 - d. *Practical Activity - Establish personal goals for savings and investments.*
4. *Explain procedures for use of personal credit.*
 - a. *Oral/Written Report - Identify the types and sources of credit.*
 - b. *Oral/Written Report - Describe procedures for obtaining credit.*

- c. Practical Activity - Demonstrate procedures for wise use of personal credit.*
 - d. Practical Activity - Relate personal financial management skills to supervised experience and business.*
- 5. *Describe use of personal insurance.*
 - a. Oral/Written Report - Identify types of medical insurance.*
 - b. Oral/Written Report - Identify types of life insurance.*
 - c. Oral/Written Report - Identify types of property and casualty insurance.*
 - d. Practical Activity - Develop a proposed personal insurance portfolio.*

Suggested Resources:

Decisions and dollars. (Latest ed.). Alexandria, VA: The Council on Agricultural Education.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Text) Albany, NY: Delmar.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Electronic Record Book) Albany, NY: Delmar.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Instructor's Guide) Albany, NY: Delmar.

The Agricultural Educator. (Software). Brighton, IL: AgriSolutions.

AGRIBUSINESS AND ENTREPRENEURSHIP TECHNOLOGY
UNIT 3: CONDUCTING A BUSINESS INVENTORY

(7 hours)

Competencies and Suggested Objectives:

1. Explain the importance of an accurate inventory.
 - a. Identify the specific uses of an inventory.
 - b. Describe the specific uses of an inventory.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
2. Determine when to inventory.
 - a. Distinguish timing of inventory according to fiscal year.
 - b. Distinguish timing of inventory according to calendar year.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
3. Determine what to inventory.
 - a. Distinguish among liquid assets, consumable supplies, and capital assets.
 - b. Account for liabilities.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
4. Establish inventory values.
 - a. Calculate inventory values of non-depreciable assets.
 - b. Calculate inventory values of depreciable assets.
 - c. Describe methods of depreciation.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Explain the importance of an accurate inventory.*
 - a. *Oral/Written assignment to identify the specific uses of an inventory.*
 - b. *Oral/Written assignment to describe the specific uses of an inventory.*
2. *Determine when to inventory.*
 - a. *Oral/Written assignment to distinguish timing of inventory according to fiscal year.*
 - b. *Oral/Written assignment to distinguish timing of inventory according to calendar year.*
3. *Determine what to inventory.*
 - a. *Oral/Written assignment to distinguish among liquid assets, consumable supplies, and capital assets.*
 - b. *Oral/Written assignment to account for liabilities.*

4. *Establish inventory values.*
 - a. *Practical exercise to calculate inventory values of non-depreciable assets.*
 - b. *Practical exercise to calculate inventory values of depreciable assets.*
 - c. *Oral/Written assignment to describe methods of depreciation.*

Suggested Assessment Strategies:

1. *Explain the importance of an accurate inventory.*
 - a. *Test - Identify the specific uses of an inventory.*
 - b. *Test - Describe the specific uses of an inventory.*
2. *Determine when to inventory.*
 - a. *Oral/Written Report - Distinguish timing of inventory according to fiscal year.*
 - b. *Oral/Written Report - Distinguish timing of inventory according to calendar year.*
3. *Determine what to inventory.*
 - a. *Oral/Written Report - Distinguish among liquid assets, consumable supplies, and capital assets.*
 - b. *Oral/Written Report - Account for liabilities.*
4. *Establish inventory values.*
 - a. *Practical Activity - Calculate inventory values of non-depreciable assets.*
 - b. *Practical Activity - Calculate inventory values of depreciable assets.*
 - c. *Oral/Written Report - Describe methods of depreciation.*

Suggested Resources:

Decisions and dollars. (Latest ed.). Alexandria, VA: The Council on Agricultural Education.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Text). Albany, NY: Delmar.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Electronic Record Book). Albany, NY: Delmar.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Instructor's Guide). Albany, NY: Delmar.

AGRIBUSINESS AND ENTREPRENEURSHIP TECHNOLOGY
UNIT 4: USING THE BALANCE SHEET

(7 hours)

Competencies and Suggested Objectives:

1. Describe the purpose of a balance sheet.
 - a. Explain the uses of a balance sheet.
 - b. Explain the timing of preparing a balance sheet.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
2. Explain the relationship of a balance sheet with other base financial statements.
 - a. Describe the relationship between a balance sheet and an income statement.
 - b. Describe the relationship between a balance sheet and a statement of cash flow.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
3. Describe the major areas of a balance sheet.
 - a. Identify each of the areas of a balance sheet.
 - b. Describe structure and components of a balance sheet.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
4. Complete a balance sheet.
 - a. Identify assets.
 - b. Identify liabilities.
 - c. Calculate owner equity.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Describe the purpose of a balance sheet.*
 - a. *Oral/Written assignment to explain the uses of a balance sheet.*
 - b. *Oral/Written assignment to explain the timing of preparing a balance sheet.*
2. *Explain the relationship of a balance sheet with other base financial statements.*
 - a. *Oral/Written assignment to describe the relationship between a balance sheet and an income statement.*
 - b. *Oral/Written assignment to describe the relationship between a balance sheet and a statement of cash flow.*
3. *Describe the major areas of a balance sheet.*
 - a. *Oral/Written assignment to identify each of the areas of a balance sheet.*
 - b. *Oral/Written assignment to describe structure and components of a balance*

- sheet.
4. Complete a balance sheet.
 - a. Practical exercise to identify assets.
 - b. Practical exercise to identify liabilities.
 - c. Practical exercise to calculate owner equity.

Suggested Assessment Strategies:

1. Describe the purpose of a balance sheet.
 - a. Oral/Written Report - Explain the uses of a balance sheet.
 - b. Oral/Written Report - Explain the timing of preparing a balance sheet.
2. Explain the relationship of a balance sheet with other base financial statements.
 - a. Oral/Written Report - Describe the relationship between a balance sheet and an income statement.
 - b. Oral/Written Report - Describe the relationship between a balance sheet and a statement of cash flow.
3. Describe the major areas of a balance sheet.
 - a. Oral/Written Report - Identify each of the areas of a balance sheet.
 - b. Oral/Written Report - Describe structure and components of a balance sheet.
4. Complete a balance sheet.
 - a. Practical Activity - Identify assets.
 - b. Practical Activity - Identify liabilities.
 - c. Practical Activity - Calculate owner equity.

Suggested Resources:

Decisions and dollars. (Latest ed.). Alexandria, VA: The Council on Agricultural Education.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Text). Albany, NY: Delmar.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Electronic Record Book). Albany, NY: Delmar.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Instructor's Guide). Albany, NY: Delmar.

The Agricultural Educator. (Software). Brighton, IL: AgriSolutions.

AGRIBUSINESS AND ENTREPRENEURSHIP TECHNOLOGY
UNIT 5: USING AN INCOME STATEMENT

(7 hours)

Competencies and Suggested Objectives:

1. Analyze an income statement.
 - a. Summarize revenues and expenses.
 - b. Determine profit and/or loss.
 - c. Explain changes in owner equity.
 - d. Calculate financial measures of profitability, financial efficiency, and repayment capacity.
 - e. Use an income statement to support a loan application.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
2. Establish the relationship of an income statement with other base financial statements.
 - a. Describe the relationship between an income statement and a balance sheet.
 - b. Describe the relationship between an income statement and a statement of cash flow.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
3. Differentiate between cash and accrual accounting.
 - a. Define cash accounting system.
 - b. Define accrual accounting system.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Analyze an income statement.*
 - a. *Practical exercise to summarize revenues and expenses.*
 - b. *Practical exercise to determine profit and/or loss.*
 - c. *Practical exercise to explain changes in owner equity.*
 - d. *Practical exercise to calculate financial measures of profitability, financial efficiency, and repayment capacity.*
 - e. *Practical exercise to use an income statement to support a loan application.*
2. *Establish the relationship of an income statement with other base financial statements.*
 - a. *Oral/written assignment to describe the relationship between an income statement and a balance sheet.*
 - b. *Oral/Written assignment to describe the relationship between an income statement and a statement of cash flow.*

3. *Differentiate between cash and accrual accounting.*
 - a. *Oral/Written assignment to define cash accounting system.*
 - b. *Oral/Written assignment to define accrual accounting system.*

Suggested Assessment Strategies:

1. *Analyze an income statement.*
 - a. *Practical Activity - Summarize revenues and expenses.*
 - b. *Practical Activity - Determine profit and/or loss.*
 - c. *Practical Activity - Explain changes in owner equity.*
 - d. *Practical Activity - Calculate financial measures of profitability, financial efficiency, and repayment capacity.*
 - e. *Practical Activity - Use an income statement to support a loan application.*
2. *Establish the relationship of an income statement with other base financial statements.*
 - a. *Oral/Written Report - Describe the relationship between an income statement and a balance sheet.*
 - b. *Oral/Written Report - Describe the relationship between an income statement and a statement of cash flow.*
3. *Differentiate between cash and accrual accounting.*
 - a. *Oral/Written Report - Define cash accounting system.*
 - b. *Oral/Written Report - Define accrual accounting system.*

Suggested Resources:

Decisions and dollars. (Latest ed.). Alexandria, VA: The Council on Agricultural Education.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Text). Albany, NY: Delmar.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Electronic Record Book). Albany, NY: Delmar.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Instructor's Guide). Albany, NY: Delmar.

The Agricultural Educator. (Software). Brighton, IL: AgriSolutions.

AGRIBUSINESS AND ENTREPRENEURSHIP TECHNOLOGY UNIT 6: PREPARING A STATEMENT OF CASH FLOWS

(7 hours)

Competencies and Suggested Objectives:

1. Compare statement of cash flows versus cash flow statement.
 - a. Describe the differences between a statement of cash flows and a cash flow

- statement.
- b. Describe uses for a statement of cash flows.
- c. Describe uses for a cash flow statement.
- Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6*
- Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP6, WP7, WP8*
- 2. Describe the relationship of statement of cash flows with other base financial statements.
 - a. Describe the relationship between a statement of cash flows and a balance sheet.
 - b. Describe the relationship between a statement of cash flows and an income statement.
 - Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6*
 - Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP6, WP7, WP8*
- 3. Explain sources of cash flow.
 - a. Identify sources of cash flow.
 - b. Distinguish between sources of cash flow.
 - c. Identify a financial activity associated with cash flow.
 - Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6*
 - Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP6, WP7, WP8*

Suggested Teaching Strategies:

- 1. Compare statement of cash flows versus cash flow statement.
 - a. Oral/Written assignment to describe the differences between a statement of cash flows and a cash flow statement.
 - b. Oral/Written assignment to describe uses for a statement of cash flows.
 - c. Oral/Written assignment to describe uses for a cash flow statement.
- 2. Describe the relationship of statement of cash flows with other base financial statements.
 - a. Oral/Written assignment to describe the relationship between a statement of cash flows and a balance sheet.
 - b. Oral/Written assignment to describe the relationship between a statement of cash flows and an income statement.
- 3. Explain sources of cash flow.
 - a. Oral/Written assignment to identify sources of cash flow.
 - b. Oral/Written assignment to distinguish between sources of cash flow.
 - c. Oral/Written assignment to identify a financial activity associated with cash flow.

Suggested Assessment Strategies:

- 1. Compare statement of cash flows versus cash flow statement.
 - a. Test - Describe the differences between a statement of cash flows and a cash flow statement.
 - b. Test - Describe uses for a statement of cash flows.
 - c. Test - Describe uses for a cash flow statement.

2. *Describe the relationship of statement of cash flows with other base financial statements.*
 - a. *Test - Describe the relationship between a statement of cash flows and a balance sheet.*
 - b. *Test - Describe the relationship between a statement of cash flows and an income statement.*
3. *Explain sources of cash flow.*
 - a. *Oral/Written Report - Identify sources of cash flow.*
 - b. *Oral/Written Report - Distinguish between sources of cash flow.*
 - c. *Oral/Written Report - Identify a financial activity associated with cash flow.*

Suggested Resources:

Decisions and dollars. (Latest ed.). Alexandria, VA: The Council on Agricultural Education.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Text). Albany, NY: Delmar.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Electronic Record Book). Albany, NY: Delmar.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Instructor's Guide). Albany, NY: Delmar.

The Agricultural Educator. (Software). Brighton, IL: AgriSolutions.

AGRIBUSINESS AND ENTREPRENEURSHIP TECHNOLOGY
UNIT 7: PREPARING A STATEMENT OF OWNER EQUITY

(7 hours)

Competencies and Suggested Objectives:

1. Describe the purposes of a statement of owner equity.
 - a. Identify the purposes of a statement of owner equity.
 - b. Analyze possible changes in total owner equity.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
2. Describe the relationship of a statement of owner equity with other base financial statements.
 - a. Utilize a balance sheet and an income statement to reconcile owner equity.
 - b. Utilize a statement of cash flows to reconcile owner equity.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Describe the purposes of a statement of owner equity.*
 - a. *Oral/written assignment to identify the purposes of a statement of owner equity.*
 - b. *Practical exercise to analyze possible changes in total owner equity.*
2. *Describe the relationship of a statement of owner equity with other base financial statements.*
 - a. *Practical exercise to utilize a balance sheet and an income statement to reconcile owner equity.*
 - b. *Practical exercise to utilize a statement of cash flows to reconcile owner equity.*

Suggested Assessment Strategies:

1. *Describe the purposes of a statement of owner equity.*
 - a. *Oral/Written Report - Identify the purposes of a statement of owner equity.*
 - b. *Practical Activity - Analyze possible changes in total owner equity.*
2. *Describe the relationship of a statement of owner equity with other base financial statements.*
 - a. *Practical Activity - Utilize a balance sheet and an income statement to reconcile owner equity.*
 - b. *Practical Activity - Utilize a statement of cash flows to reconcile owner equity.*

Suggested Resources:

Decisions and dollars. (Latest ed.). Alexandria, VA: The Council on Agricultural Education.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Text). Albany, NY: Delmar.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Electronic Record Book). Albany, NY: Delmar.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Instructor's Guide). Albany, NY: Delmar.

The Agricultural Educator. (Software). Brighton, IL: AgriSolutions.

AGRIBUSINESS AND ENTREPRENEURSHIP TECHNOLOGY
UNIT 8: ANALYZING FINANCIAL PERFORMANCE

(7 hours)

Competencies and Suggested Objectives:

1. Identify key areas of financial analysis.
 - a. Determine liquidity.
 - b. Determine solvency.
 - c. Determine profitability.
 - d. Establish repayment capacity.
 - e. Analyze financial efficiency.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
2. Identify guidelines for applying the use of financial measures.
 - a. Identify limitations in using and comparing various financial measures of financial condition.
 - b. Interpret the various financial criteria which determine the condition and performance of a business.
 - c. Project future business trends.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Identify key areas of financial analysis.*
 - a. *Practical exercise to determine liquidity.*
 - b. *Practical exercise to determine solvency.*
 - c. *Practical exercise to determine profitability.*
 - d. *Practical exercise to establish repayment capacity.*
 - e. *Practical exercise to analyze financial efficiency.*
2. *Identify guidelines for applying the use of financial measures.*
 - a. *Oral/Written assignment to identify limitations in using and comparing various financial measures of financial condition.*
 - b. *Oral/Written assignment to interpret the various financial criteria which determine the condition and performance of a business.*
 - c. *Practical exercise to project future business trends.*

Suggested Assessment Strategies:

1. *Identify key areas of financial analysis.*
 - a. *Practical Activity - Determine liquidity.*
 - b. *Practical Activity - Determine solvency.*
 - c. *Practical Activity - Determine profitability.*

- d. *Practical Activity - Establish repayment capacity.*
 - e. *Practical Activity - Analyze financial efficiency.*
 - 2. *Identify guidelines for applying the use of financial measures.*
 - a. *Oral/Written Report - Identify limitations in using and comparing various financial measures of financial condition.*
 - b. *Oral/Written Report - Interpret the various financial criteria which determine the condition and performance of a business.*
 - c. *Practical Activity - Project future business trends.*

Suggested Resources:

Decisions and dollars. (Latest ed.). Alexandria, VA: The Council on Agricultural Education.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Text). Albany, NY: Delmar.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Electronic Record Book). Albany, NY: Delmar.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Instructor's Guide). Albany, NY: Delmar.

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AGRIBUSINESS AND ENTREPRENEURSHIP TECHNOLOGY
UNIT 9: IMPLEMENTING PLANNING AND
DECISION MAKING PROCEDURES

(10 hours)

Competencies and Suggested Objectives:

1. Identify steps in the decision making process.
 - a. Define steps in the decision making process.
 - b. Establish relationships between the steps in the decision making process.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP6, WP7, WP8
2. Describe the purposes of a budget.
 - a. Identify the purposes of a budget.
 - b. Identify the components of a budget.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP6, WP7, WP8
3. Prepare budgets.
 - a. Conduct systematic planning using the decision making process.
 - b. Prepare a budget.

Related Academic Topics See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Identify steps in the decision making process.*
 - a. *Oral/Written assignment to define steps in the decision making process.*
 - b. *Oral/Written assignment to establish relationships between the steps in the decision making process.*
2. *Describe the purposes of a budget.*
 - a. *Oral/Written assignment to identify the purposes of a budget.*
 - b. *Oral/Written assignment to identify the components of a budget.*
3. *Prepare budgets.*
 - a. *Practical exercise to conduct systematic planning using the decision making process.*
 - b. *Practical exercise to prepare a budget.*

Suggested Assessment Strategies:

1. *Identify steps in the decision making process.*
 - a. *Oral/Written assignment to define steps in the decision making process.*
 - b. *Oral/Written assignment to establish relationships between the steps in the decision making process.*
2. *Describe the purposes of a budget.*
 - a. *Oral/Written assignment to identify the purposes of a budget.*

- b. Oral/Written assignment to identify the components of a budget.*
- 3. *Prepare budgets.*
 - a. Practical Activity - Conduct systematic planning using the decision making process.*
 - b. Practical Activity - Prepare a budget.*

Suggested Resources:

Decisions and dollars. (Latest ed.). Alexandria, VA: The Council on Agricultural Education.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Text). Albany, NY: Delmar.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Electronic Record Book). Albany, NY: Delmar.

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AGRIBUSINESS AND ENTREPRENEURSHIP TECHNOLOGY
UNIT 10: EXPLAINING BUSINESS
BORROWING/INVESTING PRACTICES

(7 hours)

Competencies and Suggested Objectives:

1. Describe types of capital.
 - a. Identify different types of capital.
 - b. Describe uses of different types of capital.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP6, WP7, WP8
2. Describe borrowing and decision making.
 - a. Use tools for evaluating capital needs.
 - b. Evaluate risks associated with borrowing.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
3. Describe loan options.
 - a. Identify different types of loan options.
 - b. Identify sources of loan funds.
 - c. Calculate the cost of borrowing.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Describe types of capital.*
 - a. *Oral/Written assignment to identify different types of capital.*
 - b. *Oral/Written assignment to describe uses of different types of capital.*
2. *Describe borrowing and decision making.*
 - a. *Practical exercise to use tools for evaluating capital needs.*
 - b. *Practical exercise to evaluate risks associated with borrowing.*
3. *Describe loan options.*
 - a. *Practical exercise to identify different types of loan options.*
 - b. *Practical exercise to identify sources of loan funds.*
 - c. *Practical exercise to calculate the cost of borrowing.*

Suggested Assessment Strategies:

1. *Describe types of capital.*
 - a. *Practical Activity - Identify different types of capital.*
 - b. *Practical Activity - Describe different types of capital.*

2. *Describe borrowing and decision making.*
 - a. *Practical Activity - Use tools for evaluating capital needs.*
 - b. *Practical Activity - Evaluate risks associated with borrowing.*
3. *Describe loan options.*
 - a. *Practical Activity - Identify different types of loan options.*
 - b. *Practical Activity - Identify sources of loan funds.*
 - c. *Practical Activity - Calculate the cost of borrowing.*

Suggested Resources:

Decisions and dollars. (Latest ed.). Alexandria, VA: The Council on Agricultural Education.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Text). Albany, NY: Delmar.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Electronic Record Book). Albany, NY: Delmar.

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AGRIBUSINESS AND ENTREPRENEURSHIP TECHNOLOGY

UNIT 11: MANAGING BUSINESS AND SELF-EMPLOYMENT TAXES

(7 hours)

Competencies and Suggested Objectives:

1. Identify documents filed with an employer.
 - a. Identify payroll tax documents to be filed with an employer.
 - b. Prepare documents necessary for tax withholding.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
2. Calculate take-home pay.
 - a. Determine gross wages.
 - b. Determine taxes and withholdings.
 - c. Calculate net pay and net income.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
3. File business income tax returns.
 - a. Identify business tax requirements.
 - b. Collect data for filing business income tax returns.
 - c. Select appropriate forms for filing business income tax returns.
 - d. Complete forms as required.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Identify documents filed with an employer.*
 - a. *Practical exercise to identify payroll tax documents to be filed with an employer.*
 - b. *Practical exercise to prepare documents necessary for tax withholding.*
2. *Calculate take-home pay.*
 - a. *Practical exercise to determine gross wages.*
 - b. *Practical exercise to determine taxes and withholdings.*
 - c. *Practical exercise to calculate net pay and net income.*
3. *File business income tax returns.*
 - a. *Practical exercise to identify business tax requirements.*
 - b. *Practical exercise to collect data for filing business income tax returns.*
 - c. *Practical exercise to select appropriate forms for filing business income tax returns.*
 - d. *Practical exercise to complete forms as required.*

Suggested Assessment Strategies:

1. *Identify documents filed with an employer.*
 - a. *Practical Activity - Identify payroll tax documents to be filed with an employer.*
 - b. *Practical Activity - Prepare documents necessary for tax withholding.*
2. *Calculate take-home pay.*
 - a. *Practical Activity - Determine gross wages.*
 - b. *Practical Activity - Determine taxes and withholdings.*
 - c. *Practical Activity - Calculate net pay and net income.*
3. *File business income tax returns.*
 - a. *Practical Activity - Identify business tax requirements.*
 - b. *Practical Activity - Collect data for filing business income tax returns.*
 - c. *Practical Activity - Select appropriate forms for filing business income tax returns.*
 - d. *Practical Activity - Complete forms as required.*

Suggested Resources:

Decisions and dollars. (Latest ed.). Alexandria, VA: The Council on Agricultural Education.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Text). Albany, NY: Delmar.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Electronic Record Book). Albany, NY: Delmar.

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The Agricultural Educator. (Software). Brighton, IL: AgriSolutions.

AGRIBUSINESS AND ENTREPRENEURSHIP TECHNOLOGY
UNIT 12: APPLYING LEGAL CONCEPTS

(7 hours)

Competencies and Suggested Objectives:

1. Describe legal aspects of business transactions.
 - a. Identify common legal documents.
 - b. Identify applications of legal documents, such as contracts, mortgage, promissory notes, bill of sale, leases, and deeds.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP6, WP7, WP8
2. Identify types of laws related to business.
 - a. Identify forms of taxation.
 - b. Describe the need for permits and licensing.
 - c. Identify the types of insurance required in business.
 - d. Describe liability and negligence as related to business.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP6, WP7, WP8
3. Describe health and safety regulations regarding agribusinesses.
 - a. Identify local, state, and federal agencies responsible for employee health and safety regulations.
 - b. Describe sources of information regarding health and safety regulations.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Describe legal aspects of business transactions.*
 - a. *Oral/Written assignment to identify common legal documents.*
 - b. *Oral/Written assignment to identify applications of legal documents, such as contracts, mortgage, promissory notes, bill of sale, leases, and deeds.*
2. *Identify types of laws related to business.*
 - a. *Oral/Written assignment to identify forms of taxation.*
 - b. *Oral/Written assignment to describe the need for permits and licensing.*
 - c. *Practical exercise to identify the types of insurance required in business.*
 - d. *Oral/Written assignment to describe liability and negligence as related to business.*
3. *Describe health and safety regulations regarding agribusinesses.*
 - a. *Oral/Written assignment to identify local, state, and federal agencies responsible for employee health and safety regulations.*
 - b. *Oral/Written assignment to describe sources of information regarding health and safety regulations.*

Suggested Assessment Strategies:

1. *Describe legal aspects of business transactions.*

- a. *Oral/Written Report - Identify common legal documents.*
 - b. *Oral/Written Report - Identify applications of legal documents, such as contracts, mortgage, promissory notes, bill of sale, leases, and deeds.*
2. *Identify types of laws related to business.*
 - a. *Oral/Written Report - Identify forms of taxation.*
 - b. *Oral/Written Report - Describe the need for permits and licensing.*
 - c. *Practical Activity - Identify the types of insurance required in business.*
 - d. *Oral/Written Report - Describe liability and negligence as related to business.*
3. *Describe health and safety regulations regarding agribusinesses.*
 - a. *Oral/Written Report - Identify local, state, and federal agencies responsible for employee health and safety regulations.*
 - b. *Oral/Written Report - Describe sources of information regarding health and safety regulations.*

Suggested Resources:

Decisions and dollars. (Latest ed.). Alexandria, VA: The Council on Agricultural Education.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Text). Albany, NY: Delmar.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Electronic Record Book). Albany, NY: Delmar.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Instructor's Guide). Albany, NY: Delmar.

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AGRIBUSINESS AND ENTREPRENEURSHIP TECHNOLOGY
UNIT 13: USING MANAGEMENT INFORMATION SYSTEMS

(10 hours)

Competencies and Suggested Objectives:

1. Describe management information systems.
 - a. Identify components of the management system.
 - b. Collect and record data for the management information system.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
2. Complete forms for management information.
 - a. Use information in the system to complete business documents.
 - b. Use information in the system to complete supervised experience documents.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Describe management information systems.*
 - a. *Oral/Written assignment to identify components of the management system.*
 - b. *Practical exercise to collect and record data for the management information system.*
2. *Complete forms for management information.*
 - a. *Practical exercise to use information in the system to complete business documents.*
 - b. *Practical exercise to use information in the system to complete supervised experience documents.*

Suggested Assessment Strategies:

1. *Describe management information systems.*
 - a. *Oral/Written Report - Identify components of the management system.*
 - b. *Practical Activity - Collect and record data for the management information system.*
2. *Complete forms for management information.*
 - a. *Practical Activity - Use information in the system to complete business documents.*
 - b. *Practical Activity - Use information in the system to complete supervised experience documents.*

Suggested Resources:

Decisions and dollars. (Latest ed.). Alexandria, VA: The Council on Agricultural

Education.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Text). Albany, NY: Delmar.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Electronic Record Book). Albany, NY: Delmar.

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AGRIBUSINESS AND ENTREPRENEURSHIP TECHNOLOGY
UNIT 14: PLANNING AND CONDUCTING MARKETING

(10 hours)

Competencies and Suggested Objectives:

1. Develop a marketing plan.
 - a. Identify the components of a marketing plan.
 - b. Develop a marketing plan.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
2. Explore international marketing opportunities.
 - a. Explore the importance of international marketing trade.
 - b. Describe economic and legal issues of international trade.
 - c. Investigate the process of trading agricultural products in international markets.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8

Suggested Teaching Strategies:

1. *Develop a marketing plan.*
 - a. *Oral/Written assignment to identify the components of a marketing plan.*
 - b. *Practical exercise to develop a marketing plan.*
2. *Explore international marketing opportunities.*
 - a. *Oral/Written assignment to explore the importance of international marketing trade.*
 - b. *Oral/Written assignment to describe economic and legal issues of international trade.*
 - c. *Practical exercise to investigate the process of trading agricultural products in international markets.*

Suggested Assessment Strategies:

1. *Develop a marketing plan.*
 - a. *Oral/Written Report - Identify the components of a marketing plan.*
 - b. *Practical exercise to develop a marketing plan.*
2. *Explore international marketing opportunities.*
 - a. *Oral/Written Report - Explore the importance of international marketing trade.*
 - b. *Oral/Written Report - Describe economic and legal issues of international trade.*
 - c. *Practical Activity - Investigate the process of trading agricultural products in international markets.*

Suggested Resources:

Decisions and dollars. (Latest ed.). Alexandria, VA: The Council on Agricultural

Education.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Text). Albany, NY: Delmar.

Elliot, J. (1998). Agribusiness: Decisions and dollars. (Electronic Record Book). Albany, NY: Delmar.

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SECTION VIII:
CURRICULUM FRAMEWORK
FOR
AGRICULTURAL AND ENVIRONMENTAL SCIENCE AND TECHNOLOGY

June 21, 2002

CURRICULUM FRAMEWORK

Course Name: Concepts of Agriscience Technology

Course CIP Code: 02.9999

Course Description: Concepts of Agriscience Technology is a course to introduce students to the sciences, technologies, and applied practices of the progressive agriculture/agriscience industry. Emphasis is on an active learning environment enriched with technology and science-based applications. The course serves as the entry-level course for other courses in agriculture, including horticulture and forestry. The focus is to begin the preparation of students for further study leading to successful careers in the agricultural industry. (Grades 9-10; 1 Carnegie Unit)

Competencies and Suggested Objectives:

1. Examine the nature of the agricultural industry.
 - a. Explain the meaning of agriculture.
 - b. Identify and define the major areas of agriculture in the agricultural industry.
 - c. Describe the role of agriculture in the quality of human life and meeting human needs.
 - d. Explain the importance of education and training in the agricultural industry.

Related Academic Topics (See Appendix A): C1, C2, C4
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
2. Examine the relationships among the sciences, agriculture, and agriscience.
 - a. Describe the different areas of pure science.
 - b. Describe the applied sciences as related to agriculture.
 - c. Investigate the role of physical science in agriculture.
 - d. Describe the broad areas of agriculture.
 - e. Discuss the concept of agriscience and its relationships to the sciences and agriculture.
 - f. Use the scientific method to conduct research.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
3. Examine the size and scope of the total industry of agriculture from the global to local level.
 - a. Describe the role of agriculture in the global economy.
 - b. Describe the role of agriculture in the United States economy.
 - c. Describe the role of agriculture in the Mississippi economy.
 - d. Describe the role of agriculture in the local economy.

Related Academic Topics (See Appendix A): C1, C2, C4, C6, M7, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
4. Investigate current and emerging trends related to agriculture/agriscience.
 - a. Identify sources of information on current and emerging trends in agriculture/agriscience.
 - b. Discuss examples of new and emerging trends and practices in

agriculture/agriculture/agriculture.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

5. Examine standard agricultural safety and work practices.
 - a. Identify safety and work standards for the agricultural classroom and laboratory.
 - b. Identify on-the-farm safety and work standards.
 - c. Identify agricultural industry related safety and work standards.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
6. Examine the role of FFA in agricultural education.
 - a. Examine the history of the FFA.
 - b. Examine the types and degrees of membership in FFA.
 - c. Identify the leadership development and career opportunities in FFA.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP2, WP3, WP6, WP7, WP8
7. Examine the concept of leadership.
 - a. Explain the role of effective leadership.
 - b. List and discuss major traits of effective leaders.
 - c. Develop a plan for developing personal leadership qualities.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP2, WP3, WP6, WP7, WP8
8. Develop interpersonal skills necessary for successful careers.
 - a. Identify and describe essential interpersonal skills.
 - b. Explain the concepts of team building and team member participation.
 - c. Participate in communication exercise(s) to build interpersonal communication skills.
 - d. Demonstrate skills in parliamentary procedure.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP2, WP3, WP6, WP7, WP8
9. Describe the role of work ethics and values in establishing and building a successful career.
 - a. Identify and describe universally accepted work ethics and values.
 - b. Practice work ethics and values in the agriscience classroom and lab. (ongoing)

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP2, WP3, WP6, WP7, WP8
10. Explain basic concepts associated with supervised experience.
 - a. Describe the purpose and benefits of supervised experience in agriscience.
 - b. Identify and describe the types of supervised experience.
 - c. Identify personal interests associated with selecting a supervised experience.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP4, WP6, WP7, WP8
11. Plan supervised experience(s).
 - a. Identify long-range and short-range goals of supervised experience.
 - b. Identify resources and opportunities for supervised experience to include a

- training agreement and a net worth statement.
 - c. Develop a plan for conducting supervised experience during the current year.
Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP4, WP6, WP7, WP8
12. Implement and evaluate a supervised experience.
 - a. Identify records required for each type of supervised experience and discuss their purpose.
 - b. Maintain records of supervised experience.
 - c. Prepare an end-of-the-year summary of the supervised experience.
Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP4, WP6, WP7, WP8
13. Explore the animal agriculture industry and enterprises.
 - a. Identify ways animals benefit people.
 - b. Describe the different classes of domestic animals, including food animals.
 - c. Identify and discuss the major animal industry enterprises including poultry and eggs, catfish, beef cattle, dairy, swine, and goat production.
 - d. Describe the development of important breeds of animals.
 - e. Discuss the concept of animal well-being as related to agricultural animal enterprises.
Related Academic Topics (See Appendix A): C1, C2, C4, C6, S3
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
14. Describe the role of biological science in animal production.
 - a. Identify important body structures including cells, tissues, and organs.
 - b. Explain how animals grow by cell mitosis and maturation.
 - c. List and explain the life processes of animals.
 - d. Identify the body systems of animals and explain the functions of each.
 - e. Identify the major external body parts of cattle, swine, and sheep.
Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S3
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
15. Examine the role of genetics and breeding in animal production.
 - a. Explain basic concepts of heredity and genetics.
 - b. Describe the role of breeding systems in animal production.
Related Academic Topics (See Appendix A): C1, C2, C4, C5, S3
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
16. Explore current and emerging trends, technologies, and career opportunities associated with animal science.
 - a. Identify trends in technology related to animal science.
 - b. Describe the impact of emerging technology on careers in animal science.
 - c. Determine sources of information using the Internet and other resources.
Related Academic Topics (See Appendix A): C1, C2, C4, C6, S3
Workplace Skills (See Appendix B): WP2, WP3, WP6, WP7, WP8
17. Describe the physical characteristics of soil.
 - a. Explain the meaning and importance of soil.
 - b. Describe the process of soil formation.
 - c. Distinguish between physical and chemical weathering.
 - d. Identify the components of soil.

- e. Classify the texture of a soil.
- f. Identify the different profiles of a soil and discuss their importance.
- g. Investigate the internal and external drainage of soils.
- h. Discuss the use of chemical and physical soil amendments to improve texture and drainage.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7, S4

Workplace Skills (See Appendix B): WP2, WP3, WP4, WP6, WP7, WP8

18. Investigate the chemical characteristics of soils.
 - a. State the purpose of soil testing and develop a soil testing plan.
 - b. Describe how to take a soil sample.
 - c. Determine soil pH and describe how it affects the productivity of a soil.
 - d. Describe liming and acidifying practices.
 - e. Identify the macro and micro nutrients in a soil which promote plant growth.
 - f. Explain the meaning and importance of fertilizers.
 - g. Compare and contrast fertilizer grade and analysis.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M1, M4, M7, S4, S8

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

19. Determine the capability class of land.
 - a. Define land and distinguish land from soil.
 - b. Describe the concept of land capability classes and highest productive use.
 - c. Describe factors that determine the capability class of land.
 - d. Classify land as to its highest productive use.

Related Academic Topics (See Appendix A): C1, C2, C4, C6, S4, S8

Workplace Skills (See Appendix B): WP2, WP4, WP6, WP7, WP8

20. Examine soil conservation practices.
 - a. Discuss soil degradation.
 - b. Describe the different types of soil erosion.
 - c. Identify and discuss the applications of soil conservation practices.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S4

Workplace Skills (See Appendix B): WP2, WP4, WP6, WP7, WP8

21. Explore current and emerging trends, technologies, and career opportunities associated with soil science.
 - a. Identify trends in soil science areas.
 - b. Describe important areas of emerging technologies in soil science.
 - c. Describe career opportunities in areas related to soil science.

Related Academic Topics (See Appendix A): C1, C2, C4, C6, S4

Workplace Skills (See Appendix B): WP2, WP4, WP6, WP7, WP8

22. Investigate the physical characteristics and processes of plants.
 - a. Diagram a plant showing the major parts and describing the functions of the parts.
 - b. Describe the process of photosynthesis.
 - c. Describe the process of transpiration.
 - d. Describe the process of respiration.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7, S2

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

23. Explore the requirements for plant growth.
 - a. Identify and describe the functions of the primary plant nutrients.
 - b. Identify and describe the functions of the secondary plant nutrients.
 - c. Recognize symptoms of nutritional deficiencies in plants.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2, S8
Workplace Skills (See Appendix B): WP2, WP4, WP6, WP7, WP8
24. Examine the process of plant reproduction.
 - a. Describe the process of sexual reproduction in plants including the process of pollination in complete and incomplete flowers.
 - b. Describe common methods of asexual propagation including cuttings, layering, grafting, and tissue culture.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2
Workplace Skills (See Appendix B): WP2, WP3, WP6, WP7, WP8
25. Explore current and emerging trends, technologies, and career opportunities associated with plant science.
 - a. Identify trends in areas of plant science.
 - b. Describe important areas of emerging technologies in plant science.
 - c. Describe career opportunities in areas of plant science.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2
Workplace Skills (See Appendix B): WP2, WP3, WP6, WP7, WP8
26. Investigate the importance of crop production.
 - a. List the major uses of crop plant products.
 - b. Classify crops by the kind of product produced.
 - c. Classify crops by the part of the plant that is used.
 - d. Identify common crops based on seed, leaf structure, and other physical features.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, S2
Workplace Skills (See Appendix B): WP2, WP7, WP8
27. Identify cultural practices in crop production.
 - a. Determine the growing conditions needed by crops.
 - b. List important factors in crop selection.
 - c. Describe the selection of crop varieties.
 - d. Explain seedbed preparation and tillage.
 - e. Describe the process of planting seed and the types of planters used.
 - f. Describe the importance of using soil amendments based on soil analysis and crop needs.
 - g. Explain irrigation and how it is used.
 - h. List sources of potential loss in crop production.

Related Academic Topics (See Appendix A): C1, C2, C4, S8
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
28. Explore basic concepts of pest management.
 - a. Identify the different classes of pests and describe the ways in which they cause damage and loss in agricultural enterprises.
 - b. Identify the different classes of pest control strategies and describe their advantages and disadvantages.
 - c. Discuss principles and concepts of integrated pest management systems.

- d. Describe safety and environmental concerns associated with the use of chemical pesticides.
 - e. Classify pesticides as herbicides, insecticides, and fungicides.
 - f. Interpret a pesticide label.
 - g. Select an approach in pest management for a given crop and situation.
- Related Academic Topics (See Appendix C1, C2, C4, C6, S3, S5, S8)*
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
29. Explain practices in harvesting crops.
 - a. Define harvesting and explain how the process varies with the kind of crop.
 - b. Select machinery appropriate for harvesting a crop.
 - c. Describe when harvesting should occur.
 - d. List advantages and disadvantages of crop storage.

Related Academic Topics (See Appendix A): C1, C2, C4, C5
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
 30. Examine the nature of horticulture.
 - a. Define and describe the major areas of horticulture.
 - b. Compare and contrast agriculture and horticulture.
 - c. Relate horticulture to the environment.
 - d. Identify the impact of horticulture on the economy.
 - e. Describe the nature and scope of horticulture in the local area.

Related Academic Topics (See Appendix A): C1, C2, C3
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
 31. Determine the role of biological science in horticulture.
 - a. Classify horticultural plants based on life cycle, scientific classification, and cultivar.
 - b. Describe methods of plant propagation.
 - c. Identify examples of annual and perennial plants in horticulture.

Related Academic Topics (See Appendix A): C1, C2, C4, S2
Workplace Skills (See Appendix B): WP2, WP7, WP8
 32. Examine how to use a greenhouse in growing plants.
 - a. Explain the importance of greenhouses in plant production.
 - b. Describe the four types of greenhouses and how they function.
 - c. Explain how to control light, temperature, humidity, and irrigation in a greenhouse.
 - d. List the types of systems used to control the greenhouse environment.
 - e. Describe the maintenance needed on a greenhouse.
 - f. Identify and practice safety in greenhouse work.
 - g. Describe general practices used in producing greenhouse crops.

Related Academic Topics (See Appendix A): C1, C2, C4
Workplace Skills (See Appendix B): WP1, WP2, WP7, WP8
 33. Describe the fundamentals of landscaping.
 - a. Explain the phases in planning and installing a landscape.
 - b. Identify the steps in the landscape design process.
 - c. List and explain the five basic principles of landscape design.
 - d. Classify plants as trees, shrubs, ground covers, flowers, or turf and give examples of each.

- e. Prepare a simple landscape plan.
- f. Describe how to establish a lawn as part of a landscape plan including selecting turf variety, preparing the soil, using soil amendments, and irrigating.
Related Academic Topics (See Appendix A): C1, C2, C4, C6
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
34. Examine the importance of forestry.
 - a. Explain the meaning of forestry.
 - b. List uses of forestry products.
 - c. Describe the benefits of forestry to the public.
 - d. Describe the purpose of a forest management plan.
Related Academic Topics (See Appendix A): C1, C2, C4
Workplace Skills (See Appendix B): WP2, WP7, WP8
35. Describe forest production and management.
 - a. Explain the natural forest cycle.
 - b. Identify ways of classifying forests.
 - c. Compare and contrast mensuration and biometrics.
 - d. Determine how forests are measured and select the appropriate measuring tool.
 - e. Classify common silviculture practices.
 - f. Identify common insect and disease pests in forest production.
 - g. Describe artificial reforestation methods.
 - h. List methods of selling timber.
Related Academic Topics (See Appendix A): C1, C2, C3, C4, M4, M7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
36. Investigate forest fire prevention.
 - a. Explain a fire triangle.
 - b. Describe the advantages and disadvantages of forest fires.
 - c. Explain the importance of preventing uncontrolled fires.
 - d. Describe the use of prescribed fires.
Related Academic Topics (See Appendix A): C1, C2, C4, C5
Workplace Skills (See Appendix B): WP2, WP7, WP8
37. Identify the kinds and importance of natural resources.
 - a. List natural resources and classify as renewable or nonrenewable.
 - b. Describe the importance of natural resources in the environment of the Earth.
 - c. Explain concepts associated with sustainable resource use.
 - d. Describe natural resource conservation.
Related Academic Topics (See Appendix A): C1, C2, C4, C5
Workplace Skills (See Appendix B): WP2, WP7, WP8
38. Relate the importance of ecology in natural resources.
 - a. Explain the importance of biomes, ecospheres, and niches.
 - b. Compare and contrast producers, consumers, and decomposers.
 - c. Describe the role of trees, including both commercial and noncommercial forests, in the ecology of an area.
 - d. Explain the role of trees based on age and maturity.
Related Academic Topics (See Appendix A): C1, C2, C4, C5, S2
Workplace Skills (See Appendix B): WP2, WP7, WP8

39. Describe the role of wildlife as natural resources.
 - a. Identify important wildlife species.
 - b. Explain the survival needs of wildlife.
 - c. Describe factors that determine the wildlife found in a habitat.
 - d. Explain endangered wildlife and how endangerment can be reduced.

Related Academic Topics (See Appendix A): C1, C2, C4, C5
Workplace Skills (See Appendix B): WP2, WP7, WP8
40. Identify important areas of waste management.
 - a. Determine major waste products from human activity.
 - b. Explain how waste can be reduced and more efficiently managed.
 - c. Develop a household waste management plan.

Related Academic Topics (See Appendix A): C1, C2, C4, C5
Workplace Skills (See Appendix B): WP2, WP7, WP8
41. Examine sources of alternative energy.
 - a. Describe wind as a source of energy.
 - b. Describe water as a source of energy.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, S6
Workplace Skills (See Appendix B): WP2, WP7, WP8
42. Examine the nature of aquaculture.
 - a. Explain the meaning of aquaculture.
 - b. List the major aquaculture crops.
 - c. Identify reasons aquaculture is important.
 - d. Contrast and compare aquaculture with terrestrial agriculture.
 - e. Describe requirements for successful aquaculture.
 - f. Identify business records which must be maintained.

Related Academic Topics (See Appendix A): C1, C4
Workplace Skills (See Appendix B): WP2, WP7, WP8
43. Describe the importance of water in aquaculture.
 - a. List the chemical formula for water.
 - b. Explain the hydrologic cycle.
 - c. Explain the importance of dissolved oxygen.
 - d. Identify methods of testing water quality.
 - e. Identify the role of the nitrogen cycle in water.
 - f. Explain how oxygen, nitrogen, and other substances in water are measured.
 - g. Explain how water is managed to assure a good aquatic environment.
 - h. Explain how weather affects water quality in ponds.

Related Academic Topics (See Appendix A): C1, C2, C4, M4
Workplace Skills (See Appendix B): WP2, WP7, WP8
44. Explain the importance of proper nutrition.
 - a. Describe the digestive system of a fish.
 - b. List factors that affect the metabolic rate of fish.
 - c. List factors that affect the amount of food a fish will consume.
 - d. Describe the general nutritional requirements of fish.
 - e. Describe the kind of feed that is used with fish and how and when fish are fed.

Related Academic Topics (See Appendix A): C1, C2, S3
Workplace Skills (See Appendix B): WP2, WP7, WP8

45. Explain the importance of promoting fish health.
 - a. Describe the role of growing conditions in promoting good health.
 - b. Name common diseases and list methods of prevention and treatment.
 - c. Identify the role of stress in fish health.
 - d. Describe the role of competition and predation in fish production.

Related Academic Topics (See Appendix A): C1, C2, S3
Workplace Skills (See Appendix B): WP2, WP7, WP8
46. Describe marketing procedures.
 - a. Assess marketing alternatives.
 - b. Identify proper methods of harvesting, handling, and transporting fish.
 - c. List the equipment needed for harvesting.
 - d. Explain the size and condition of fish when harvested.
 - e. Explain the importance of producing quality fish.

Related Academic Topics (See Appendix A): C1, C2, C4, C5
Workplace Skills (See Appendix B): WP2, WP7, WP8
47. Examine the importance of physical and mechanical technology in agriscience.
 - a. Define physical and mechanical technology as related to agricultural mechanics.
 - b. Describe contributions made by mechanical applications to agriculture.
 - c. List inventors and their inventions of important mechanical technology in agriculture.
 - d. Identify hand and power tools, equipment, and fasteners used in agriscience.

Related Academic Topics (See Appendix A): C1, C6, S6
Workplace Skills (See Appendix B): WP2, WP7, WP8
48. Examine and identify basic safety processes and concepts associated with physical and mechanical technology in agriculture.
 - a. Explain how to create a safe place to work.
 - b. Demonstrate the use of appropriate safety rules.
 - c. Describe appropriate personal protection equipment.
 - d. Interpret the safety color coding system.
 - e. Describe the classes of fires and the types of fire extinguishers needed.
 - f. Apply basic first aid procedures with burns, spills, cuts, and electrical shock.

Related Academic Topics (See Appendix A): C1, C2, C6
Workplace Skills (See Appendix B): WP2, WP4, WP7, WP8
49. Explore the use of electrical power in agriculture.
 - a. Explain the basic principles of electricity.
 - b. Describe how electrical energy is measured and conducted.
 - c. Prepare a simple wiring plan using electrical symbols, including circuits with switches, outlets, and fixtures.
 - d. Describe the purpose and operation of circuit breakers and fuses.
 - e. Use test equipment on electrical circuits, including ammeters, voltmeters, ohmmeters, and wattmeters.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7, S6
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
50. Explore the principles of metals fabrication.
 - a. Describe processes used in metals fabrication.

- b. Identify equipment and tools used in metals fabrication.
 - c. Explain the process of fusion welding.

Related Academic Topics (See Appendix A): C1, C5, S5, S6
Workplace Skills (See Appendix B): WP2, WP5, WP7, WP8
- 51. Explore the principles of plumbing in agriculture.
 - a. Determine how communities are supplied with water.
 - b. Identify common code requirements.
 - c. Explain advantages and disadvantages of using different types of pipes in plumbing systems.
 - d. Identify pipe fittings and valves.

Related Academic Topics (See Appendix A): C1, C5, S5, S6
Workplace Skills (See Appendix B): WP2, WP5, WP7, WP8
- 52. Explore the use of internal combustion engine power in agriculture.
 - a. Describe the basic operating principles of an internal combustion engine.
 - b. Identify the parts of a cylinder and piston unit and describe their operations.
 - c. Identify the different types of internal combustion engines and discuss their applications and uses.

Related Academic Topics (See Appendix C1, C2, C4, C6, S6)
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
- 53. Examine the role of marketing in the agricultural industry.
 - a. Explain marketing and the basic functions involved.
 - b. List and explain marketing channels.
 - c. Describe the infrastructure needed for agricultural marketing.
 - d. Distinguish between wholesale and retail marketing.
 - e. Identify important concepts in successful marketing.

Related Academic Topics (See Appendix A): C1, C2, C4, C5
Workplace Skills (See Appendix B): WP2, WP7, WP8
- 54. Relate agricultural marketing to the free enterprise system.
 - a. Describe the role of supply and demand in marketing.
 - b. Compare and contrast cash, contract, and futures marketing.
 - c. Explain how cash prices and futures markets are linked.
 - d. Describe how a futures market is used.

Related Academic Topics (See Appendix A): C1, C2, C4, C5
Workplace Skills (See Appendix B): WP2, WP7, WP8
- 55. Examine the importance of planning in successful marketing.
 - a. Identify the major purposes of a marketing plan.
 - b. Describe the major parts of a marketing plan.
 - c. Explain the procedures in developing a marketing plan.
 - d. List the reasons for developing and properly using a marketing plan.
 - e. Describe the role of promotion in implementing a marketing plan.

Related Academic Topics (See Appendix A): C1, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
- 56. Investigate marketing processes with agricultural products.
 - a. Explain the importance of reliable grading standards in marketing.
 - b. Compare and contrast the marketing of animals and animal products.
 - c. Compare and contrast the marketing of various grain and fiber crops.

- d. Use information sources as aids in agricultural marketing.
Related Academic Topics (See Appendix A): C1, C4, C5, C6
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

CURRICULUM FRAMEWORK

Course Name: The Science of Agricultural Animals

Course CIP Code: 02.0201

Course Description: The Science of Agricultural Animals is designed as a one-unit course that offers an in-depth study of the animal industry. This includes both traditional livestock and poultry enterprises as well as companion animals. Emphasis is on production methods used in beef operations, swine, dairy, and poultry. The course also includes equine science, companion and laboratory animal care, and aquaculture. Instruction is undergirded with fundamentals of biological science. (Prerequisite: Concepts of Agriscience Technology or Biology; Grades 10-12; 1 Carnegie Unit)

Competencies and Suggested Objectives:

1. Investigate the nature of animal agriculture.
 - a. Explain the importance of animals.
 - b. Describe the nature of the class, including course outline and learning activities.

Related Academic Topics (See Appendix A): C1, C3, C4, S1, S2, S3, S7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
2. Investigate the opportunities in student and youth organizations in the animal industry.
 - a. List the requirements for Chapter, State, and American FFA Degrees.
 - b. Prepare for student development events on the local, state, and national levels.

Related Academic Topics (See Appendix A): C1, C2, C4, S3, S8
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
3. Demonstrate career and communication skills required for employment in the animal industry.
 - a. Identify careers in animal agriculture and the skills required by employers.
 - b. Prepare an appropriate resume.
 - c. Explain the importance of responding to authority.
 - d. Explain the importance of ethics in the workplace.
 - e. Demonstrate the proper use of a business phone.
 - f. Write a business letter following an acceptable format.
 - g. Use electronic media to communicate information.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C6
Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5, WP6, WP7, WP8
4. Use the Internet to identify emerging technologies.
 - a. Investigate a topic related to animal agriculture using the Internet and make an oral presentation to the class.

Related Academic Topics (See Appendix A): C1, C2, C4, C6, S3, S8
Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5, WP6, WP7, WP8
5. Plan, implement, and expand supervised experience in animal agriculture.
 - a. Explain the purpose, kinds, and nature of supervised experience.

- b. Explain how supervised experience is part of a carefully planned and long-term supervised agricultural experience program (SAE).
 - c. Describe how supervised experience relates to achievement of FFA proficiency awards and other activities.
 - d. Identify appropriate experiences for a supervised agricultural experience program.
 - e. Develop short-term, intermediate, and long-term SAE goals.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, S3, S8
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP6, WP7, WP8
6. Prepare and keep appropriate written documentation on supervised experience.
 - a. Develop a training plan.
 - b. Develop a training agreement.
 - c. Keep records of competencies developed, inventory, income, and expenses.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, S3, S8
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP6, WP7, WP8
7. Examine the importance of animals in the United States.
 - a. Explain the major uses of animals in the United States.
 - b. Identify the economic importance of animal production.
 - c. List the per capita consumption of products from animals.
 - d. Justify the use of agricultural land to produce meat animals or animal products.

Related Academic Topics (See Appendix A): C1, C2, C4, C6, S7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
8. Assess the animal industries in the local area.
 - a. List the major animal enterprises in the local area.
 - b. Identify businesses and industries that support animal production and use.
 - c. Explain the role of entrepreneurship in animal agriculture.

Related Academic Topics (See Appendix A): C1, C2, C4
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
9. Identify the major species and breeds of domesticated animals.
 - a. List the breeds and descriptions of animals used for food products.
 - b. List the breeds and descriptions of animals used for non-food products.
 - c. Name the major species of companion, service, and pleasure animals.
 - d. List the species of fish that are found in the local area.

Related Academic Topics (See Appendix A): C1, C4, S3, S7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
10. Examine the importance of consumers in producing and marketing animal products.
 - a. Define consumer and describe why consumers are important.
 - b. Identify nutrition and health concerns of consumers.
 - c. Assess consumer concerns about feed additives and anabolic steroids.
 - d. Identify quality assurance programs.

Related Academic Topics (See Appendix A): C1, C4, S3
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP6, WP7, WP8
11. Explain consumer concerns about animal waste and its effects on the environment.
 - a. Determine the kinds of wastes resulting from animal agriculture.

- b. Identify regulations on animal waste disposal.
Related Academic Topics (See Appendix A): C1, C4, S2, S4
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
12. Investigate animal food products and processing.
 - a. Assess consumer concerns about food product safety.
 - b. Explain general methods used in processing animal food products.
 - c. Explain the role of HACCP in food safety.
Related Academic Topics (See Appendix A): C1, C2, C4, S3
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
13. Explain animal well-being.
 - a. Define animal well-being and describe how it is used in production.
 - b. Assess the use of animal confinement.
Related Academic Topics (See Appendix A): C1, C4, S2, S3
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
14. Explore the use of animals in research and laboratory production.
 - a. Explain why animals are used in research.
 - b. Assess the use of animals in laboratory production.
Related Academic Topics (See Appendix A): C1, C4, S3
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
15. Investigate the behavioral patterns of animals.
 - a. Observe and describe the social behavior of animals.
 - b. Observe and describe the reproductive behavior of animals.
 - c. Describe how animals can be trained to exhibit desired behavior patterns.
Related Academic Topics (See Appendix A): C1, C2, C3, C4, S3, S7, S8
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
16. Examine the importance of personal safety in animal production.
 - a. Explain the importance of personal safety with animals.
 - b. Identify hazards related to livestock production.
 - c. List the safety practices necessary when working with animals.
Related Academic Topics (See Appendix A): C1, C2, C4, S1, S2, S3, S8
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
17. Use scientific classification with animals.
 - a. Explain taxonomy and how it is used with domesticated animals.
 - b. Distinguish between mammals and non-mammals.
 - c. Give the scientific names of common domesticated animals.
Related Academic Topics (See Appendix A): C1, C2, C4, S2, S3, S7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
18. Examine the characteristics of life and living organisms.
 - a. Explain the role of protoplasm in living organisms.
 - b. Explain how cell specialization forms structures needed for life processes.
 - c. Identify the stages in the life span of living organisms.
 - d. Match names of young and mature animals with the species.
 - e. Name the life processes of animals and describe how these processes occur.
Related Academic Topics (See Appendix A): C1, C2, C4, S1, S2, S3, S7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
19. Examine the characteristics of animals as organisms.

- a. Distinguish between and explain the importance of anatomy and physiology.
 - b. Describe the types of animal tissue and give the purpose of the tissue.
 - c. Name and explain the functions of the organ systems.
 - d. Identify the major external parts of animals.
- Related Academic Topics (See Appendix A): C1, C2, C4, S1, S3*
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
20. Assess the importance of heredity and genetics.
 - a. Define heredity and genetics and relate the terms to variability.
 - b. Identify the major heredity material of living organisms.
 - c. Explain how breeding is used to improve animals.
 - d. Explain the meaning of genetic manipulation in animal biotechnology.

Related Academic Topics (See Appendix A): C1, C2, C4, S1, S2, S3, S7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
 21. Examine the role of nutrition in animal growth and health.
 - a. Explain metabolism.
 - b. List six nutrients essential to life and identify sources of the nutrients.
 - c. Discuss the relationship between proteins and amino acids.
 - d. Develop a complete ration for an animal.
 - e. Explain the differences in monogastric, ruminant, avian, and psuedo-ruminant feed utilization.
 - f. Explain the addition of microorganisms to ruminants in order to increase feed utilization.

Related Academic Topics (See Appendix A): C1, C2, C4, S1, S2, S3
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
 22. Provide the proper care of pregnant and lactating females.
 - a. Explain the three phases of pre-natal growth.
 - b. Describe the functions of the placenta.
 - c. Explain the role of nutrition with pregnant females and the developing fetus.
 - d. Explain the role of nutrition with lactating females.

Related Academic Topics (See Appendix A): C1, C2, C4, S1, S3, S7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
 23. Provide post-natal care of females and offspring.
 - a. Explain the development of the central nervous, circulatory, respiratory, and digestive systems in new-born animals.
 - b. Explain the changes in feed requirement in the dam after birth.
 - c. Discuss expulsion of the afterbirth.

Related Academic Topics (See Appendix A): C1, C2, C4, S1, S3, S7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
 24. Identify animals based on food consumption.
 - a. Explain carnivore, herbivore, and omnivore as related to food sources and types.
 - b. Classify animals as being carnivores, omnivores, or herbivores.

Related Academic Topics (See Appendix A): C1, C2, C4, S1, S3
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
 25. Assess the effects of hormones on animal growth.
 - a. List and discuss the major hormone producing glands and their effect on

- growth.
- b. Identify issues with consumers on the use of hormones in food animal production.
Related Academic Topics (See Appendix A): C1, C2, C4, S1, S3
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
 26. Assess the importance of vitamins and minerals in the diet of an animal.
 - a. List sources of vitamins in animal feeds.
 - b. List sources of minerals in animal feeds.*Related Academic Topics (See Appendix A): C1, C2, C4, S1, S3*
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
 27. Assess the importance of concentrates and roughage in the diet of an animal.
 - a. Distinguish between concentrates and roughage food materials.
 - b. List sources of concentrates for use in feed rations.
 - c. List sources of roughage for animal rations.*Related Academic Topics (See Appendix A): C1, C2, C4, S1, S3*
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
 28. Identify the importance of water to animals.
 - a. Explain the role of water in metabolism.
 - b. List sources of water for animals.
 - c. List the types of watering systems.
 - d. Demonstrate the ability to determine water quality.*Related Academic Topics (See Appendix A): C1, C2, C4, S1, S2, S3*
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
 29. Assess the importance of reproduction in animal production.
 - a. Define reproduction and relate it to animal production.
 - b. Identify male and female sex cells.
 - c. Distinguish between mating and conception.
 - d. Explain the process of fertilization.
 - e. Explain the importance of reproduction efficiency.*Related Academic Topics (See Appendix A): C1, C4, S3*
Workplace Skills (See Appendix B): WP2, WP7, WP8
 30. Examine the reproduction process with mammals.
 - a. List the male and female reproduction organs and give the function of each.
 - b. Identify the phases of the female mammal reproductive cycle.
 - c. Distinguish between natural and artificial insemination.
 - d. List the gestation lengths for common animals.
 - e. Select breeding animals for a specific goal in an animal enterprise.
 - f. Observe the artificial insemination method of breeding.
 - g. Observe the procedure for evaluation of semen for sperm count.*Related Academic Topics (See Appendix A): C1, C2, C4, S1, S3, S7*
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
 31. Examine the reproduction process with poultry.
 - a. Describe poultry reproduction.
 - b. Indicate incubation period and conditions required by various species.
 - c. Care for newly-hatched poultry.*Related Academic Topics (See Appendix A): C1, C4, S3*

Workplace Skills (See Appendix B): WP2, WP7, WP8

32. Examine the reproduction process with finfish.
- Trace the general process of spawning and incubation with finfish.
 - Indicate conditions for spawning of a species common in the local area.
 - Explain incubation naturally and artificially to assure a good hatch.
 - Care for newly-hatched fry.

Related Academic Topics (See Appendix A): C1, C4, S3

Workplace Skills (See Appendix B): WP2, WP7, WP8

33. Investigate the selection of market animals.
- Explain the importance of animal selection.
 - Identify the high quality meat cuts on a market animal.
 - List the main points to consider when evaluating a market class (type, muscle, finish, carcass merit, yield, quality, balance, and style).
 - Evaluate classes of market animals and present reasons for each class.
 - Demonstrate the proper fitting procedures to prepare an animal for show.

Related Academic Topics (See Appendix A): C1, C2, C4, S3, S7

Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8

34. Investigate the selection of breeding animals.
- Explain the points to consider when selecting a breeding animal (structural soundness, growth, capacity, breed, and sex character).
 - Use performance records in selecting breeding animals.
 - Evaluate classes of breeding animals and present reasons for each class.
 - Demonstrate the proper fitting procedures to prepare an animal for show.

Related Academic Topics (See Appendix A): C1, C2, C4, S3, S7

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

35. Evaluate non-mammal species on the basis of productive efficiency.
- Assess the role of feed conversion in animal efficiency.
 - Examine reproductive capability in productive efficiency.
 - Determine the role of disease in productive efficiency.

Related Academic Topics (See Appendix A): C1, C2, C4, S3, S7

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

36. Examine the effects of disease on livestock, companion, and laboratory animals.
- Explain health and the importance of promoting animal health through disease prevention.
 - Define disease and list the major causes of disease.
 - Assess animal losses due to poor health.
 - Explain practices that promote good health.
 - List the signs of good health in animals.

Related Academic Topics (See Appendix A): C1, C2, C4, S1, S2, S3

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

37. Examine the effects of environment on animal health.
- Identify environmental conditions that affect animal health.
 - Explain the importance of animal housing.
 - Assess the role of nutrition in animal health.
 - Assess the importance of quality water in animal health.
 - Investigate how population density is related to health.

- f. Explain the role of air quality in animal health.
Related Academic Topics (See Appendix A): C1, C2, C4, S1, S2, S3, S7
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
38. Examine the role of the host animal as related to health.
 - a. Describe how age, gender, breed, stocking density, and immunity affect host health.
 - b. Explain the functions of red blood cells and white blood cells.
 - c. Identify the role of immunity in disease control.
 - d. Describe how vaccines work.
 - e. Explain how antigens enter the body.*Related Academic Topics (See Appendix A): C1, C2, C4, S1, S2, S3, S7*
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
39. Examine the role of pathogens in animal health.
 - a. List and describe the types of disease organisms.
 - b. Discuss how pathogens enter the body.
 - c. Classify common diseases of domesticated animals.
 - d. Identify ways medicines are delivered to animals.*Related Academic Topics (See Appendix A): C1, C4, S1, S2, S3, S7*
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
40. Examine the role of parasites and plant toxins in animal health.
 - a. Discuss how parasites cause harm to host animals.
 - b. Classify internal parasites.
 - c. Explain the effects of external parasites.
 - d. Discuss the control of external and internal parasites.
 - e. Explain plant toxins and how they affect animal health.*Related Academic Topics (See Appendix A): C1, C2, C4, S1, S2, S3, S7*
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
41. Identify the facility and equipment needs with various animal production enterprises.
 - a. Discuss facility and equipment needs based on species and breed of animal.
 - b. Explain climate and weather conditions related to species requirements.*Related Academic Topics (See Appendix A): C1, C2, C4, C5, S2, S3*
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
42. Explore the design and construction features of facilities and equipment in the animal industry.
 - a. List the factors to consider when planning a facility.
 - b. List the factors to consider when selecting equipment for a selected facility.*Related Academic Topics (See Appendix A): C1, C2, C4, C5, S2, S3*
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
43. Investigate the approved practices for managing animal enterprises.
 - a. Identify management practices with cow-calf and farrowing operations.
 - b. Describe pre-conditioning and backgrounding calves and hogs.
 - c. Describe approved practices in caring for weaning age animals.
 - d. Explain the purpose of castration and spaying.
 - e. Observe dehorning, tattooing, and branding.
 - f. Develop an enterprise budget for animal production.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, S3, S7, S8

Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8

44. Analyze the approved practices in marketing animals.

- a. Assess marketing alternatives for meat animals.
- b. Assess marketing alternatives for dairy products.
- c. Assess marketing alternatives for aquaculture.
- d. Assess marketing alternatives for companion animals.
- e. Assess marketing alternatives for laboratory animals.

Related Academic Topics (See Appendix A): C1, C2, C4, S3

Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8

45. Investigate new and emerging technologies in managing and marketing animals.

- a. Discuss examples of new and emerging trends and practices in managing and marketing animals.

Related Academic Topics (See Appendix A): C1, C4

Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8

46. Examine small business management in animal agriculture.

- a. Determine the important practices in managing a small business.
- b. Use spreadsheets to keep records.
- c. Describe the procedures to follow in gaining and succeeding in employment in a small business.

Related Academic Topics (See Appendix A): C1, C2, C4

Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5, WP6, WP7, WP8

47. Determine the types, uses, care, and management of companion animals.

- a. Describe the domestication and history of companion animals.
- b. Determine the economic impact of various classes of companion animals.
- c. Identify the types and uses of various classes of companion animals.
- d. Describe the approved practices in feeding and caring for companion animals.

Related Academic Topics (See Appendix A): C1, C2, C4

Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5, WP6, WP7, WP8

CURRICULUM FRAMEWORK

Course Name: The Science of Agricultural Environment

Course CIP Code: 03.0102

Course Description: The Science of Agricultural Environment is a course to introduce and develop skills in environmental areas related to the use and management of natural resources in the food and fiber systems. New technologies being used to enhance human capabilities to monitor and protect the environment are introduced. The overall focus is on maintaining and protecting resources to assure quality human life. Important relationships of living organisms to land and soil, water, the atmosphere, waste management, forestry, and energy management are included. Stress is on understanding global environmental issues and developing appropriate attitudes of environmental stewardship. (Prerequisite: Concepts of Agriscience Technology or Biology; Grades 10-12; 1 year, 1 Carnegie Unit)

Competencies and Suggested Objectives:

1. Examine the environment and how human and agricultural activities create environmental change.
 - a. Describe environmental resources and distinguish between renewable and nonrenewable resources.
 - b. Explain sustainability in the environment.
 - c. Examine relationships of the ecosystem to energy transfer and food chains.
 - d. Explain the relationship of agriculture to the quality of the environment.

Related Academic Topics (See Appendix A): C1, C4, C6, S4
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
2. Analyze issues affecting the global environment and how these relate to agriculture.
 - a. Explain human population trends and factors influencing population changes.
 - b. Investigate the demands of human population on the environment and how these relate to agriculture.
 - c. Describe the effect of landscape degradation on the environment.
 - d. Examine natural resource conservation and interdependency.
 - e. Explain the decline of the world's natural fisheries.

Related Academic Topics (See Appendix A): C1, C4, S4
Workplace Skills (Appendix B): WP2, WP6, WP7, WP8
3. Plan, implement, and expand supervised experience in agricultural environment.
 - a. Explain the purpose, kinds, and nature of supervised experience.
 - b. Explain how supervised experience is part of a carefully planned and long-term supervised agricultural experience program (SAE).
 - c. Describe how supervised experience relates to achievement of FFA proficiency awards and other activities.
 - d. Identify appropriate experiences for a supervised agricultural experience program.

- e. Develop short-term, intermediate, and long-term SAE goals.
Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, S3, S8
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP6, WP7, WP8
4. Prepare and keep appropriate written documentation on supervised experience.
 - a. Develop a training plan.
 - b. Develop a training agreement.
 - c. Keep records of competencies developed, inventory, income, and expenses.
Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, S3, S8
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP6, WP7, WP8
5. Investigate living organisms in the environment.
 - a. Classify living organisms in the environment.
 - b. Examine the roles of living organisms in the environment.
 - c. Demonstrate microbiology applications in environmental study.
Related Academic Topics (See Appendix A): C1, C4, S2, S3, S4
Workplace Skills (See Appendix B): WP2, WP7, WP8
6. Examine relationships of living organisms and the environment.
 - a. Explain life span and the stages of life.
 - b. Investigate the life processes essential for the living condition.
 - c. Examine the anatomy and physiology of living organisms as related to the environment.
 - d. Describe the role of biodiversity.
Related Academic Topics (See Appendix A): C1, C4, S2, S4
Workplace Skills (See Appendix B): WP2, WP7, WP8
7. Identify agricultural pests as they relate to the environment.
 - a. Explain the economic impact of agricultural pests on the environment.
 - b. Relate methods of controlling agricultural pests to impact on the environment.
Related Academic Topics (See Appendix A): C, C4, S3
Workplace Skills (See Appendix B): WP2, WP7, WP8
8. Examine the principles of ecology as related to environmental quality.
 - a. Develop a working definition of ecology.
 - b. Describe agricultural and wildlife ecosystems and identify factors in those ecosystems.
 - c. Explain community organization and structure.
 - d. Diagram the food chain and web for organisms in a local agricultural or wildlife ecosystem.
 - e. Identify the roles of natural selection and succession.
Related Academic Topics (See Appendix A): C1, C4, S3
Workplace Skills (See Appendix B): WP2, WP7, WP8
9. Identify ecological diversity in agricultural and wildlife ecosystems.
 - a. Distinguish between terrestrial and aquatic biomes and give examples of each.
 - b. Explain the importance of homeostasis in the survival of organisms.
 - c. Describe population ecology, including natality and mortality.
Related Academic Topics (See Appendix A): C1, C4, S1, S2, S3, S4
Workplace Skills (See Appendix B): WP2, WP7, WP8
10. Identify the process of planning for urban and rural land use.
 - a. Explain the concepts of land and land use.

- b. Describe land-use planning and zoning.

Related Academic Topics (See Appendix A): C1, C2, C4, S4
Workplace Skills (See Appendix B): WP2, WP7, WP8
11. Explain the importance of soil and proper soil management.
 - a. Identify the materials in soil and growing media.
 - b. Demonstrate how soil is formed.
 - c. Investigate the physical and chemical nature of soil using appropriate analyses.
 - d. Identify soil degradation and ways degradation occurs.
 - e. Explain the importance of soil conservation and relate conservation to management practices.
 - f. Describe how soil erosion impacts the water in streams, lakes, and oceans.

Related Academic Topics (See Appendix A): C1, C4, S4
Workplace Skills (See Appendix B): WP2, WP7, WP8
12. Assess the impact of agricultural, horticultural, and forestry practices on land and soil.
 - a. Identify tillage practices that promote and prevent soil erosion.
 - b. Illustrate the importance of protecting the soil from degradation.
 - c. Demonstrate principal elements of land surveying including measuring horizontal distances, slope chaining, direction measurements, elevation measurements, area measurements, and boundary surveys.

Related Academic Topics (See Appendix A): C1, C4, S4
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
13. Explain water uses and quality.
 - a. Describe the nature and states of water.
 - b. Identify important uses of water.
 - c. Identify sources of water.
 - d. Demonstrate the qualities of potable water.

Related Academic Topics (See Appendix A): C, C4, S4
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
14. Describe important water management practices.
 - a. Diagram and explain the water cycle.
 - b. Explain natural water supplies in flowing and non-flowing sources.
 - c. Identify common causes of water pollution and distinguish between point and nonpoint sources of pollution.
 - d. Explain the role of water quality monitoring and monitor the water in a stream.

Related Academic Topics (See Appendix A): C1, C2, S2, S4
Workplace Skills (See Appendix B): WP2, WP7, WP8
15. Describe how wastewater is treated to maintain water quality.
 - a. Explain the classes and sources of wastewater.
 - b. Identify hazards that may be present in wastewater.
 - c. Explain methods and processes in wastewater treatment.

Related Academic Topics (See Appendix A): C1, C2, S2, S4
Workplace Skills (See Appendix B): WP2, WP7, WP8
16. Examine the relationship of the atmosphere to the Earth's environment.
 - a. Define atmosphere and describe its contents.
 - b. Explain the structure of the atmosphere.

Related Academic Skills (See Appendix A): C1, C2, C4, S4

Workplace Skills (See Appendix B): WP2, WP7, WP8

17. Use weather and climate information in making decisions about the environment.
 - a. Define and distinguish between weather and environment.
 - b. Describe climate types and differences.
 - c. Make and interpret weather measurements.
 - d. Illustrate weather fronts, clouds, and storms and how these affect the environment.

Related Academic Topics (See Appendix A): C1, C2, C4, S4

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

18. Assess air quality and identify sources of air pollution.
 - a. Define air quality and relate quality to pollution and air quality standards.
 - b. Explain the movement of air and global pollution.
 - c. Describe the major kinds and sources of air pollution.
 - d. Identify the effects of air pollution on the Earth's environment.
 - e. Make air quality measurements.

Related Academic Topics (See Appendix A): C1, C2, S4

Workplace Skills (See Appendix B): WP2, WP5, WP6, WP7, WP8

19. Use appropriate procedures in managing solid waste.
 - a. Explain the kinds of solid waste materials.
 - b. Identify sources of solid waste.
 - c. Identify hazards associated with improperly managed waste.
 - d. Explain how solid waste materials should be managed.
 - e. Select recycling processes and identify materials that are recycled.
 - f. Explain the use of residential, agricultural, and industrial composting.

Related Academic Topics (See Appendix A): C1, C4, S2, S4

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

20. Select appropriate procedures for managing hazardous waste.
 - a. Explain the meaning of hazardous waste.
 - b. Classify hazardous waste materials.
 - c. Identify the environmental problems created by hazardous waste.
 - d. Explain methods of disposing of hazardous waste.
 - e. Select appropriate procedures to follow with spills or accidents involving hazardous waste.

Related Academic Topics (See Appendix A): C1, C4, S4

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

21. Examine the relationship of forests to the environment.
 - a. Examine the layered structure of forests and how these layers provide habitat for various wildlife species.
 - b. Identify locally important tree species by common names, scientific names, and physical characteristics.
 - c. Determine the age of a tree using an increment borer and counting annual rings in a tree cross-section.
 - d. Demonstrate procedures used in timber cruising, including standing timber estimation of tree volume using a tree scale stick, determining stand density, measuring tree height, and measuring diameter at breast height (DBH).

- e. Demonstrate proper procedures for planting trees.
Related Academic Topics (See Appendix A): C1, C2, C4, S2, S4
Workplace Skills (See Appendix B): WP2, WP7, WP8
- 22. Explain the contributions made by forests to the economy and environmental quality.
 - a. Identify consumer goods derived from forest locally, statewide, and nationally.
 - b. Describe the relationships of biodiversity and old growth forests.
 - c. Recommend ways of preventing forest fires.
 - d. Explain damage caused by forest fires.
 - e. Explain the importance of reforestation.*Related Academic Topics (See Appendix A): C1, C4, S4*
Workplace Skills (See Appendix B): WP2, WP7, WP8
- 23. Examine the relationships of wildlife well-being and environmental quality.
 - a. Identify the wildlife species found in the local area and classify as terrestrial or aquatic.
 - b. Identify the habitat requirements of various wildlife species and assess habitat found locally.
 - c. Investigate the role of the environment on the health and population status of wildlife using local situations.
 - d. Explain the importance of wildlife to the environment and human well-being.
 - e. Recommend procedures for improving environmental quality for wildlife.*Related Academic Topics (See Appendix A): C1, C2, C4, S2, S3, S4*
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
- 24. Investigate approaches in protecting wildlife species.
 - a. Explain the need for wildlife protection and conservation and how species are lost from the Earth.
 - b. Classify wildlife species based on threats to their continued existence.
 - c. Implement practices that can be used to protect and conserve wildlife species.
 - d. Explain practices in using and enjoying wildlife that conserve wildlife populations.*Related Academic Topics (See Appendix A): C1, C2, C4, C5, S3, S4*
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
- 25. Examine how energy is classified and used.
 - a. Identify energy in the environment, including renewable and nonrenewable forms.
 - b. Describe the sources of energy, including fuel, nonfuel, and alternative energy sources.
 - c. Explain the production and use of fuel from agricultural crops.*Related Academic Topics (See Appendix A): C1, C2, C4, S4, S6*
Workplace Skills (See Appendix B): WP2, WP7, WP8
- 26. Implement practices that conserve energy.
 - a. Explain the importance of efficiently using energy.
 - b. Select practices that can be used to increase energy efficiency.
 - c. Describe alternative energy sources and the possibilities such sources provide in energy conservation.*Related Academic Topics (See Appendix A): C1, C4, S6, S8*

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

27. Explain sustainable agriculture.
 - a. Describe the importance of sustainable agriculture.
 - b. Identify sustainable agriculture practices.
 - c. Describe the role of agriculture precision technologies in environmental stewardship.

Related Academic Topics (See Appendix A): C1, C4, S2, S4

Workplace Skills (See Appendix B): WP2, WP7, WP8

28. Use the services of agricultural agencies and organizations in maintaining the environment.
 - a. Name government agencies concerned with environmental quality and explain the general role of each agency. Include information on the EPA, DEQ, and OSHA regulations and fines.
 - b. Name organizations concerned with environmental quality and explain the general role of each organization.

Related Academic Topics (See Appendix A): C1, C4

Workplace Skills (See Appendix B): WP1, WP2, WP7, WP8

29. Analyze issues related to the global environment.
 - a. Explain how issues are identified.
 - b. Describe the procedures used in solving environmental problems.

Related Academic Topics (See Appendix A): C1, C4, S4

Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8

30. Identify trends that affect the global environment.
 - a. Investigate the effect of landscape defacement on the environment.
 - b. Evaluate the effect of acid rain deposition on the environment.
 - c. Evaluate the effect of tropical rain forest destruction on the environment.
 - d. Investigate the meaning and importance of ozone destruction on the environment.
 - e. Investigate alternative agricultural crops used in producing food, fiber, and energy.

Related Academic Topics (See Appendix A): C1, C4, S4, S5

Workplace Skills (See Appendix B): WP2, WP7, WP8

31. Describe the effect of agricultural, horticultural, and forestry activities on the environment.
 - a. Identify ways agricultural, horticultural, and forestry activities alter the environment.
 - b. Explain water depletion, degradation, and conservation.
 - c. List and explain causes of soil degradation and conservation.

Related Academic Topics (See Appendix A): C1, S4

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

32. Participate in designing alternative futures.
 - a. Explain the role of forecasting in the environment.
 - b. Describe how futuring is used to assure a desired environment.
 - c. Identify major environmental trends.
 - d. Demonstrate the role of environmental planning.

Related Academic Topics (See Appendix A): C1, C2, C4, S4, S8

Workplace Skills (See Appendix B): WP2, WP7, WP8

33. Assess personal interests in environmental careers.
 - a. Identify career areas in environmental science and technology.
 - b. Describe the education and experience needed for environmental careers.
 - c. Identify important traits for success in environmental careers.

Related Academic Topics (See Appendix A): C1, C4, S8

Workplace Skills (Appendix B): WP1, WP6, WP7, WP8

34. Evaluate availability of environmental occupations in agricultural, horticultural, and forestry areas.
 - a. Determine working conditions in the occupations.
 - b. Identify education and training requirements.
 - c. Locate potential employers.

Related Academic Topics (See Appendix A): C1, C4, S8

Workplace Skills (See Appendix B): WP1, WP6, WP7, WP8

CURRICULUM FRAMEWORK

Course Name: The Science of Agricultural Mechanics

Course CIP Code: 01.0201

Course Description: The Science of Agricultural Mechanics is a course which includes physical science principles and applications in agricultural technology, agricultural mechanics, and agricultural mechanization. Topics of instruction are: safety; physics technology, including work and power, mechanics, heat, light, sound, and magnetism and electricity; concepts of agricultural mechanization; electricity/electronics technology systems; computer technology in agricultural mechanization; hydraulics and pneumatics systems; internal combustion engines; and preventive maintenance and diagnostics. (Prerequisite: Concepts of Agriscience Technology; Grades 10-12; 1 year, 1 Carnegie Unit)

Competencies and Suggested Objectives:

1. Investigate the role of physical and mechanical technology in agriculture.
 - a. Explain how technology has changed how food and fiber are produced.
 - b. Describe the role of power technology in agriculture.
 - c. Describe emerging technologies in site-specific crop management.

Related Academic Topics (See Appendix A): C1, C2, C3, S6
Workplace Skills (See Appendix B): WP1, WP2, WP7, WP8
2. Identify science applications in agriculture technology.
 - a. Explain how the science of mathematics is used in agriculture.
 - b. Explain how physical science is used in agriculture.
 - c. Identify and describe areas of physics in agriculture technology.
 - d. Name and distinguish between the simple machines used in agricultural implements.
 - e. Explain relationship of machines and efficiency in agriculture.
 - f. Identify common tools that apply mechanical advantage by their correct names and demonstrate their correct uses.

Related Academic Topics (See Appendix A): C1, C2, C3, M1, M7, S6, S8
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
3. Plan, implement, and expand supervised experience in physical and mechanical technology.
 - a. Explain the purpose, kinds, and nature of supervised experience.
 - b. Explain how supervised experience is part of a carefully planned and long-term supervised agricultural experience program (SAE).
 - c. Describe how supervised experience relates to achievement of FFA proficiency awards and other activities.
 - d. Identify appropriate experiences for a supervised agricultural experience program.
 - e. Develop short-term, intermediate, and long-term SAE goals.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, S3, S8

- Workplace Skills (See Appendix B): WP1, WP2, WP3, WP6, WP7, WP8*
4. Prepare and keep appropriate written documentation on supervised experience.
 - a. Develop a training plan.
 - b. Develop a training agreement.
 - c. Keep records of competencies developed, inventory, income, and expenses.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, S3, S8
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP6, WP7, WP8
 5. Identify general safety precautions for the work site and laboratory.
 - a. Describe procedures for maintaining a clean and orderly work site.
 - b. Describe personal behavior and personal safety requirements.
 - c. Describe work site and laboratory organization.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6, S8
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
 6. Apply personal behavior and safety procedures required at the work site.
 - a. Demonstrate appropriate personal manners, cooperation, work attitude, and goal setting.
 - b. Demonstrate safe use of head, eye, hearing, body, hand, and foot protective devices.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6, S8
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP8
 7. Apply general safety rules pertaining to hand and stationary power tools.
 - a. Demonstrate rules for hand tools including use, danger points, and observer safety.
 - b. Demonstrate rules for power tools including basic operation, safeguards in place, danger points, observer safety, and electrical safety.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6, S8
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
 8. Apply rules of safety and first aid measures relating to different situations at the work site or in the laboratory.
 - a. Demonstrate rules of safety with fire prevention, oil and grease, lifting and hoisting, electricity, compressed air equipment, and batteries.
 - b. Demonstrate safe storage, use, and disposal of hazardous waste.
 - c. Demonstrate procedures to clear airway passages, stop bleeding, protect a wound, and prevent shock.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6, S8
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
 9. Explain concepts of management and maintenance systems.
 - a. Describe concepts of management of agricultural mechanization.
 - b. Describe concepts of maintenance of agricultural mechanics systems.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
 10. Describe economics of agricultural mechanization.
 - a. Determine cost-benefit of new technology in agricultural mechanization.
 - b. Determine cost of machinery replacement.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8

11. Explore career concepts associated with agricultural mechanization.
 - a. Identify career opportunities in agricultural mechanization.
 - b. Describe educational requirements for participation in careers in agricultural mechanization.
 - c. Identify emerging technology in agricultural mechanization.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
12. Develop related workplace skills required in agricultural mechanization.
 - a. Demonstrate human relations skills required for employees in agricultural mechanization.
 - b. Identify concepts of quality assurance related to agricultural mechanization.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
13. Develop leadership and citizenship skills necessary for employment and successful performance in agricultural mechanization.
 - a. Participate in FFA leadership and citizenship development activities.
 - b. Develop a supervised agricultural experience program (SAE).

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
14. Demonstrate applications of physical and mechanical technology in agricultural enterprises.
 - a. Identify applications of physical and mechanical technology in the local area.
 - b. Interpret information in operators' manuals in the use of equipment.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
15. Apply physical and mechanical technology in operating equipment.
 - a. Identify equipment function controls.
 - b. Demonstrate safe operation of equipment and machinery.
 - c. Select and use materials handling equipment, including augers, conveyors, pumps, and blowers.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
16. Identify computer applications related to physical and mechanical technology.
 - a. Discuss the uses of the computer for information management.
 - b. Demonstrate the use of computers in record keeping, including inventory, service records, and financial records.
 - c. Demonstrate the use of computers in remote sensing.
 - d. Demonstrate the application of computers in monitoring and controlling operations.
 - e. Demonstrate the use of test instruments that involve computer applications.

Related Academic Topics (See Appendix C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
17. Acquire technical information.
 - a. Demonstrate how to search a database on CD-ROM.
 - b. Demonstrate how to use the Internet in obtaining information, such as equipment service data.

- Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6*
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
18. Prepare and send information using electronic technology.
 - a. Use a computer to prepare reports and spreadsheets.
 - b. Use e-mail to send and receive information.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
 19. Identify electrical/electronics systems used in agriculture.
 - a. Demonstrate uses of sensors and monitoring systems.
 - b. Demonstrate uses of controllers.
 - c. Explain the role of integrated systems.
 - d. Select and use electric motors.
 - e. List applications of electrical/electronics systems in plant and animal production.

Related Academic Skills (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
 20. Investigate electrical/electronics systems used on tractors and implements and with stationary systems.
 - a. Interpret symbols, schematics, and blueprints.
 - b. Identify components of electrical systems.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
 21. Identify parts and functions of charging systems on internal combustion engines.
 - a. Operate charging circuit.
 - b. Test charging circuit operation according to specifications.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
 22. Identify components and functions of starting systems on internal combustion engines.
 - a. Operate a starting system.
 - b. Test and service components of a starting system according to specifications.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
 23. Describe how hydraulic and pneumatic systems are used in agriculture.
 - a. Compare and contrast the operation of hydraulic and pneumatic systems.
 - b. Identify the components and functions of hydraulic and pneumatic systems.
 - c. Read and interpret flow charts depicting hydraulic and pneumatic systems.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
 24. Apply safe practices in servicing and using hydraulic and pneumatic systems.
 - a. Inspect system components and assess and correct unsafe conditions.
 - b. Service hydraulic and pneumatic systems according to operators' manual specifications following safe practices.
 - c. Operate hydraulic and pneumatic systems safely.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8

25. Describe the importance and uses of internal combustion engines.
 - a. Explain the meaning of “internal combustion engine” and relate its operation to the combustion triangle.
 - b. Explain and distinguish between the kinds of internal combustion engines, including 2-cycle and 4-cycle gasoline engines and diesel engines.
 - c. List important principles in the safe and efficient operation of internal combustion engines.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6

Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8

26. Identify parts and functions of internal combustion engine systems.
 - a. Demonstrate lubrication system parts and functions and the kinds of lubricants used.
 - b. Demonstrate cooling system parts and functions.
 - c. Demonstrate fuel system components and functions.
 - d. Demonstrate ignition system components and functions.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6

Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8

27. Disassemble and inspect internal combustion systems.

- a. Disassemble an internal combustion engine.
 - b. Inspect internal combustion engine parts to specifications.
 - c. Identify failed component parts and obtain replacement parts.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6

Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8

28. Assemble, operate, and test an internal combustion engine following safe and approved procedures.

- a. Assemble an internal combustion engine according to manufacturer's specifications.
 - b. Operate an assembled engine.
 - c. Test an engine for performance according to manufacturer's specifications.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6, M7

Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8

29. Identify the importance of preventive maintenance.

- a. Explain the meaning of preventive maintenance.
 - b. Describe the use of an operator's manual in identifying needed maintenance.
 - c. List general preventive maintenance practices.
 - d. Describe the meaning and importance of “maintenance intervals.”

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6

Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8

30. Identify components and systems on small engines requiring preventive maintenance.

- a. Use manufacturers' manuals to identify preventive maintenance recommendations.
 - b. Explain the importance of routine maintenance based on manufacturer's recommendations.
 - c. Identify safety practices while performing preventive maintenance activities.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6

- Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8*
31. Perform basic preventive maintenance service on a small engine.
- Service the air filter on an engine.
 - Service the fuel system on an engine.
 - Service the lubrication system on an engine.
 - Service the cooling system on an engine.
 - Service the exhaust system on an engine.
 - Service the starting system on an engine.
 - Service the ignition system on an engine.
- Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6, M7*
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
32. Identify principles of diagnostics.
- Explain the meaning and importance of diagnostics.
 - Describe the processes used in diagnostics, including equipment.
 - Demonstrate how to identify a problem that is preventing proper function of equipment.
 - Demonstrate how to identify the system where a problem is occurring.
 - Demonstrate how to identify the probable cause of a problem.
- Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6*
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
33. Apply diagnostic procedures in solving a problem.
- Operate the equipment as best possible to assess a problem.
 - Explain how to isolate a problem.
 - Select and use the proper diagnostic equipment and service data.
 - Perform the needed work and repairs according to manufacturer's specifications.
- Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6,*
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
34. Identify common equipment and tools used in welding.
- Describe major types of welders including electric arc and metal inert gas (MIG).
 - Describe tools used with each type of welding.
- Related Academic Topics (See Appendix C1, C2, C3, C4*
Workplace Skills (See Appendix B): WP1, WP2, WP6, WP7, WP8
35. Apply safety precautions used in welding.
- Use eye protection and proper apparel.
 - Use ventilation and materials handling procedures.
- Related Academic Topics (See Appendix A): C1, C2, C3, C4*
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
36. Describe different welding supplies used in welding.
- Identify low hydrogen, mild steel, and alloy welding electrodes.
 - Identify the different types of gases involved in the shielded arc welding process.
- Related Academic Topics (See Appendix A): C1, C2, C3, C4*
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
37. Explain the meanings of the numbers in the electrode classification system.

- a. Identify electrodes based upon tensile strength, position, and special characteristics.
- b. Identify different types of wire and wire sizes (e.g., flux cored wire).
- c. Describe the function of welding flux.
Related Academic Topics (See Appendix A): C1, C2, C3, C4, M1, M8
Workplace Skills (See Appendix B): WP1, WP2, WP7, WP8
38. Compare the different types of welds.
 - a. Identify bead, groove, and fillet welds.
 - b. Identify the types of weld joints including T, lap, corner, edge, and butt.
Related Academic Topics (See Appendix A): C1, C2, C3, C4
Workplace Skills (See Appendix B): WP1, WP2, WP7, WP8
39. Perform various welding techniques.
 - a. Perform welding techniques including start, stop and re-start, pad construction, flat butt construction, and flat fillet.
 - b. Utilize various welding equipment including electric arc and MIG.
Related Academic Topics (See Appendix A): C1, C2, C3, C4
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
40. Identify parts of the oxyacetylene welding equipment.
 - a. Assemble cutting attachment with regulator and gauges.
 - b. Assemble welding attachments with regulators and gauges.
Related Academic Topics (See Appendix A): C1, C2, C3, C4
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
41. Apply safety procedures for using oxyacetylene equipment.
 - a. Demonstrate removal of flammable materials.
 - b. Demonstrate lighting, adjustment, and operations.
Related Academic Topics (See Appendix A): C1, C2, C3, C4
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP7, WP8
42. Identify the different types of oxyacetylene flames.
 - a. Compare neutral, oxidizing, and carburizing flames.
 - b. Demonstrate proper adjustment of flames.
Related Academic Topics (See Appendix A): C2, C3, C4
Workplace Skills (See Appendix B): WP4, WP7, WP8
43. Operate oxyacetylene equipment.
 - a. Set up and adjust oxyacetylene equipment.
 - b. Make a cut in mild steel.
Related Academic Topics (See Appendix A): C2, C3
Workplace Skills (See Appendix B): WP1, WP2, WP4, WP7, WP8

CURRICULUM FRAMEWORK

Course Name: The Science of Agricultural Plants

Course CIP Code: 02.0401

Course Description: The Science of Agricultural Plants is a course which develops competencies related to the production of plants for food, fiber, ornamental, and other purposes. It includes instruction in the basic principles of plant science as well as cultural practices and the use of technology to efficiently and effectively meet consumer needs. Plant growing structures, plant classification, growth, propagation, culture, pests, harvesting, and marketing are included. (Prerequisite: Concepts of Agriscience Technology or Biology; Grades 10-12; 1 year, 1 Carnegie Unit)

Competencies and Suggested Objectives:

1. Investigate student organizations in the plant agriculture industry.
 - a. Identify student organizations related to agriculture.
 - b. List the requirements for Chapter, State, and American FFA Degrees.
 - c. Prepare for student development on the local, state, and national level.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
2. Demonstrate communication skills for employment in the plant agriculture industry.
 - a. Identify skills required by employers.
 - b. Explain the importance of responding to authority.
 - c. Explain the importance of ethics in the workplace.
 - d. Demonstrate the proper use of a business telephone.
 - e. Write a business letter using accepted procedures.
 - f. Complete a resume, letter of application, and job application form.
 - g. Role play a job interview in the classroom.

Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6
Workplace Skills (See Appendix B): WP2, WP3, WP6, WP7, WP8
3. Use the Internet to discover emerging technologies.
 - a. Investigate topics in plant agriculture and make an oral presentation to the class.
 - b. Investigate careers in plant agriculture.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP2, WP3, WP6, WP7, WP8
4. Plan, implement, and expand supervised experience in plant agriculture.
 - a. Explain the purpose, kinds, and nature of supervised experience.
 - b. Explain how supervised experience is part of a carefully planned and long-term supervised agricultural experience program (SAE).
 - c. Describe how supervised experience relates to achievement of FFA proficiency awards and other activities.
 - d. Identify appropriate experiences for a supervised agricultural experience program.

- e. Develop short-term, intermediate, and long-term SAE goals.
Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, S3, S8
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP6, WP7, WP8
5. Prepare and keep appropriate written documentation on supervised experience.
 - a. Develop a training plan.
 - b. Develop a training agreement.
 - c. Keep records of competencies developed, inventory, income, and expenses.
Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, S3, S8
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP6, WP7, WP8
6. Examine how plants are used to meet human needs.
 - a. Explain the importance of plants in meeting human food needs.
 - b. Explain how plants are used as a source of clothing material.
 - c. Identify how wood and wood products are used in construction.
Related Academic Topics (See Appendix A): C1, C2, C4, C6, S2, S8
Workplace Skills (See Appendix B): WP2, WP4, WP6, WP7, WP8
7. Examine plant production enterprises.
 - a. Identify different types of field crops used for food and fiber production.
 - b. Identify the different types of horticulture crops grown including ornamental horticulture, floriculture, landscape horticulture, etc.
 - c. Define forestry and the products made from trees.
 - d. Identify important plants and their uses including grain crops, sugar and oil crops, fiber crops, vegetable, fruit, and nut crops.
Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M1, M4, M7, S8
Workplace Skills (See Appendix B): WP2, WP4, WP6, WPP7, WP8
8. Assess the functions and importance of plants.
 - a. Explain why plants are essential for life.
 - b. Identify the parts of plants that are used to meet human needs.
Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M1, S2, S5, S8
Workplace Skills (See Appendix B): WP2, WP4, WP6, WP7, WP8
9. Examine the principles of plant growth.
 - a. Discuss the principles of cell division, including both mitosis and meiosis.
 - b. Demonstrate the use of growth retardants and stimulants.
 - c. List and explain types of tropism.
Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7, S2, S5, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
10. Describe nutrients necessary for plant growth.
 - a. Explain macro and micro nutrients.
 - b. Discuss the Law of Limiting Factors.
 - c. Describe the effect of excesses and deficiencies of plant nutrients.
Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M1, M7, S2, S5
Workplace Skills (See Appendix B): WP2, WP4, WP6, WP7, WP8
11. Identify the pH of soil and its effect on plant nutrition and growth.
 - a. Discuss soil pH.
 - b. Predict the effect various pH levels will have on plant nutrition and growth.
Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M1, S2, S5, S8
Workplace Skills (See Appendix B): WP2, WP4, WP6, WP7, WP8

12. Use soil test results to calculate application rates of fertilizer on a selected crop.
 - a. Demonstrate the proper way of taking a soil sample.
 - b. Analyze a soil sample for nutrient deficiencies.
 - c. Calculate fertilizer application rates to meet nutritional requirements of a crop.
 - d. Select fertilizer application methods for different plant enterprises.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M1, M4, M7, S2
Workplace Skills (See Appendix B): WP2, WP4, WP6, WP7, WP8
13. Examine the methods by which plants are classified.
 - a. Explain the botanical classification of plants.
 - b. Explain variety and variety selection of various plants.
 - c. Explain how plants are classified according to life cycle.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
14. Examine the anatomy of a plant.
 - a. Identify the types and structures of leaves.
 - b. Draw and label the parts of a leaf.
 - c. Identify different types of stems.
 - d. Draw and label the parts of a stem.
 - e. Identify different types of root systems.
 - f. Draw and label the parts of a root.
 - g. Identify the types and structure of a flower.
 - h. Draw and label the parts of a complete flower.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
15. Assess the physiological principles of a plant (how the plant functions as a system).
 - a. Describe photosynthesis, including the chemical reactions that occur.
 - b. Describe the process of transpiration.
 - c. Describe the process of respiration.
 - d. Explain how each plant part and process is important in the growth and development of a plant.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
16. Examine the principles of genetics.
 - a. Explain the principles of Mendel's law.
 - b. Identify the makeup of chromosomes in a plant cell.
 - c. Describe the structure of DNA.
 - d. Discuss the use of recombinant DNA in producing new varieties of plants.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M1, M7, S2, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
17. Distinguish between sexual and asexual reproduction.
 - a. Explain and list advantages and disadvantages of sexual reproduction in plants.
 - b. Use seed germination tests.
 - c. Describe the conditions needed for good seed germination.
 - d. Describe the two types of seed leaves.

- e. Explain the importance of seed quality.
 - f. Explain the methods of asexual reproduction of plants.
- Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M1, M7, S2, S8*
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
18. Demonstrate the propagation of plants.
 - a. Use tissue culture, cuttings, layering, budding, and separation and division to propagate plants.
 - b. Demonstrate the use of rooting hormones.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7, S2, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
 19. Describe the various plant growing structures and the environmental controls used by each type.
 - a. Illustrate five different greenhouse structures by drawing the end view.
 - b. Explain the uses of hotbeds and cold frames.
 - c. Discuss the purpose of a lath house and shade house.
 - d. Differentiate between environmental controls including humidistat, thermostat, cooling, watering, and heating.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M4, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
 20. Examine plant production in growing structures.
 - a. Distinguish between bedding, ornamental, and seasonal potted plants.
 - b. Identify five common bedding, ornamental, and seasonal potted plants.
 - c. Grow a selection of common bedding plants.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7
 21. Examine the types of growing media.
 - a. Explain the contents of soil including minerals, water, organic matter, and other constituents.
 - b. Explain the soil components including sand, silt, clay, and others.
 - c. Explain land classification and use.
 - d. Identify the characteristics of an ideal growing medium.
 - e. Identify different types of soil-less growing media mixes.
 - f. Explain hydroponic plant growth and its advantages and disadvantages.
 - g. Compare and contrast soil, soil-less media, and hydroponics.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2, S4, S8
Workplace Skills (See Appendix B): WP2, WP4, WP6, WP7, WP8
 22. Discuss the different soil amendments.
 - a. Explain organic soil amendments including bark, compost, leaf mold, and peat moss.
 - b. Explain inorganic soil amendments including perlite, sand, and vermiculite.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2, S4
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
 23. Determine the conditions needed for plant growth in a greenhouse.
 - a. Explain the importance of light in plant growth.
 - b. Explain how plants respond to different light rays.
 - c. Explain how temperature affects the growth of a plant.

- d. Describe the proper water management in growing plants.
Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2, S6, S8
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
24. Assess tillage and cultivation practices.
 - a. Explain the different types of tillage practices.
 - b. Name the advantages and disadvantages of plowing and tillage.
 - c. Name the advantages and disadvantages of non-tillage planting.
 - d. Contrast and compare the two major groups of fertilizers.
 - e. Explain the role of moisture management in plant production.
 - f. Define irrigation and the types of irrigation systems.
 - g. Develop an irrigation schedule.
 - h. Determine water quality for irrigation.
 - i. Identify sources of irrigation water.*Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7, S4*
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
25. Explain the meaning and importance of harvesting.
 - a. Define harvesting.
 - b. Describe the importance of harvesting in successful plant production.*Related Academic Topics (See Appendix A): C1, C2*
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
26. Explain the different harvesting methods, equipment, and facilities.
 - a. Describe the methods of harvesting.
 - b. Explain the timing of harvest as related to maturity, nutrition, and marketing.
 - c. Discuss the different types of harvesting equipment including containers, combines, pickers, and diggers.
 - d. Discuss the different types of storage facilities.
 - e. Discuss preharvest loss and harvest loss.*Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M1, M7*
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
27. Assess the effects of pests on plant production.
 - a. Explain plant sanitation as related to production, animal health, and HACCP.
 - b. Explain common pests and how plants resist pests.
 - c. Identify types and causes of disease, including viral, fungal, and bacterial diseases.
 - d. List common diseases in plants such as rot, wilt, blight, etc.
 - e. Identify how diseases are spread.
 - f. Demonstrate how diseases are prevented through sanitation.*Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2, S8*
Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8
28. Discuss biological control systems.
 - a. List five varieties of plants resistant to disease and insects.
 - b. List five plants that show promise as containing natural pesticides.
 - c. Examine the life cycles of insects as related to methods of biological control.
 - d. Explain how crop rotation can be used as a method of controlling pests and diseases in plants.
 - e. Identify types of beneficial insects and how they are used to control pests.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

29. Describe chemical control with pests.
 - a. Discuss how chemical pesticides work.
 - b. Explain the different types of pesticides.
 - c. Analyze factors in selection of pesticides.
 - d. Interpret safety precautions and mixing formulations on a pesticide label.
 - e. Demonstrate proper method of mixing and using agricultural chemicals.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M1, M4, M7, S2, S5, S8

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

30. Demonstrate different types of mechanical pest control.
 - a. Identify and explain mechanical pest control including plowing, mowing, mulching, and hoeing.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S3

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

31. Examine integrated pest management.
 - a. Discuss integrated pest management.
 - b. Design an integrated pest management system for a designated crop.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S8

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

32. Explain the management practices needed in plant production.
 - a. Identify factors to consider in plant selection.
 - b. Determine market availability.
 - c. Describe the importance of the likes and dislikes of growers and customers.
 - d. Identify software available for farm record keeping and management.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S2, S8

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

33. Examine marketing in plant production.
 - a. Define marketing in plant production.
 - b. Explain cash markets and futures.
 - c. Explain how to use the Internet in selecting a marketing strategy.
 - d. Discuss the selection of the best marketing alternative.
 - e. Evaluate niches in the market place.
 - f. Identify the importance of timing harvesting in marketing.
 - g. Discuss the importance of inventory control.
 - h. Define wholesale and retail marketing.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

34. Examine how agricultural activities can affect the environment.
 - a. Explain sustainable agriculture.
 - b. Distinguish between the ways agricultural activities can potentially pollute the environment including point and non-point source pollution.
 - c. Explain the dangers of water table depletion by agriculture use.
 - d. Explain soil and water conservation methods.
 - e. Explain the relationship between ozone depletion and environmental pollution.

f. Explain global warming and the greenhouse effect.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S4, S8

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

35. Discuss disposal methods of agricultural waste.

a. Determine reentry time into treated areas after chemical application.

b. Discuss the effects of increased carbon dioxide levels on plants.

c. Describe the causes of soil contamination.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, S4, S8

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

36. Examine precision farming as a new technology in plant production.

a. Describe precision farming.

b. Identify the use of microcomputers in precision farming.

c. Use a global positioning system in plant production.

d. Demonstrate geographic information system technology in plant production.

e. Demonstrate variable rate application equipment in precision farming.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7, S6, S8

Workplace Skills (See Appendix B): WP2, WP6, WP7, WP8

CURRICULUM FRAMEWORK

Course Name: Agribusiness and Entrepreneurship Technology

Course CIP Code: 01.0103

Course Description: This is a course in the role and characteristics of agricultural and related businesses in our economy. The purpose of this course is to: provide a basis for making effective business decisions; setting goals; assessing and solving problems; determining financial progress and success; evaluating the management of resources; and gaining skills useful in everyday life in the diverse fields of agribusiness and entrepreneurship. Students explore principles in the successful organization and management of businesses as owners, managers, and operators. (Grades 11-12; 1 year, 1 Carnegie Unit)

Competencies and Suggested Objectives:

1. Describe terms associated with agribusiness and entrepreneurship.
 - a. Define terms associated with agribusiness.
 - b. Define terms associated with entrepreneurship.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP2, WP3, WP6, WP7, WP8
2. Explain types of business organizations.
 - a. Identify the types of business organizations.
 - b. Identify characteristics of business organizations.
 - c. Describe the advantages and disadvantages of different types of business organizations.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP6, WP7, WP8
3. Describe concepts of entrepreneurship.
 - a. Describe the characteristics of successful entrepreneurs.
 - b. Discuss the advantages and disadvantages of being an entrepreneur.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP6, WP7, WP8
4. Explain personal financial management.
 - a. Describe the importance of personal financial management.
 - b. Oral/written assignment to categorize personal income and expenses.
 - c. Practical exercise to prepare a personal budget.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
5. Describe how to manage a personal checking and savings account.
 - a. Identify types of checking and savings accounts.
 - b. Maintain a checking and savings register.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7,

WP8

6. Describe personal investment opportunities.
 - a. Identify types of investments with reasons for each.
 - b. Explain the concepts of simple and compound interest.
 - c. Calculate the future value of money.
 - d. Establish personal goals for savings and investments.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
7. Explain procedures for use of personal credit.
 - a. Identify the types and sources of credit.
 - b. Describe procedures for obtaining credit.
 - c. Demonstrate procedures for wise use of personal credit.
 - d. Relate personal financial management skills to supervised experience and business.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
8. Describe use of personal insurance.
 - a. Identify types of medical insurance.
 - b. Identify types of life insurance.
 - c. Identify types of property and casualty insurance.
 - d. Develop a proposed personal insurance portfolio.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
9. Explain the importance of an accurate inventory.
 - a. Identify the specific uses of an inventory.
 - b. Describe the specific uses of an inventory.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
10. Determine when to inventory.
 - a. Distinguish timing of inventory according to fiscal year.
 - b. Distinguish timing of inventory according to calendar year.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
11. Determine what to inventory.
 - a. Distinguish among liquid assets, consumable supplies, and capital assets.
 - b. Account for liabilities.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
12. Establish inventory values.
 - a. Calculate inventory values of non-depreciable assets.

- b. Calculate inventory values of depreciable assets.
 - c. Describe methods of depreciation.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
- 13. Describe the purpose of a balance sheet.
 - a. Explain the uses of a balance sheet.
 - b. Explain the timing of preparing a balance sheet.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
- 14. Explain the relationship of a balance sheet with other base financial statements.
 - a. Describe the relationship between a balance sheet and an income statement.
 - b. Describe the relationship between a balance sheet and a statement of cash flow.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
- 15. Describe the major areas of a balance sheet.
 - a. Identify each of the areas of a balance sheet.
 - b. Describe structure and components of a balance sheet.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
- 16. Complete a balance sheet.
 - a. Identify assets.
 - b. Identify liabilities.
 - c. Calculate owner equity.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
- 17. Analyze an income statement.
 - a. Summarize revenues and expenses.
 - b. Determine profit and/or loss.
 - c. Explain changes in owner equity.
 - d. Calculate financial measures of profitability, financial efficiency, and repayment capacity.
 - e. Use an income statement to support a loan application.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
- 18. Establish the relationship of an income statement with other base financial statements.
 - a. Describe the relationship between an income statement and a balance sheet.
 - b. Describe the relationship between an income statement and a statement of cash flow.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8

19. Differentiate between cash and accrual accounting.

- a. Define cash accounting system.
- b. Define accrual accounting system.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8

20. Compare statement of cash flows versus cash flow statement.
 - a. Describe the differences between a statement of cash flows and a cash flow statement.
 - b. Describe uses for a statement of cash flows.
 - c. Describe uses for a cash flow statement.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP6, WP7, WP8

21. Describe the relationship of statement of cash flows with other base financial statements.
 - a. Describe the relationship between a statement of cash flows and a balance sheet.
 - b. Describe the relationship between a statement of cash flows and an income statement.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP6, WP7, WP8

22. Explain sources of cash flow.
 - a. Identify sources of cash flow.
 - b. Distinguish between sources of cash flow.
 - c. Identify a financial activity associated with cash flow.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP6, WP7, WP8

23. Describe the purposes of a statement of owner equity.
 - a. Identify the purposes of a statement of owner equity.
 - b. Analyze possible changes in total owner equity.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8

24. Describe the relationship of a statement of owner equity with other base financial statements.
 - a. Utilize a balance sheet and an income statement to reconcile owner equity.
 - b. Utilize a statement of cash flows to reconcile owner equity.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8

25. Identify key areas of financial analysis.
 - a. Determine liquidity.
 - b. Determine solvency.

- c. Determine profitability.
- d. Establish repayment capacity.
- e. Analyze financial efficiency.
- Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7*
- Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8*
- 26. Identify guidelines for applying the use of financial measures.
 - a. Identify limitations in using and comparing various financial measures of financial condition.
 - b. Interpret the various financial criteria which determine the condition and performance of a business.
 - c. Project future business trends.
 - Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7*
 - Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8*
- 27. Identify steps in the decision making process.
 - a. Define steps in the decision making process.
 - b. Establish relationships between the steps in the decision making process.
 - Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6*
 - Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP6, WP7, WP8*
- 28. Describe the purposes of a budget.
 - a. Identify the purposes of a budget.
 - b. Identify the components of a budget.
 - Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6*
 - Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP6, WP7, WP8*
- 29. Prepare budgets.
 - a. Conduct systematic planning using the decision making process.
 - b. Prepare a budget.
 - Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7*
 - Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8*
- 30. Describe types of capital.
 - a. Identify different types of capital.
 - b. Describe uses of different types of capital.
 - Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6*
 - Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP6, WP7, WP8*
- 31. Describe borrowing and decision making.
 - a. Use tools for evaluating capital needs.
 - b. Evaluate risks associated with borrowing.
 - Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7*
 - Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8*
- 32. Describe loan options.
 - a. Identify different types of loan options.
 - b. Identify sources of loan funds.
 - c. Calculate the cost of borrowing.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8

33. Identify documents filed with an employer.
 - a. Identify payroll tax documents to be filed with an employer.
 - b. Prepare documents necessary for tax withholding.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
34. Calculate take-home pay.
 - a. Determine gross wages.
 - b. Determine taxes and withholdings.
 - c. Calculate net pay and net income.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
35. File business income tax returns.
 - a. Identify business tax requirements.
 - b. Collect data for filing business income tax returns.
 - c. Select appropriate forms for filing business income tax returns.
 - d. Complete forms as required.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8
36. Describe legal aspects of business transactions.
 - a. Identify common legal documents.
 - b. Identify applications of legal documents, such as contracts, mortgage, promissory notes, bill of sale, leases, and deeds.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP6, WP7, WP8
37. Identify types of laws related to business.
 - a. Identify forms of taxation.
 - b. Describe the need for permits and licensing.
 - c. Identify the types of insurance required in business.
 - d. Describe liability and negligence as related to business.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP6, WP7, WP8
38. Describe health and safety regulations regarding agribusinesses.
 - a. Identify local, state, and federal agencies responsible for employee health and safety regulations.
 - b. Describe sources of information regarding health and safety regulations.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6
Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP6, WP7, WP8
39. Describe management information systems.
 - a. Identify components of the management system.
 - b. Collect and record data for the management information system.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7

Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8

40. Complete forms for management information.
- a. Use information in the system to complete business documents.
 - b. Use information in the system to complete supervised experience documents.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7

Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8

41. Develop a marketing plan.
- a. Identify the components of a marketing plan.
 - b. Develop a marketing plan.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7

Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8

42. Explore international marketing opportunities.
- a. Explore the importance of international marketing trade.
 - b. Describe economic and legal issues of international trade.
 - c. Investigate the process of trading agricultural products in international markets.

Related Academic Topics (See Appendix A): C1, C2, C4, C5, C6, M7

Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8

APPENDIX A:
RELATED ACADEMIC TOPICS

June 21, 2002

APPENDIX A

RELATED ACADEMIC TOPICS FOR COMMUNICATIONS

- C1 Interpret written material.
- C2 Interpret visual materials (maps, charts, graphs, tables, etc.).
- C3 Listen, comprehend, and take appropriate actions.
- C4 Access, organize, and evaluate information.
- C5 Use written and/or oral language skills to work cooperatively to solve problems, make decisions, take actions, and reach agreement.
- C6 Communicate ideas and information effectively using various oral and written forms for a variety of audiences and purposes.

EXPANDED TOPICS FOR COMMUNICATIONS

TOPIC C1: Interpret written material.

- C1.01 Read and follow complex written directions.
- C1.02 Recognize common words and meanings associated with a variety of occupations.
- C1.03 Adjust reading strategy to purpose and type of reading.
- C1.04 Use sections of books and reference sources to obtain information.
- C1.05 Compare information from multiple sources and check validity.
- C1.06 Interpret items and abbreviations used in multiple forms.
- C1.07 Interpret short notes, memos, and letters.
- C1.08 Comprehend technical words and concepts.
- C1.09 Use various reading techniques depending on purpose for reading.
- C1.10 Find, read, understand, and use information from printed matter or electronic sources.

TOPIC C2: Interpret visual materials (maps, charts, graphs, tables, etc.).

- C2.01 Use visuals in written and in oral presentations.
- C2.02 Recognize visual cues to meaning (layout, typography, etc.).
- C2.03 Interpret and apply information using visual materials.

TOPIC C3: Listen, comprehend, and take appropriate action.

- C3.01 Identify and evaluate orally-presented messages according to purpose.
- C3.02 Recognize barriers to effective listening.
- C3.03 Recognize how voice inflection changes meaning.
- C3.04 Identify speaker signals requiring a response and respond accordingly.
- C3.05 Listen attentively and take accurate notes.
- C3.06 Use telephone to receive information.
- C3.07 Analyze and distinguish information from formal and informal oral presentations.

TOPIC C4: Access, organize, and evaluate information.

- C4.01 Distinguish fact from opinion.
- C4.02 Use various print and non-print sources for specialized information.
- C4.03 Interpret and distinguish between literal and figurative meaning.
- C4.04 Interpret written or oral communication in relation to context and writer's point of view.
- C4.05 Use relevant sources to gather information for written or oral communication.

TOPIC C5: Use written and/or oral language skills to work cooperatively to solve problems, make decisions, take actions, and reach agreement.

- C5.01 Select appropriate words for communication needs.
- C5.02 Use reading, writing, listening, and speaking skills to solve problems.
- C5.03 Compose inquiries and requests.
- C5.04 Write persuasive letters and memos.
- C5.05 Edit written reports, letters, memos, and short notes for clarity, correct grammar, and effective sentences.
- C5.06 Write logical and understandable statements, phrases, or sentences for filling out forms, for correspondence or reports.
- C5.07 Write directions or summaries of processes, mechanisms, events, or concepts.
- C5.08 Select and use appropriate formats for presenting reports.
- C5.09 Convey information to audiences in writing.
- C5.10 Compose technical reports and correspondence that meet accepted standards for written communications.

TOPIC C6: Communicate ideas and information using oral and written forms for a variety of audiences and purposes.

- C6.01 Give complex oral instructions.
- C6.02 Describe a business or industrial process/mechanism.
- C6.03 Participate effectively in group discussions and decision making.
- C6.04 Produce effective oral messages utilizing different media.
- C6.05 Explore ideas orally with partners.
- C6.06 Participate in conversations by volunteering information when appropriate and asking relevant questions when appropriate.
- C6.07 Restate or paraphrase a conversation to confirm one's own understanding.
- C6.08 Gather and provide information utilizing different media.
- C6.09 Prepare and deliver persuasive, descriptive, and demonstrative oral presentations.

RELATED ACADEMIC TOPICS FOR MATHEMATICS

- M1 Relate number relationships, number systems, and number theory.
- M2 Explore patterns and functions.
- M3 Explore algebraic concepts and processes.
- M4 Explore the concepts of measurement.
- M5 Explore the geometry of one-, two-, and three-dimensions.
- M6 Explore concepts of statistics and probability in real world situations.
- M7 Apply mathematical methods, concepts, and properties to solve a variety of real-world problems.

EXPANDED TOPICS FOR MATHEMATICS

TOPIC M1: Relate number relationships, number systems, and number theory.

- M1.01 Understand, represent, and use numbers in a variety of equivalent forms (integer, fraction, decimal, percent, exponential, and scientific notation) in real world and mathematical problem situations.
- M1.02 Develop number sense for whole numbers, fractions, decimals, integers, and rational numbers.
- M1.03 Understand and apply ratios, proportions, and percents in a wide variety of situations.
- M1.04 Investigate relationships among fractions, decimals, and percents.
- M1.05 Compute with whole numbers, fractions, decimals, integers, and rational numbers.
- M1.06 Develop, analyze, and explain procedures for computation and techniques for estimations.
- M1.07 Select and use an appropriate method for computing from among mental arithmetic, paper-and-pencil, calculator, and computer methods.
- M1.08 Use computation, estimation, and proportions to solve problems.
- M1.09 Use estimation to check the reasonableness of results.

TOPIC M2: Explore patterns and functions.

- M2.01 Describe, extend, analyze, and create a wide variety of patterns.
- M2.02 Describe and represent relationships with tables, graphs, and rules.
- M2.03 Analyze functional relationships to explain how a change in one quantity results in a change in another.
- M2.04 Use patterns and functions to represent and solve problems.
- M2.05 Explore problems and describe results using graphical, numerical, physical, algebraic, and verbal mathematical models or representations.
- M2.06 Use a mathematical idea to further their understanding of other mathematical ideas.
- M2.07 Apply mathematical thinking and modeling to solve problems that arise in other disciplines, such as art, music, and business.

TOPIC M3: Explore algebraic concepts and processes.

- M3.01 Represent situations and explore the interrelationships of number patterns with tables, graphs, verbal rules, and equations.
- M3.02 Analyze tables and graphs to identify properties and relationships and to interpret expressions and equations.
- M3.03 Apply algebraic methods to solve a variety of real world and mathematical problems.

TOPIC M4: Explore the concepts of measurement.

- M4.01 Estimate, make, and use measurements to describe and compare phenomena.
- M4.02 Select appropriate units and tools to measure to the degree of accuracy required in a particular situation.
- M4.03 Extend understanding of the concepts of perimeter, area, volume, angle measure, capacity, and weight and mass.
- M4.04 Understand and apply reasoning processes, with special attention to spatial reasoning and reasoning with proportions and graphs.

TOPIC M5: Explore the geometry of one-, two-, and three-dimensions.

- M5.01 Identify, describe, compare, and classify geometric figures.
- M5.02 Visualize and represent geometric figures with special attention to developing spatial sense.
- M5.03 Explore transformations of geometric figures.
- M5.04 Understand and apply geometric properties and relationships.
- M5.05 Classify figures in terms of congruence and similarity and apply these relationships.

TOPIC M6: Explore the concepts of statistics and probability in real world situations.

- M6.01 Systematically collect, organize, and describe data.
- M6.02 Construct, read, and interpret tables, charts, and graphs.
- M6.03 Develop an appreciation for statistical methods as powerful means for decision making.
- M6.04 Make predictions that are based on exponential or theoretical probabilities.
- M6.05 Develop an appreciation for the pervasive use of probability in the real world.

TOPIC M7: Apply mathematical methods, concepts, and properties to solve a variety of real-world problems.

- M7.01 Use computers and/or calculators to process information for all mathematical situations.
- M7.02 Use problem-solving approaches to investigate and understand mathematical content.
- M7.03 Formulate problems from situations within and outside mathematics.
- M7.04 Generalize solutions and strategies to new problem situations.

RELATED ACADEMIC TOPICS FOR SCIENCE

- S1 Explain the Anatomy and Physiology of the human body.
- S2 Apply the basic biological principles of Plants, Viruses and Monerans, Algae, Protista, and Fungi.
- S3 Relate the nine major phyla of the kingdom animalia according to morphology, anatomy, and physiology.
- S4 Explore the chemical and physical properties of the earth to include Geology, Meteorology, Oceanography, and the Hydrologic Cycle.
- S5 Investigate the properties and reactions of matter to include symbols, formulas and nomenclature, chemical equations, gas laws, chemical bonding, acid-base reactions, equilibrium, oxidation-reduction, nuclear chemistry, and organic chemistry.
- S6 Explore the principles and theories related to motion, mechanics, electricity, magnetism, light energy, thermal energy, wave energy, and nuclear physics.
- S7 Explore the principles of genetic and molecular Biology to include the relationship between traits and patterns of inheritance, population genetics, the structure and function of DNA, and current applications of DNA technology.
- S8 Apply concepts related to the scientific process and method to include safety procedures for classroom and laboratory; use and care of scientific equipment; interrelationships between science, technology and society; and effective communication of scientific results in oral, written, and graphic form.

EXPANDED TOPICS FOR SCIENCE

TOPIC S1: Explain the Anatomy and Physiology of the human body.

- S1.01 Recognize common terminology and meanings.
- S1.02 Explore the relationship of the cell to more complex systems within the body.
- S1.03 Summarize the functional anatomy of all the major body systems.
- S1.04 Relate the physiology of the major body systems to its corresponding anatomy.
- S1.05 Compare and contrast disease transmission and treatment within each organ system.
- S1.06 Explore the usage of medical technology as related to human organs and organ systems.
- S1.07 Explain the chemical composition of body tissue.

TOPIC S2: Apply the basic biological principles of Plants, Viruses and Monerans, Algae, Protista, and Fungi.

- S2.01 Identify the major types and structures of plants, viruses, monera, algae protista, and fungi.
- S2.02 Explain sexual and asexual reproduction.
- S2.03 Describe the ecological importance of plants as related to the environment.
- S2.04 Analyze the physical chemical and behavioral process of a plant.

TOPIC S3: Relate the nine major phyla of the kingdom animalia according to morphology, anatomy, and physiology.

S3.01 Explain the morphology, anatomy, and physiology of animals.

S3.02 Describe the characteristics, behaviors, and habitats of selected animals.

TOPIC S4: Explore the chemical and physical properties of the earth to include Geology, Meteorology, Oceanography, and the Hydrologic Cycle.

S4.01 Examine minerals and their identification, products of the rock cycle, byproducts of weathering, and the effects of erosion.

S4.02 Relate the Hydrologic Cycle to include groundwater its zones, movement, and composition; surface water systems, deposits, and runoff.

S4.03 Consider the effects of weather and climate on the environment.

S4.04 Examine the composition of seawater; wave, tides, and currents; organisms, environment, and production of food; energy, food and mineral resources of the oceans.

TOPIC S5: Investigate the properties and reactions of matter to include symbols, formulas and nomenclature, chemical equations, gas laws, chemical bonding, acid-base reactions, equilibrium, oxidation-reduction, nuclear chemistry, and organic chemistry.

S5.01 Examine the science of chemistry to include the nature of matter, symbols, formulas and nomenclature, and chemical equations.

S5.02 Identify chemical reactions including precipitation, acids-bases, and reduction-oxidation.

S5.03 Explore the fundamentals of chemical bonding and principles of equilibrium.

S5.04 Relate the behavior of gases.

S5.05 Investigate the structure, reactions, and uses of organic compounds; and investigate nuclear chemistry and radiochemistry.

TOPIC S6: Explore the principles and theories related to motion, mechanics, electricity, magnetism, light energy, thermal energy, wave energy, and nuclear physics.

S6.01 Examine fundamentals of motion of physical bodies and physical dynamics.

S6.02 Explore the concepts and relationships among work, power, and energy.

S6.03 Explore principles, characteristics, and properties of electricity, magnetism, light energy, thermal energy, and wave energy.

S6.04 Identify principles of modern physics related to nuclear physics.

TOPIC S7: Explore the principles of genetic and molecular Biology to include the relationship between traits and patterns of inheritance; population genetics, the structure and function of DNA, and current applications of DNA technology.

- S7.01 Examine principles, techniques, and patterns of traits and inheritance in organisms.
- S7.02 Apply the concept of population genetics to both microbial and multicellular organism.
- S7.03 Identify the structure and function of DNA and the uses of DNA technology in science, industry, and society.

TOPIC S8: Apply concepts related to the scientific process and method to include safety procedures for classroom and laboratory; use and care of scientific equipment; interrelationships between science, technology and society; and effective communication of scientific results in oral, written, and graphic form.

- S8.01 Apply the components of scientific processes and methods in classroom and laboratory investigations.
- S8.02 Observe and practice safe procedures in the classroom and laboratory.
- S8.03 Demonstrate proper use and care for scientific equipment.
- S8.04 Investigate science careers, and advances in technology.
- S8.05 Communicate results of scientific investigations in oral, written, and graphic form.

June 21, 2002

APPENDIX B:
WORKPLACE SKILLS

June 21, 2002

APPENDIX B WORKPLACE SKILLS FOR THE 21ST CENTURY

- WP1 Allocates resources (time, money, materials and facilities, and human resources).
- WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
- WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
- WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
- WP5 Selects, applies, and maintains/troubleshoots technology.
- WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
- WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
- WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

June 21, 2002

APPENDIX C:
STUDENT COMPETENCY PROFILE

June 21, 2002

STUDENT COMPETENCY PROFILE FOR CONCEPTS OF AGRISCIENCE TECHNOLOGY

Student: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Introduction to Concepts of Agriscience Technology

- _____ 1. Examine the nature of the agricultural industry.
- _____ 2. Examine the relationships among the sciences, agriculture, and agriscience.
- _____ 3. Examine the size and scope of the total industry of agriculture from the global to local level.
- _____ 4. Investigate current and emerging trends related to agriculture/agriscience.
- _____ 5. Examine standard agricultural safety and work practices.

Unit 2: Leadership and Human Relations

- _____ 1. Examine the role of FFA in agricultural education.
- _____ 2. Examine the concept of leadership.
- _____ 3. Develop interpersonal skills necessary for successful careers.
- _____ 4. Describe the role of work ethics and values in establishing and building a successful career.

Unit 3: Supervised Agricultural Experience

- _____ 1. Explain basic concepts associated with supervised experience.
- _____ 2. Plan supervised experience(s).
- _____ 3. Implement and evaluate a supervised experience.

Unit 4: Principles of Animal Science

- _____ 1. Explore the animal agriculture industry and enterprises.
- _____ 2. Describe the role of biological science in animal production.
- _____ 3. Examine the role of genetics and breeding in animal production.
- _____ 4. Explore current and emerging trends, technologies, and career opportunities associated with animal science.

Unit 5: Principles of Soil Science

- _____ 1. Describe the physical characteristics of soil.
- _____ 2. Investigate the chemical characteristics of soils.

- _____ 3. Determine the capability class of land.
- _____ 4. Examine soil conservation practices.
- _____ 5. Explore current and emerging trends, technologies, and career opportunities associated with soil science.

Unit 6: Principles of Plant Science

- _____ 1. Investigate the physical characteristics and processes of plants.
- _____ 2. Explore the requirements for plant growth.
- _____ 3. Examine the process of plant reproduction.
- _____ 4. Explore current and emerging trends, technologies, and career opportunities associated with plant science.

Unit 7: Principles of Crop Production

- _____ 1. Investigate the importance of crop production.
- _____ 2. Identify cultural practices in crop production.
- _____ 3. Explore basic concepts of pest management.
- _____ 4. Explain practices in harvesting crops.

Unit 8: Principles of Horticulture

- _____ 1. Examine the nature of horticulture.
- _____ 2. Determine the role of biological science in horticulture.
- _____ 3. Examine how to use a greenhouse in growing plants.
- _____ 4. Describe the fundamentals of landscaping.

Unit 9: Principles of Forestry

- _____ 1. Examine the importance of forestry.
- _____ 2. Describe forest production and management.
- _____ 3. Investigate forest fire prevention.

Unit 10: Principles of Natural Resources

- _____ 1. Identify the kinds and importance of natural resources.
- _____ 2. Relate the importance of ecology in natural resources.
- _____ 3. Describe the role of wildlife as natural resources.
- _____ 4. Identify important areas of waste management.
- _____ 5. Examine sources of alternative energy.

Unit 11: Principles of Aquaculture

- _____ 1. Examine the nature of aquaculture.
- _____ 2. Describe the importance of water in aquaculture.
- _____ 3. Explain the importance of proper nutrition.
- _____ 4. Explain the importance of promoting fish health.

_____ 5. Describe marketing procedures.

Unit 12: Principles of Physical and Mechanical Technology

- _____ 1. Examine the importance of physical and mechanical technology in agriscience.
- _____ 2. Examine and identify basic safety processes and concepts associated with physical and mechanical technology in agriculture.
- _____ 3. Explore the use of electrical power in agriculture.
- _____ 4. Explore the principles of metals fabrication.
- _____ 5. Explore the principles of plumbing in agriculture.
- _____ 6. Explore the use of internal combustion engine power in agriculture.

Unit 13: Principles of Agriculture Marketing

- _____ 1. Examine the role of marketing in the agricultural industry.
- _____ 2. Relate agricultural marketing to the free enterprise system.
- _____ 3. Examine the importance of planning in successful marketing.
- _____ 4. Investigate marketing processes with agricultural products.

STUDENT COMPETENCY PROFILE FOR THE SCIENCE OF AGRICULTURAL ANIMALS

Student: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Introduction to Agricultural Animals

- _____ 1. Investigate the nature of animal agriculture.
- _____ 2. Investigate the opportunities in student and youth organizations in the animal industry.
- _____ 3. Demonstrate career and communication skills required for employment in the animal industry.
- _____ 4. Use the Internet to identify emerging technologies.

Unit 2: Supervised Experience in Agricultural Animals

- _____ 1. Plan, implement, and expand supervised experience in animal agriculture.
- _____ 2. Prepare and keep appropriate written documentation on supervised experience.

Unit 3: The Animal Industries

- _____ 1. Examine the importance of animals in the United States.
- _____ 2. Assess the animal industries in the local area.
- _____ 3. Identify the major species and breeds of domesticated animals.

Unit 4: Consumer Trends and Concerns

- _____ 1. Examine the importance of consumers in producing and marketing animal products.
- _____ 2. Explain consumer concerns about animal waste and its effects on the environment.
- _____ 3. Investigate animal food products and processing.

Unit 5: Animal Well-Being and Behavior

- _____ 1. Explain animal well-being.
- _____ 2. Explore the use of animals in research and laboratory production.
- _____ 3. Investigate the behavioral patterns of animals.
- _____ 4. Examine the importance of personal safety in animal production.

Unit 6: Animals as Living Organisms

- _____ 1. Use scientific classification with animals.
- _____ 2. Examine the characteristics of life and living organisms.
- _____ 3. Examine the characteristics of animals as organisms.
- _____ 4. Assess the importance of heredity and genetics.

Unit 7: Animal Growth and Nutrition

- _____ 1. Examine the role of nutrition in animal growth and health.
- _____ 2. Provide the proper care of pregnant and lactating females.
- _____ 3. Provide post-natal care of females and offspring.
- _____ 4. Identify animals based on food consumption.
- _____ 5. Assess the effects of hormones on animal growth.
- _____ 6. Assess the importance of vitamins and minerals in the diet of an animal.
- _____ 7. Assess the importance of concentrates and roughage in the diet of an animal.
- _____ 8. Identify the importance of water to animals.

Unit 8: Reproduction

- _____ 1. Assess the importance of reproduction in animal production.
- _____ 2. Examine the reproduction process with mammals.
- _____ 3. Examine the reproduction process with poultry.
- _____ 4. Examine the reproduction process with finfish.

Unit 9: Animal Evaluation

- _____ 1. Investigate the selection of market animals.
- _____ 2. Investigate the selection of breeding animals.
- _____ 3. Evaluate non-mammal species on the basis of productive efficiency.

Unit 10: Animal Health

- _____ 1. Examine the effects of disease on livestock, companion, and laboratory animals.
- _____ 2. Examine the effects of environment on animal health.
- _____ 3. Examine the role of the host animal as related to health.
- _____ 4. Examine the role of pathogens in animal health.
- _____ 5. Examine the role of parasites and plant toxins in animal health.

Unit 11: Facilities and Equipment

- _____ 1. Identify the facility and equipment needs with various animal production enterprises.
- _____ 2. Explore the design and construction features of facilities and equipment in the animal industry.

Unit 12: Management and Marketing

- _____ 1. Investigate the approved practices for managing animal enterprises.
- _____ 2. Analyze the approved practices in marketing animals.
- _____ 3. Investigate new and emerging technologies in managing and marketing animals.
- _____ 4. Examine small business management in animal agriculture.

Unit 13: Companion Animal Care and Management

- _____ 1. Determine the types, uses, care, and management of companion animals.

STUDENT COMPETENCY PROFILE FOR THE SCIENCE OF AGRICULTURAL ENVIRONMENT

Student: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: The Environmental and Quality of Life

- _____ 1. Examine the environment and how human and agricultural activities create environmental change.
- _____ 2. Analyze issues affecting the global environment and how these relate to agriculture.

Unit 2: Supervised Experience in Agricultural Environment

- _____ 1. Plan, implement, and expand supervised experience in agricultural environment.
- _____ 2. Prepare and keep appropriate written documentation on supervised experience.

Unit 3: Living Organisms and the Environment

- _____ 1. Investigate living organisms in the environment.
- _____ 2. Examine relationships of living organisms and the environment.
- _____ 3. Identify agricultural pests as they relate to the environment.

Unit 4: Ecology and the Environment

- _____ 1. Examine the principles of ecology as related to environmental quality.
- _____ 2. Identify ecological diversity in agricultural and wildlife ecosystems.

Unit 5: Land and Soil Management

- _____ 1. Identify the process of planning for urban and rural land use.
- _____ 2. Explain the importance of soil and proper soil management.
- _____ 3. Assess the impact of agricultural, horticultural, and forestry practices on land and soil.

Unit 6: Water Quality Management

- _____ 1. Explain water uses and quality.

- _____ 2. Describe important water management practices.
- _____ 3. Describe how wastewater is treated to maintain water quality.

Unit 7: The Atmosphere and Environmental Quality

- _____ 1. Examine the relationship of the atmosphere to the Earth's environment.
- _____ 2. Use weather and climate information in making decisions about the environment.
- _____ 3. Assess air quality and identify sources of air pollution.

Unit 8: Bioremediation and Waste Management

- _____ 1. Use appropriate procedures in managing solid waste.
- _____ 2. Select appropriate procedures for managing hazardous waste.

Unit 9: Forestry and the Environment

- _____ 1. Examine the relationship of forests to the environment.
- _____ 2. Explain the contributions made by forests to the economy and environmental quality.

Unit 10: Wildlife and the Environment

- _____ 1. Examine the relationships of wildlife well-being and environmental quality.
- _____ 2. Investigate approaches in protecting wildlife species.

Unit 11: Energy Management

- _____ 1. Examine how energy is classified and used.
- _____ 2. Implement practices that conserve energy.

Unit 12: Environmental Stewardship

- _____ 1. Explain sustainable agriculture.
- _____ 2. Use the services of agricultural agencies and organizations in maintaining the environment.

Unit 13: Issues in a Global Environment

- _____ 1. Analyze issues related to the global environment.
- _____ 2. Identify trends that affect the global environment.
- _____ 3. Describe the effect of agricultural, horticultural, and forestry activities on the environment.

Unit 14: Future Environments and Occupational Opportunities

- _____ 1. Participate in designing alternative futures.

- _____ 2. Assess personal interests in environmental careers.
- _____ 3. Evaluate availability of environmental occupations in agricultural, horticultural, and forestry areas.

STUDENT COMPETENCY PROFILE FOR THE SCIENCE OF AGRICULTURAL MECHANICS

Student: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Using Physical and Mechanical Technology in Agriculture

- _____ 1. Investigate the role of physical and mechanical technology in agriculture.
- _____ 2. Identify science applications in agriculture technology.

Unit 2: Supervised Experience in Physical and Mechanical Technology

- _____ 1. Plan, implement, and expand supervised experience in physical and mechanical technology.
- _____ 2. Prepare and keep appropriate written documentation on supervised experience.

Unit 3: Practicing Safety in Physical and Mechanical Technology

- _____ 1. Identify general safety precautions for the work site and laboratory.
- _____ 2. Apply personal behavior and safety procedures required at the work site.
- _____ 3. Apply general safety rules pertaining to hand and stationary power tools.
- _____ 4. Apply rules of safety and first aid measures relating to different situations at the work site or in the laboratory.

Unit 4: Applying Physical and Mechanical Technology in Agricultural Mechanization and Careers

- _____ 1. Explain concepts of management and maintenance systems.
- _____ 2. Describe economics of agricultural mechanization.
- _____ 3. Explore career concepts associated with agricultural mechanization.
- _____ 4. Develop related workplace skills required in agricultural mechanization.
- _____ 5. Develop leadership and citizenship skills necessary for employment and successful performance in agricultural mechanization.

Unit 5: Applying Physical and Mechanical Technology in Agricultural Enterprises

- _____ 1. Demonstrate applications of physical and mechanical technology in agricultural enterprises.
- _____ 2. Apply physical and mechanical technology in operating equipment.

Unit 6: Using Computer Applications in Agriculture

- _____ 1. Identify computer applications related to physical and mechanical technology.
- _____ 2. Acquire technical information.
- _____ 3. Prepare and send information using electronic technology.

Unit 7: Analyzing Electricity/Electronics Systems

- _____ 1. Identify electrical/electronics systems used in agriculture.
- _____ 2. Investigate electrical/electronics systems used on tractors and implements and with stationary systems.
- _____ 3. Identify parts and functions of charging systems on internal combustion engines.
- _____ 4. Identify components and functions of starting systems on internal combustion engines.

Unit 8: Using Hydraulic and Pneumatic Systems

- _____ 1. Describe how hydraulic and pneumatic systems are used in agriculture.
- _____ 2. Apply safe practices in servicing and using hydraulic and pneumatic systems.

Unit 9: Applying Principles of Internal Combustion Engines

- _____ 1. Describe the importance and uses of internal combustion engines.
- _____ 2. Identify parts and functions of internal combustion engine systems.
- _____ 3. Disassemble and inspect internal combustion systems.
- _____ 4. Assemble, operate, and test an internal combustion engine following safe and approved procedures.

Unit 10: Performing Preventive Maintenance

- _____ 1. Identify the importance of preventive maintenance.
- _____ 2. Identify components and systems on small engines requiring preventive maintenance.
- _____ 3. Perform basic preventive maintenance service on a small engine.

Unit 11: Applying Principles of Diagnostics

- _____ 1. Identify principles of diagnostics.
- _____ 2. Apply diagnostic procedures in solving a problem.

Unit 12: Basic Welding

- _____ 1. Identify common equipment and tools used in welding.
- _____ 2. Apply safety precautions used in welding.
- _____ 3. Describe different welding supplies used in welding.
- _____ 4. Explain the meanings of the numbers in the electrode classification system.

- _____ 5. Compare the different types of welds.
- _____ 6. Perform various welding techniques.

Unit 13: Basic Gas Cutting and Welding

- _____ 1. Identify parts of the oxyacetylene welding equipment.
- _____ 2. Apply safety procedures for using oxyacetylene equipment.
- _____ 3. Identify the different types of oxyacetylene flames.
- _____ 4. Operate oxyacetylene equipment.

STUDENT COMPETENCY PROFILE FOR THE SCIENCE OF AGRICULTURAL PLANTS

Student: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Introduction to Agricultural Plants

- _____ 1. Investigate student organizations in the plant agriculture industry.
- _____ 2. Demonstrate communication skills for employment in the plant agriculture industry.
- _____ 3. Use the Internet to discover emerging technologies.

Unit 2: Supervised Experience in Agricultural Plants

- _____ 1. Plan, implement, and expand supervised experience in plant agriculture.
- _____ 2. Prepare and keep appropriate written documentation on supervised experience.

Unit 3: Plant Enterprises and Systems

- _____ 1. Examine how plants are used to meet human needs.
- _____ 2. Examine plant production enterprises.
- _____ 3. Assess the functions and importance of plants.

Unit 4: Plant Growth

- _____ 1. Examine the principles of plant growth.
- _____ 2. Describe nutrients necessary for plant growth.
- _____ 3. Identify the pH of soil and its effect on plant nutrition and growth.
- _____ 4. Use soil test results to calculate application rates of fertilizer on a selected crop.

Unit 5: Plant Classification and Physiology

- _____ 1. Examine the methods by which plants are classified.
- _____ 2. Examine the anatomy of a plant.
- _____ 3. Assess the physiological principles of a plant (how the plant functions as a system).

Unit 6: Reproduction and Propagation

- _____ 1. Examine the principles of genetics.
- _____ 2. Distinguish between sexual and asexual reproduction.
- _____ 3. Demonstrate the propagation of plants.

Unit 7: Plant Growing Structures

- _____ 1. Describe the various plant growing structures and the environmental controls used by each type.
- _____ 2. Examine plant production in growing structures.

Unit 8: Cultural and Harvesting Practices

- _____ 1. Examine the types of growing media.
- _____ 2. Discuss the different soil amendments.
- _____ 3. Determine the conditions needed for plant growth in a greenhouse.
- _____ 4. Assess tillage and cultivation practices.
- _____ 5. Explain the meaning and importance of harvesting.
- _____ 6. Explain the different harvesting methods, equipment, and facilities.

Unit 9: Pest Management

- _____ 1. Assess the effects of pests on plant production.
- _____ 2. Discuss biological control systems.
- _____ 3. Describe chemical control with pests.
- _____ 4. Demonstrate different types of mechanical pest control.
- _____ 5. Examine integrated pest management.

Unit 10: Management and Marketing in Plant Production

- _____ 1. Explain the management practices needed in plant production.
- _____ 2. Examine marketing in plant production.

Unit 11: Environmental Concerns for Sustainable Agriculture

- _____ 1. Examine how agricultural activities can affect the environment.
- _____ 2. Discuss disposal methods of agricultural waste.

Unit 12: New Technologies in Plant Production

- _____ 1. Examine precision farming as a new technology in plant production.

STUDENT COMPETENCY PROFILE FOR AGRIBUSINESS AND ENTREPRENEURSHIP TECHNOLOGY

Student: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Introduction to Agribusiness and Entrepreneurship

- _____ 1. Describe terms associated with agribusiness and entrepreneurship.
- _____ 2. Explain types of business organizations.
- _____ 3. Describe concepts of entrepreneurship.

Unit 2: Developing Personal Financial Management

- _____ 1. Explain personal financial management.
- _____ 2. Describe how to manage a personal checking and savings account.
- _____ 3. Describe personal investment opportunities.
- _____ 4. Explain procedures for use of personal credit.
- _____ 5. Describe use of personal insurance.

Unit 3: Conducting a Business Inventory

- _____ 1. Explain the importance of an accurate inventory.
- _____ 2. Determine when to inventory.
- _____ 3. Determine what to inventory.
- _____ 4. Establish inventory values.

Unit 4: Using the Balance Sheet

- _____ 1. Describe the purpose of a balance sheet.
- _____ 2. Explain the relationship of a balance sheet with other base financial statements.
- _____ 3. Describe the major areas of a balance sheet.
- _____ 4. Complete a balance sheet.

Unit 5: Using an Income Statement

- _____ 1. Analyze an income statement.
- _____ 2. Establish the relationship of an income statement with other base financial statements.
- _____ 3. Differentiate between cash and accrual accounting.

Unit 6: Preparing a Statement of Cash Flows

- _____ 1. Compare statement of cash flows versus cash flow statement.
- _____ 2. Describe the relationship of statement of cash flows with other base financial statements.
- _____ 3. Explain sources of cash flow.

Unit 7: Preparing a Statement of Owner Equity

- _____ 1. Describe the purposes of a statement of owner equity.
- _____ 2. Describe the relationship of a statement of owner equity with other base financial statements.

Unit 8: Analyzing Financial Performance

- _____ 1. Identify key areas of financial analysis.
- _____ 2. Identify guidelines for applying the use of financial measures.

Unit 9: Implementing Planning and Decision Making Procedures

- _____ 1. Identify steps in the decision making process.
- _____ 2. Describe the purposes of a budget.
- _____ 3. Prepare budgets.

Unit 10: Explaining Business Borrowing/Investing Practices

- _____ 1. Describe types of capital.
- _____ 2. Describe borrowing and decision making.
- _____ 3. Describe loan options.

Unit 11: Managing Business and Self-Employment Taxes

- _____ 1. Identify documents filed with an employer.
- _____ 2. Calculate take-home pay.
- _____ 3. File business income tax returns.

Unit 12: Applying Legal Concepts

- _____ 1. Describe legal aspects of business transactions.
- _____ 2. Identify types of laws related to business.
- _____ 3. Describe health and safety regulations regarding agribusinesses.

Unit 13: Using Management Information Systems

- _____ 1. Describe management information systems.
- _____ 2. Complete forms for management information.

Unit 14: Planning and Conducting Marketing

- _____ 1. Develop a marketing plan.
- _____ 2. Explore international marketing opportunities.

Science of Agricultural Animals

Program CIP: 01.0901

Ordering Information

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Dr. Tom Burnham, State Superintendent
Mr. William Harold Jones, Chair
Mr. Charles McClelland, Vice Chair
Ms. Kami Bumgarner
Mr. Howell "Hal" N. Gage
Dr. O. Wayne Gann
Mr. Claude Hartley
Ms. Martha "Jackie" Murphy
Ms. Rosetta Richards
Dr. Sue Matheson

Jean Massey, Associate Superintendent of Education for the Office of Vocational Education and Workforce Development, at the Mississippi Department of Education assembled an oversight committee to provide input throughout the development of the *Science of Agricultural Animals* curriculum framework and supporting materials. Members of this task force were as follows:

Mr. Sammy Blossom, Executive Director, Mississippi Cattlemen's Association
Dr. Gwendolyn Boyd, Assistant Professor, Alcorn State University
Dr. Ron Brown, Executive Director, Association of Southern Region Extension Directors
Mr. Harry Dendy, Capitol City Ag Services
Dr. Frank Flanders, Agricultural Education Subject Matter Specialist, Georgia Department of Workforce Development
Dr. Gary Jackson, Chair, School of Human Sciences, Mississippi State University
Ms. Karen McKie, Green Oak Florist
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Dr. Tom Monaghan, Executive Director, Mississippi Forestry Association
Mr. Mike Pepper, Executive Director, Mississippi Poultry Association
Dr. Kenneth Stallings, Department of Agriculture Chairperson, Alcorn State University
Mr. J. D. Sumrall, Grower Relations Coordinator, Mississippi Poultry Association
Dr. Kirk Swartzel, Associate Professor of Life Sciences, Mississippi State University
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Finally, standards in the *Science of Agricultural Animals Curriculum Framework and Supporting Materials* are based on the following:

National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards

The National AFNR Career Cluster Content Standards were developed by the National Council on Agricultural Education to serve as a guide for what students should know or be able to do through a study of agriculture in grades 9–12 and 2-year postsecondary programs. The standards were extensively researched and reviewed by leaders in the agricultural industry, secondary and postsecondary instructors, and university specialists. The standards consist of a pathway content standard for each of the eight career pathways. For each content standard, performance elements representing major topic areas with accompanying performance indicators were developed. Measurements of assessment of the performance elements and performance indicators were developed at the basic, intermediate, and advanced levels. A complete copy of the standards can be accessed at <https://aged.learn.com>. The National AFNR Career Cluster Content Standards are copyrighted to the National Council for Agricultural Education and are used by permission.

Applied Academic Credit Benchmarks

Mississippi Department of Education 2010 Mississippi Science Framework

21st Century Skills and Information and Communication Technologies Literacy Standards

In defining 21st century learning, the Partnership for 21st Century Skills has embraced five content and skill areas that represent the essential knowledge for the 21st century: global awareness; civic engagement; financial, economic, and business literacy; learning skills that encompass problem-solving, critical-thinking, and self-directional skills; and Information and Communication Technology (ICT) literacy.

National Educational Technology Standards for Students

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ACT College Readiness Standards



The College Readiness Standards are sets of statements intended to help students understand what is expected of them in preparation for the ACT. These standards are integrated into teaching and assessment strategies throughout the curriculum framework.

Preface

Secondary vocational–technical education programs in Mississippi are faced with many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing true learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, Mississippi Code of 1972, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, ch. 487, §14; Laws, 1991, ch. 423, §1; Laws, 1992, ch. 519, §4 eff. from and after July 1, 1992; Carl D. Perkins Vocational Education Act IV, 2007; and No Child Left Behind Act of 2001).

Research Synopsis

Agricultural and Environmental Science and Technology Research

The Agricultural Sciences Career Cluster covers the broad field of occupations related to the production and use of plants and animals for food, fiber, aesthetic, and environmental purposes. According to the U.S. Department of Labor, the growing interest in worldwide standardization of agricultural equipment should result in increased employment of agricultural engineers. Job opportunities should also result from the increasing demand for agricultural products, the continued efforts for more efficient agricultural production, and the increasing emphasis on the conservation of resources. The sales of food and fiber products amounted to 5.8 billion dollars in 2005 according to USDA statistics. Additionally, the Mississippi Department of Agriculture and Commerce estimates that 30% of the state's workforce is employed in jobs relating directly or indirectly to agriculture.

Agriculture and Environmental Science and Technology will target careers at the professional and technical levels in agriculture. Students enrolled in these courses should be better prepared to pursue degrees at the community college and 4-year college levels.

Employment Projections

Data for this synopsis were compiled from employment projections prepared by the Mississippi Department of Employment Security and the U. S. Department of Labor. The National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards developed by the National Council for Agricultural Education and scholarly research articles were also reviewed as a guide for the redesign of the Agriculture and Natural Resources Cluster.

Industry Job Data – Employment Projections 2006 to 2016 for Mississippi

Note: Compiled by Mississippi Department of Employment Security and Labor Market Information Department

Occupational title	Employment, 2006	Projected employment, 2016	Change 2006– 2016		Total Projected Avg. Annual Job Openings
			Number	Percent	
Animal Breeders	9,770	9,870	100	1.0	165
Agricultural and Food Science Technicians	260	310	50	19.2	10
Agricultural Equipment Operators	1,090	1,190	100	9.2	40
Agricultural Sciences Teachers, Postsecondary	190	240	50	26.3	20
Conservation Scientists	790	890	100	12.7	30
Custodial and Caretaking Supervisors and Workers	46,920	54,110	7,190	15.3	2,320
Environmental Engineers	270	320	50	18.5	10

Occupational title	Employment, 2006	Projected employment, 2016	Change 2006– 2016		Total Projected Avg. Annual Job Openings
			Number	Percent	
Environmental Engineering Technicians	50	100	50	100.0	0
Environmental Scientists and Specialists	420	470	50	11.9	10
Environmental Science and Protection Technicians	100	150	50	50.0	5
Farmworkers and Laborers, Crop, Nursery, and Greenhouse	5,160	5,810	650	12.6	225
Farmworkers, Farm and Ranch Animals	1,400	1,550	150	10.7	65
First-Line Supervisors / Managers of Farming, Fishing, and Forestry Workers	1,390	1,540	150	10.8	40
Food Processing Workers	14,920	18,320	3,400	22.8	680
Foresters	470	520	50	10.6	20
Forest and Conservation Technicians	390	440	50	12.8	15
Forest and Conservation Workers	880	980	100	11.4	30
Grounds Maintenance Workers	10,310	11,810	1,500	14.5	375
Logging Equipment Operators	3,910	4,210	300	7.7	100
Purchasing Agents and Buyers, Farm Products	80	130	50	62.5	5
Soil and Plant Scientists	430	480	50	11.6	10
Veterinarians	540	640	100	18.5	25
Veterinary Assistants and Laboratory Animal Caretakers	690	890	200	29.0	35
Veterinary Technologists and Technicians	440	540	100	22.7	15

Note: Data was retrieved from the Mississippi Department of Employment Security (2009).

Occupational Employment and Wage Estimates for Mississippi May 2006

Occupation	Employment, 2006	Avg. Hourly Wage	Average Annual Wage
Farmers and Ranchers	2,760	\$17.85	\$43,560.00
Farm Managers and Supervisors	2,640	\$23.23	\$48,360.00
Logging Equipment Operators	3,890	\$14.28	\$30,880.00
Landscaping Supervisors	2,990	\$17.93	\$40,240.00
Landscape Workers	8,560	\$10.22	\$23,010.00
Agricultural Scientists/Technicians	29,680	\$18.33	\$38,555.00

Note: Data was retrieved from the U.S. Bureau of Labor Statistics (2009).

Curriculum Content

In compiling the research for the Agricultural Sciences cluster, face-to-face and telephone interviews were conducted with representatives of agricultural employers and agricultural agencies. The following comments summarize the results of these interviews:

- While opportunities to enter farming on a full-scale commercial enterprise basis are limited, opportunities do exist and are expected to increase as current operators retire and begin to rent their land to companies and individuals. Opportunities are also expected to increase for consultants and technicians who support production enterprises by providing specialized services to producers.
- There was general agreement among all persons interviewed that all students need to better develop skills related to leadership, teamwork, communication, and work ethics, habits, and values. All respondents also indicated that a basic knowledge of economics, record keeping, budgeting, and business decision-making skills will be essential in today's "lean" environment.
- Opportunities for high school graduates in all fields of agriculture are limited to the basic entry-level positions. More abundant opportunities exist for students who have received advanced training at the community college or 4-year college levels.
- All respondents agreed that a common core of knowledge and skills existed across all three major pathways related to the following themes: leadership and personal development; principles of plant science and production; principles of soil science and air and water quality; principles of agricultural power, structures, and technology; and principles of economics and management. A sixth theme, principles of animal science and production, exists for students in the AEST and Agriculture and Natural Resources pathway.
- All respondents agreed that students in all three pathways should be exposed to the process by which agricultural products are grown, managed, harvested, processed, and marketed. As students study this process, they should be also exposed to the different careers that are involved in all segments of the industry.
- The role of federal and state agencies including the USDA, OSHA, FDA, EPA, and so forth should be discussed. Also, the role of agricultural organizations such as the Poultry Association, Nurseryman's Association, and Farm Bureau needs to be investigated.

Results of the survey of employers and agricultural agency representatives show that there are six major themes or topics that apply to a majority of occupations in the agriculture and natural resources area. These themes and their respective pathways are listed below.

Theme	AEST	Ag and Nat. Resources	Horticulture/Landscape
Principles of Leadership, Personal Development, and Career Success	X	X	X
Principles of Plant Science and Production	X	X	X
Principles of Animal Science and Production	X	X	
Principles of Soil, Water, and Air Quality, Conservation, and Use	X	X	X
Principles of Agricultural Power, Structures, and Technological Systems	X	X	X
Principles of Management, Economics, and Marketing	X	X	X

Executive Summary

Program Description

Science of Agricultural Animals is an advanced level course for the Agricultural and Environmental Science and Technology Program. The course focuses on the development of skills and knowledge related to the anatomy and physiology, growth and nutrition, breeding and reproduction, evaluation, health, and management of agricultural and other domesticated animals. The course carries 1 Carnegie unit of credit that may count as an elective science credit for high school graduation. Students may also earn an additional ½ Carnegie unit by completing a successful supervised agricultural experience program.

Industry Certification

No national industry recognized certifications are known to exist at this time in the field of Agriscience. Competencies and suggested performance indicators in the *Science of Agricultural Animals* course have been correlated, however to the National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards, which have been reviewed and endorsed at the national level by the National Council on Agricultural Education.

Articulation

There is no articulation for this course at this time.

Assessment

Students will be assessed using the AEST MS-CPAS2 test. All students will be tested on *Concepts of Agriscience* and the second course that they may take in their chosen path of study. The second course may be one of the following:

- Science of Agricultural Animals
- Science of Agricultural Environment
- Science of Agricultural Mechanization
- Science of Agricultural Plants

The MS-CPAS2 blueprint can be found at <http://redesign.rcu.msstate.edu/curriculum/>. If there are questions regarding assessment of this program, please contact the instructional design specialist at the Research and Curriculum Unit at 662.325.2510.

Student Prerequisites

Prior to enrolling in *Science of Agricultural Animals*, a student must have completed *Concepts of Agriscience*. *Science of Agricultural Animals* may be offered to students in grades 10–12. It is recommended that students enrolling in the course possess at least a C average in other science courses and a TABE reading score at the eighth grade level or higher.

Proposed Applied Academic Credit

The academic credit is still pending for this curriculum.

Licensure Requirements

A 992 endorsement is currently required to teach any course in the Agricultural and Environmental Science and Technology Program. In order to receive a 992 endorsement, applicants must do the following:

1. Hold a valid Mississippi Educator License with endorsement #301 – Vocational Agriculture Education Programs or #302 – Agriculture.
2. Possess a baccalaureate degree in an agricultural subject area.
3. Complete the 3-semester-credit-hour course devoted to the teaching of Agricultural and Environmental Science and Technology courses. The course, AIS 6113 - Methods of Teaching Agriscience, is currently offered by Mississippi State University.
4. Enroll immediately in the Vocational Instructor Preparation (VIP) program or the College and Career Readiness Education Program (CCREP).
5. Complete the individualized Professional Development Plan (PDP) requirements of the VIP or CCREP prior to the expiration date of the 3-year vocational license.
6. Successfully complete an MDE-approved computer literacy certification exam.
7. Successfully complete a certification for an online learning workshop, module, or course that is approved by MDE.

Note: If the applicant meets all requirements listed above, that applicant will be issued a (992) endorsement—a 5-year license. If the applicant does not meet **all** requirements, the applicant will be issued a 3-year endorsement (license), and all requirements stated above must be satisfied prior to the ending date of that license.

Professional Learning

The professional learning itinerary for the middle school or individual pathways can be found at <http://redesign.rcu.msstate.edu>. If you have specific questions about the content of each training session provided, please contact the Research and Curriculum Unit at 662.325.2510, and ask for the Professional Learning Specialist.

Course Outlines

Course Description: Science of Agricultural Animals is designed as a one-unit course that offers an in-depth study of the animal industry. This includes both traditional livestock and poultry enterprises as well as companion animals. Emphasis is on production methods used in beef operations, swine, dairy, and poultry. The course also includes equine science, companion and laboratory animal care, and aquaculture. Instruction is undergirded with fundamentals of biological science.

Science of Agricultural Animals (One Carnegie Unit) - Course Code: 991101

Unit	Title	Hours
1	Introduction to Animal Agriculture*	15
2	Experiential Learning (SAE)*	5
3	Animals as Living Organisms	20
4	Animal Growth and Nutrition	20
5	Animal Reproduction	20
6	Animal Evaluation	20
7	Production Management	10
8	Marketing*	5
9	Companion Animal Care*	5
	Total Hours	120

* Note: These units are not tested by MS-CPAS2.

Using This Document

Unit Number and Title

Suggested Time on Task

An estimated number of clock hours of instruction that should be required to teach the competencies and objectives of the unit. A minimum of 140 hours of instruction is required for each Carnegie unit credit. The curriculum framework should account for approximately 75–80% of the time in the course.

Competencies and Suggested Objectives

A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies. The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.

Suggested Teaching Strategies

This section of each unit indicates research-based strategies that can be used to enable students to master each competency. Emphasis has been placed on strategies that reflect active learning methodologies. Teachers should feel free to modify or enhance these suggestions based on needs of their students and resources available in order to provide optimum learning experiences for their students.

Suggested Assessment Strategies

This section indicates research-based strategies that can be used to measure student mastery. Examples of suggested strategies could include rubrics, class participation, reflection, and journaling. Again, teachers should feel free to modify or enhance these suggested assessment strategies based on local needs and resources.

Integrated Academic Topics, 21st Century Skills and Information and Communication Technology Literacy Standards, ACT College Readiness Standards, and Technology Standards for Students

This section identifies related academic topics as required in the Subject Area Testing Program (SATP) in Algebra I, Biology I, English II, and U.S. History from 1877, which are integrated into the content of the unit. Research-based teaching strategies also incorporate ACT College Readiness standards. This section also identifies the 21st Century Skills and Information and Communication Technology Literacy skills. In addition, national technology standards for students associated with the competencies and suggested objectives for the unit are also identified.

References

A list of suggested references is provided for each unit. The list includes some of the primary instructional resources that may be used to teach the competencies and suggested objectives. Again, these resources are suggested, and the list may be modified or enhanced based on needs and abilities of students and on available resources.

Science of Agricultural Animals

Unit 1: Introduction to Animal Agriculture

15 Hours

Competency 1: Investigate the nature of animal agriculture and its associated enterprises. AS.01, AS.02, ZO2, ZO4

Suggested Enduring Understandings

1. In addition to providing meat, products from large animals such as cattle, hogs, sheep, and goats are also used to make clothing, medicines, cosmetics, gelatin, and other products that affect almost everyone's daily life.
2. Major animal enterprises in Mississippi include broiler, catfish, beef cow-calf, egg production, swine, and dairy production enterprises.
3. There are many different breeds of cattle, chickens, horses, sheep, goats, and other forms of livestock. A knowledge of a breed's characteristics is useful in making decisions on breed selection and breeding programs.
4. There are many promising careers in the animal industry for people who have the skills and knowledge to succeed.
5. The scientific classification system is used on a global scale to classify animals according to their characteristics.

Suggested Essential Questions

1. How do livestock products affect people's daily lives?
2. What are the major animal enterprises in Mississippi?
3. How does knowing characteristics of different breeds of livestock enhance a producer's ability to select and breed animals?
4. What are some promising careers in animal agriculture, and what skills and knowledge are necessary to enter them?
5. How is the scientific classification used to classify animals?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe the importance of agricultural animals to people. (DOK 1)	a. Prior to teaching this competency, have students read the chapter on <i>The Large Animal Industry</i> in the text (Herren, 2007). Begin by asking students to identify animal products that they use in their daily lives. List products on the LCD projector. As the discussion continues, make sure students understand the role that animals play in providing clothing, medicine, cosmetics, gelatin, and other products as well as providing services related to security, companionship, and service. Have students enter the list of products and services in their electronic notebooks or journals. CS1, CS2, CS4, T6, W4, W5	a. Use a written test to evaluate student understanding.
b. Describe the major	b. Use a teacher-developed PowerPoint	b. Use a written test

animal enterprises in Mississippi. (DOK 1)	presentation to describe the major animal enterprises in Mississippi, including beef cow-calf, dairy, swine, broiler, catfish, and egg production. The presentation should cover the scope and economic impact of the enterprise, production practices, geographic distribution, and marketing practices. CS1, CS2, CS4	to evaluate student understanding.
c. Identify and describe the major types and breeds of livestock and poultry. (DOK 1)	c. Have students search the Internet and other sources to complete an assignment to identify and describe the major breeds of beef and dairy cattle, swine, sheep, goats, and poultry. Students should complete the <i>Breeds of Livestock Assignment (1.1)</i> . CS1, CS2, CS4, T3, T6, W4, W5	c. Use a written test to evaluate student understanding.
d. Explain how taxonomy is used with domesticated animals. (DOK 1)	d. Prior to teaching this competency, have the students read the chapter on <i>The Classification of Agricultural Animals</i> in the text (Herren, 2007). Provide the students with the taxonomy of an animal (ex. Angus cattle belong to the kingdom Animalia, phylum Chordata, subphylum Vertebrata, class Mammalia, family Bovidae, genus Bos, species Taurus). Discuss the meaning of each grouping within the taxonomy and how members of each group share common characteristics. Use the <i>Taxonomy of Common Domestic Animals Assignment (1.6)</i> to have students search the Internet to determine the taxonomy of each species and note which species are more closely related. CS1, CS2, CS4, T3, T4, T6, R1, R2, R5	d. Evaluate student assignment for accuracy and completeness.
e. Identify careers in the agriculture industry and the skills required by employees. (DOK 1)	e. Provide a list of career areas in the animal industry. Have each student select an area of personal interest and prepare a PowerPoint presentation on the area. The presentation should include information on major skill areas, educational requirements, salary, specific skills, and occupational outlook. CS2, CS4, T2, T3, T4, T6, R1, R2, R4, R5, W4, W5	e. Use the <i>PowerPoint Presentation on Animal Careers Rubric (1.5)</i> to evaluate student understanding on this indicator.

Competency 2: Examine consumer concerns and their effect on animal production. AS.01, AS.08

Suggested Enduring Understandings

1. Consumer preferences for nutritionally healthier animal products have led producers to breed animals that can meet these preferences.
2. Concern over food safety has lead producers and processors to implement quality assurance and analysis programs.

Suggested Essential Questions

1. How have consumer food preferences led producers to change?
2. How are safety and quality assurance maintained in food production?
3. How have concerns over disposal of animal wastes led to safer methods of disposal?

3. Concerns over animal wastes have led producers to develop methods for safely disposing of this waste without endangering the environment or people’s health.	4. What government agencies provide assistance to producers regarding food safety and environmental concerns?	
4. Local, state, and federal agencies are monitoring and assisting producers in protecting food safety and the environment.		
Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Examine how consumer concerns and preferences about food and nutrition have affected animal production enterprises. (DOK 1)	a. Ask students what they understand about fat content in food, cholesterol, steroids, and other additives in food. Use their response to lead a discussion on how consumer concerns and preferences have lead animal producers to change the way animals are fed and managed. Show pictures of the lard-type hog of the early 1900s, and compare them to modern meat type hogs. Discuss the concepts of organic and natural foods and how production practices have changed to deliver these products to the markets. CS1, CS2, CS4	a. Use a written test to evaluate student understanding.
b. Describe the role of quality assurance and safety in meat production today. (DOK 1)	b. Use an article from a recent newspaper or magazine to call attention to concerns over food safety, and discuss how programs such as Hazards Analysis and Critical Control Point (HACCP) and animal identification systems are being used to help prevent and minimize food borne illnesses. CS1, CS2, CS4	b. Use a written test to evaluate student understanding.
c. Investigate concerns about animal waste and its effect on the environment. (DOK 1)	c. Have students indentify animal waste products such as manure, litter and bedding, and dead animals. Lead a discussion about proper disposal methods and how these methods can actually enhance an environment rather than degrade it. Have students write a paragraph that outlines the potential hazards of a specific type animal waste and outlines a method for avoiding these hazards and properly disposing of the material. CS2, CS4, T6, E1, E2, E3, E4, E5, E6, R1, R2, R4, R5, W2, W4, W5	c. Evaluate students’ paragraphs for accuracy and completeness.
d. Identify and describe the role and function of government agencies in assisting animal producers in	d. Provide the students with a list of local, state, and national agencies that are associated with food safety and environmental protection. This list could include the local health department, Mississippi Department of Agriculture and Commerce, Mississippi Department of Environmental Safety, U.S. Department of	d. Use a written test to evaluate student understanding.

producing safe food products and protecting the environment. (DOK 1)

Agriculture, U.S. Environmental Protection Agency, and U.S. Food and Drug Administration. Have students do a search on the Internet and use other sources to identify the role and function of these agencies as related to animal production. Lead a classroom discussion to allow students to share their findings. Compile a list of major roles and functions for each agency using the LCD projector, and have students enter into their electronic notebooks or journals. CS2, CS4, T2, T3, T4, T6, R1, R2, R4, R5, W4, W5

Competency 3: Explore concepts of animal welfare and animal rights. AS.03, AS.06

Suggested Enduring Understandings

1. Animal welfare activists believe that it is right for animals to be raised for human use but not be abused or mistreated.
2. Animal rights activists believe that animals have rights. Some believe that animals are free to make their own choices.
3. There are various animal welfare issues that affect consumers and producers of agriculture animal products. The main issues relate to laboratory research, animal confinement, and animal production.

Suggested Essential Questions

1. What are the sides and their viewpoints in the debate relative to animal welfare in agriculture?
2. What are the main animal welfare issues that are prevalent in today's society?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Define and discuss the concepts of animal welfare and animal rights along with their applications in modern animal enterprises. (DOK 3)	a. Prior to teaching this competency, have the students read the chapter on <i>The Issue of Animal Welfare</i> from the text (Herren, 2007). Introduce the competency by using an article from a current newspaper or magazine that is critical of the way animals are treated in our society. Some of the concepts that should be discussed are the following: • Animal Welfare • Animal Rights Lead a discussion on the two major sides of the animal welfare debate, those who feel that it is right for animals to be raised for human use but not abused or mistreated and those who think animals should have the same rights as humans. Have students compose a paragraph defending one of these positions. CS1, CS2, CS4, T1, T2, T5, T6, E1, E2, E3, E4, E5, E6, R1, R2, R3, R4, R5, W1, W2, W3, W4, W5	a. Use the <i>Animal Welfare Fact Sheet Rubric (1.2)</i> to evaluate the student mastery.

b. Assess animal welfare issues. (DOK 2)	b. Provide students with a list of animal welfare issues such as confinement, transportation, use of antibiotics in feeds, debeaking, dehorning, castration, tail docking, branding, use of animals in laboratory testing, and so forth. Have students research the issue and compile a fact sheet showing the concerns raised over the issue and the reasons why the practice is used and considered humane. CS1, CS2, CS4, T1, T2, T5, T6, E1, E2, E3, E4, E5, E6, R1, R2, R3, R4, R5, W1, W2, W3, W4, W5	b. Use the <i>Animal Welfare Fact Sheet Rubric (1.2)</i> to evaluate the student mastery.

Standards

AFNR Industry Standards

- AS.01 Examine the components, historical development, global implications, and future trends of the animal systems industry.
- AS.08. Analyze environmental factors associated with animal production.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS3 Social and Cross-Cultural Skills
- CS4 Productivity & Accountability
- CS5 Leadership & Responsibility

Applied Academic Credit Standards

Zoology

- ZO 2 Develop an understanding of levels of organization and animal classification.
- ZO 3 Differentiate among animal life cycles, behaviors, adaptations, and relationships.
- ZO 4 Demonstrate an understanding of the principles of animal genetic diversity and evolution.

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- E1 Topic Development in Terms of Purpose and Focus
- E2 Organization, Unity, and Coherence
- E3 Word Choice in Terms of Style, Tone, Clarity, and Economy
- E4 Sentence Structure and Formation
- E5 Conventions of Usage
- E6 Conventions of Punctuation
- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- W2 Focusing on the Topic
- W4 Organizing Ideas
- W5 Using Language

Suggested References

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Science of Agricultural Animals

Unit 2: Experiential Learning (SAE)

5 Hours

Competency 1: Plan and implement an experiential learning program. ABS.02, ABS.04

Suggested Enduring Understandings

1. Planning is a continuous process in business.
2. Plans must be reviewed and updated on a regular basis.

Suggested Essential Questions

1. What are my goals and plans for an SAE in the coming year?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Update and revise long-range and short-term goals of the experiential learning program. (DOK 3)	a. Based on the summary and analysis of the students' previous experiential learning activities, have students reflect and revise or amend their experiential learning long-range and short-term goals for the coming year. The goals should be added to the students' electronic portfolios. CS1, CS2, CS4, T1, T3, T4, T6, W1, W2, W4, W5	a. Use an experiential learning planning rubric and record keeping rubric to evaluate the students' goals. (See the <i>Rubric for Experiential Learning Planning and Record Keeping (2.1).</i>)
b. Update, revise, and implement the experiential learning plan/training agreement for the coming year. (DOK 3)	b. Based on the revised goals, have students update, amend, and revise their experiential learning plan/training agreement to reflect growth in skill and proficiency levels. The updated plan should be added to the students' electronic portfolios. CS1, CS2, CS4, T1, T3, T4, T6, W1, W2, W4, W5	b. Use an experiential learning planning rubric and record keeping rubric to evaluate the students' goals. (See the <i>Rubric for Experiential Learning Planning and Record Keeping (2.1).</i>)

Competency 2: Maintain records and documentation of experiential learning activities, projects, and enterprises. ABS.02, ABS.03, ABS.04, ABS.06

Suggested Enduring Understandings

1. Records must be maintained and updated on a regular and timely basis to accurately reflect progress.
2. Records should be summarized to give a "snapshot" of operations on a regular basis that can be used to make decisions.

Suggested Essential Questions

1. How do I update and maintain the records of my experiential learning program?
2. How do I summarize and analyze my experiential learning records?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Update and maintain records of experiential	a. Review requirements for record keeping for the different types of experiential learning. Have	a. Use the <i>Rubric for Experiential Learning</i>

learning related income, expenses, activities, skills, and supplementary improvement projects. (DOK 3)	students maintain and update their records electronically throughout the year. CS2, CS4, T3, T4, T6, M1, M2, W4	<i>Planning and Record Keeping (2.1)</i> to evaluate the students' goals.
b. Prepare an annual summary report.	b. Review procedures for summarizing records. Have students prepare an annual summary of their experiential learning activities at the end of the school year to include income and expense summary and a net worth statement. CS2, CS4, T3, T4, T6, M1, M2, W4	b. Use the <i>Rubric for Experiential Learning Planning and Record Keeping (2.1)</i> to evaluate the students' summaries.

Standards

AFNR Industry Standards

- ABS.02. Utilize appropriate management planning principles in AFNR business enterprises.
- ABS.03. Utilize record keeping to accomplish AFNR business objectives while complying with laws and regulations.
- ABS.04. Apply generally accepted accounting principles and skills to manage cash budgets, credit budgets, and credit for an AFNR business.
- ABS.05. Assess accomplishment of goals and objectives by an AFNR business.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS4 Productivity & Accountability

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- M1 Basic Operations and Applications
- M2 Probability, Statistics, and Data Analysis
- W1 Expressing Judgments
- W2 Focusing on the Topic
- W4 Organizing Ideas
- W5 Using Language

Suggested References

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Science of Agricultural Animals

Unit 3: Animals as Living Organisms

20 Hours

Competency 1: Examine the characteristics of life and living organisms. AS.02, BIOI 2, BIOI 4, BIOII 2, ZO2, ZO3, ZO4

Suggested Enduring Understandings

1. The animal cell is the basic building block of an animal's body and is composed of cell walls, membranes, a nucleus, cytoplasm, and organelles. Each component plays a role in the growth and reproduction of the cell.
2. As an embryo develops, cells begin to transform themselves into specialized cells through a process called cell differentiation.
3. All animals have a basic life cycle that goes from an egg to a young animal to an adult.
4. All animals share the same common life processes including respiration, digestion, growth, reproduction, movement, excretion, and sensitivity.

Suggested Essential Questions

1. What are the parts of an animal cell, and how do they function within the cell?
2. What is cell differentiation?
3. What is the basic life cycle of an animal, and how does it differ from phyla to phyla?
4. What are the common life processes that are necessary for animal growth and reproduction?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify the parts of an animal cell, and explain their functions. (DOK 1)	a. Have the students read <i>An Owner's Guide to the Cell</i> . Using the information in this document, have students view animal cells through a microscope and draw a typical cell and label its parts. Have students write a one to two sentence description of the role that each part plays in the cell. Have students scan their drawings and enter into their electronic notebooks or journals. CS1, CS2, CS4, T3, T4, T6, R1, R2, R5, W2, W4, W5	a. Evaluate the students' drawings and explanations for accuracy and completeness.
b. Describe the process of cell differentiation in the development of an animal. (DOK 2)	b. Have students view the video and read the information on the <i>Teacher's Domain</i> Web site related to cell differentiation. As students view the video and read the material, have them make written notes and record in their electronic journals or notebooks. Have students transcribe their notes into short essay describing how the process of cell differentiation allows an animal to develop. CS1, CS2, CS4, T3, T4, T6, R1, R2, R5, W2, W4, W5	b. Evaluate the students' essays for completeness and accuracy.
c. Examine the different stages in the life cycle of an	c. Have students search the Internet and other sources and prepare a chart that identifies the different stages of the life cycle of insects, fish,	c. Evaluate the chart for accuracy and completeness.

animal organism.
(DOK 1)

birds, reptiles, and mammals. Have students summarize the commonalities and differences for each category of animal. Students can complete the *Common Life Processes (3.1)* for review.

CS1, CS2, CS4, T3, T4, T6, R1, R2, R5, W2, W4, W5

Competency 2: Examine the anatomy and physiology of animals. AS.02, BIOI 4, ZO2, ZO3

Suggested Enduring Understandings

1. Anatomy refers to the physical makeup of an animal's body structure while physiology refers to the vital processes by which the animal functions.
2. There are four major types of animal tissue: epithelial, connective, muscle, and nervous. Each type performs specific functions within the body.
3. There are 11 different organ systems in an animal (skeletal, muscular, circulatory, respiratory, nervous, urinary, endocrine, digestive, integumentary, immune, and lymphatic) that must function together for animal growth, development, and reproduction.

Suggested Essential Questions

1. What is the definition of anatomy and physiology, and how do the two sciences relate to each other?
2. What are the major types of animal tissue and their functions?
3. What are the different organ systems in an animal body and their functions?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Define the terms anatomy and physiology, and discuss the relationships and differences between the two terms. (DOK 1)	a. Have students read Introduction to Anatomy and Physiology and develop definitions of anatomy and physiology and explore the relationships and differences in the two terms. Include material on the relationships of cells, tissues, and organs within the body. Summarize and discuss findings in class, and have students transcribe the summary into their electronic notebooks or journals. CS1, CS2, CS4, T6, R1, R2, R5, W2, W4, W5	a. Use a written test to evaluate student understanding.
b. Describe the types of animal tissue and the purpose of the tissue. (DOK 1)	b. Using the material from Introduction to Anatomy and Physiology identify, define and discuss the four fundamental tissue types (epithelial, connective, muscle, and nervous). Have students enter major points into their electronic notebooks or journals. CS1, CS2, CS4, T6, R1, R2, R5, W2, W4, W5	b. Use a written test to evaluate student understanding.
c. Name and explain the functions of the organ systems. (DOK 1)	c. Using the material from Introduction to Anatomy and Physiology , identify and discuss the functions of the 11 different organ systems. Have students enter major points into their	c. Use a written test to evaluate student understanding.

electronic notebooks or journals. CS1, CS2, CS4, T3, T4, T6, R1, R2, R5, W2, W4, W5

Competency 3: Investigate the importance of heredity and genetics. AS.05, BS.03, BIOI5, BIOI6, BIOII3, BIOII4, G1, G2, G3

Suggested Enduring Understandings

1. An understanding of the definitions and major terms associated with genetics and heredity is necessary to understanding the principles of the science.
2. DNA is a complex protein like substance that contains the genes and chromosomes that control the passage of traits and characteristics from parents to offspring.
3. Passage of traits from parents to offspring is based on the pairing of genes from each parent and can be predicted using a Punnett square.
4. Selective breeding is a process by which animal breeders can improve an existing breed or develop a new breed through careful selection of the best animals for breeding purposes.
5. Biotechnology in animal agriculture involves the use of artificial insemination, embryo transplants, cloning, and genetic engineering.

Suggested Essential Questions

1. What are some of the basic terms associated with genetics, and what are their definitions?
2. What function do DNA and RNA play in the transmission of traits from parent to offspring?
3. How can the passage of a trait from a parent to an offspring be predicted mathematically?
4. What is selective breeding, and how does it improve animal breeds over time?
5. What biotechnology practices are becoming more common in animal agriculture?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Define terms related to genetics and heredity including gene, chromosome, mutations, inherited traits, dominant, recessive, codominant, heterozygous, homozygous, alleles, gametes, genotype, and phenotype. (DOK 1)	a. Introduce the competency by having students bring a picture of one of their parents as a young child. Shuffle the pictures, and post on the bulletin board. Have student try to associate each picture with a student in the class. Explain that genetics and heredity are two reasons we often look like our parents. Have students read the chapter on <i>Animal Genetics</i> in the text (Herren, 2007). Have students solve the <i>Genetics and Heredity Crossword Puzzle (3.2)</i> using the terms listed in the indicator. CS1, CS2, CS4, T6, R1, R2, R4	a. Use a written test to evaluate student understanding.
b. Identify and describe the function of the major heredity	b. Use the PowerPoint presentation Genetics2 to present and discuss information on the composition and functions of DNA and RNA. CS1, CS2, CS4, R1, R2, R5	b. Use a written test to evaluate student understanding.

material of living organisms (DNA and RNA). (DOK 1)		
c. Predict the transmission of a trait from parents to offspring (Punnett square). (DOK 2)	c. Use the PowerPoint presentation Genetics to present and discuss information on heritability and transmission of traits from parents to offspring. Instruction should be limited to two traits. Have students complete an assignment to predict traits of offspring based on the pairing of dominant and recessive genes. CS1, CS2, CS4, R1, R2, S1	c. Use a written test to evaluate student understanding.
d. Explain how selective breeding methods are used to improve animals. (DOK 2)	d. Divide the class into groups of three to four students, and have each group investigate the development of a new breed of livestock (Polled Herefords, Barzona, Brangus, etc.). Have students compile a report on how selective breeding processes were used to develop this new breed. Hold a class discussion to identify key selective breeding practices that were used in the development process. Summarize and discuss these practices, and have students enter the summary statements into their electronic notebooks or journals. CS1, CS2, CS4, T2, T3, T4, T6, R1, R2, R5, W2, W4, W5	d. Evaluate the student reports for accuracy and completeness.
e. Investigate how biotechnology is used in animal production. (DOK 2)	e. Have students use the video Animal Biotechnology and take notes on how biotechnology techniques are used to improve animal production, including artificial insemination, embryo transfer, cloning, and genetic engineering. Have students write a one-page essay that discusses major points related to each biotechnology. CS1, CS2, CS4, T3, T4, T6, R1, R2, R5, R6, W2, W4, W5	e. Use the <i>Genetic Engineering Essay Rubric (3.3)</i> to evaluate the students' essays.

Standards

AFNR Industry Standards

- AS.02. Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics.
- AS.05. Evaluate and select animals based on scientific principles of animal production.
- BS.03 Demonstrate the application of biotechnology to AFNR.

Applied Academic Credit Standards

Biology I

- BIOI 2 Describe the biochemical basis of life, and explain how energy flows within and between the living systems.
- BIOI 4 Analyze and explain the structures and function of the levels of biological organization.
- BIOI 5 Demonstrate an understanding of the molecular basis of heredity.
- BIOI 6 Demonstrate an understanding of principles that explains the diversity of life and biological evolution.

Biology II

- BIOII 2 Describe and contrast the structures, functions, and chemical processes of the cell.
- BIOII 3 Investigate and discuss the molecular basis of heredity.
- BIOII 4 Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.

Genetics

- G 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- G 2 Analyze the structure and function of the cell and cellular organelles.
- G 3 Apply the principles of heredity to demonstrate genetic understandings.

Zoology

- ZO 2 Develop an understanding of levels of organization and animal classification.
- ZO 3 Differentiate among animal life cycles, behaviors, adaptations, and relationships.
- ZO 4 Demonstrate an understanding of the principles of animal genetic diversity and evolution.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS4 Productivity & Accountability

National Education Technology Standards for Students (NETS)

- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R4 Meaning of Words

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R5	Generalizations and Conclusions
S1	Interpretation of Data
W2	Focusing on the Topic
W4	Organizing Ideas
W5	Using Language

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Science of Agricultural Animals

Unit 4: Animal Growth and Nutrition

20 Hours

Competency 1: Examine the role of nutrition in animal growth and health at different life stages. AS.04, AQ.02, BIOI 3, ZO 3, ZO 4

Suggested Enduring Understandings

1. Healthy growth and development of animals are dependent upon how well food is metabolized in the body.
2. Animals must have a balanced diet composed of six essential nutrients in order to meet growth and development potential.
3. Animals use protein, fat, and carbohydrates for energy and growth.
4. Different animals have varied nutritional requirements.
5. Animals with ruminant, monogastric, and avian digestive systems have different nutritional requirements.
6. The nutritional needs of different species of animals at birth are not the same.
7. As a young animal develops, the nutritional needs change according to the purpose for the animal and the species.
8. Growing animals have specific nutritional needs depending on their purpose.
9. As animals age past maturity, their nutritional needs change.
10. Animals at a reproductive age need specialized nutritional care.
11. Female animals who are nursing their young have special nutritional needs.
12. Concentrated feed and roughage feedstuffs are distinguished by their nutritional value and how they are digested.
13. The type of digestive system in an animal influences the amount of concentrates and roughages an animal can consume.

Suggested Essential Questions

1. How does metabolic rate affect animal growth and development?
2. What are the six essential nutrients that animals need in their diet?
3. What are the sources of energy and growth in an animal's diet?
4. What are the specific nutritional requirements for various domesticated animals?
5. What are the similarities and differences between the ruminant, monogastric, and avian digestive systems?
6. What types of nutrition do baby animals need?
7. What factors affect the nutritional needs of young animals?
8. How does the purpose of an animal affect what the animal needs nutritionally?
9. How do older animals' nutritional needs change over the years?
10. What types of nutrition changes are necessary for an animal at a reproductive age?
11. What nutrients do lactating mothers need in their diet?
12. What is the difference between a concentrate and roughage?
13. Which type of feed is better digested by ruminants, monogastric, and avian digestive systems?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Explain metabolism. (DOK 1)	a. Prior to teaching this competency, have students read the chapter on <i>Animal Nutrition</i> in the text (Herren, 2007). Discuss how the metabolic rate of some people allows them to	a. Use a written test to evaluate student understanding.

	eat more food than others and still not gain weight. Explain by using a diagram how the digestive system is designed and where the metabolic processes of anabolism, catabolism, and oxidation of nutrients occur within the digestive system. CS1, T2, R3	
b. List six nutrients essential to life, and identify the sources of the nutrients. (DOK 2)	b. Assign students to prepare an informational booklet depicting the six essential nutrients. The booklet should contain a description of the nutrient, photograph of the nutrient, or graphic depiction of the nutrient and a list of sources of the nutrient that would be available to the animal. CS1, CS2, CS4, CS5, T1, T2, T3, T6, W2, W4, W5	b. Use the <i>Nutritional Information Booklet Grading Rubric (4.1)</i> to evaluate student mastery.
c. Describe how carbohydrates, proteins, and fats are used to meet nutritional requirements of animals. (DOK 1)	c. Discuss how the body uses proteins, carbohydrates, and fats to produce energy and growth. The key concept is that energy comes from fats and carbohydrates and that protein is used only for body growth. Explain how energy and growth are important to the producer for maintaining a healthy and profitable animal production enterprise. CS1, CS2	c. Use a written test to evaluate student understanding.
d. Distinguish between concentrates and roughage feedstuffs. (DOK 1)	d. Define concentrates and roughages, and discuss how they are used in developing rations. CS1, CS2,	d. Use a written test to evaluate student understanding.
e. Associate common concentrates and roughages with specific animal rations. (DOK 1)	e. Discuss why both types of feedstuffs are included in many rations. Associate common concentrates and roughages with specific animal rations. CS1, CS2,	e. Use a written test to evaluate student understanding.
f. Develop a simple (two feedstuff mix) ration for an animal. (DOK 3)	f. After discussing and demonstrating the procedure for developing and balancing rations, assign groups of two to three students to determine nutritional requirements for a specific animal and then use nutritional tables to determine a ration. Instruct students to balance the ratio using the Pearson square method. Have the groups make an oral presentation to show the class the assigned animal's ration. CS1, CS2, CS3, CS4, CS5, S1	f. Use the <i>Oral Presentation on Animal Rations Rubric (4.2)</i> to evaluate student mastery.
g. Differentiate between monogastric, including catfish, ruminant, avian, and pseudo-	g. Give students diagrams of the different digestive systems. As you discuss each type of digestive system, instruct students to label each diagram. At the end of the discussion, have them compile a listing of similarities and differences of each system based on the	g. Use the <i>Grading Checklist for Digestive System Diagrams (4.3)</i> to evaluate student understanding.

ruminant feed utilization. (DOK 3)		diagrams. CS1, CS2, CS4, S1, W4, W5	
h. Explain the role of microorganisms in ruminants in increasing feed utilization. (DOK 3)	h. Use the PowerPoint presentation Livestock Digestive Systems to discuss how microorganisms in the rumen help ruminant animals' breakdown fiber, nonprotein nitrogen, and other feedstuffs to more efficiently utilize feed for growth and energy needs. Explain how this feature allows cows and sheep to eat feeds that humans cannot digest. Explain how the pH of the rumen must be maintained for the animal to survive. CS1, CS2	h. Use a written test to evaluate student understanding.	
i. Discuss the advantages and disadvantages of different water sources. (DOK 2)	i. Assign small groups of students to create an advertisement promoting different sources of water in the local area that include the following: • Ponds • Streams • Wells • Springs • Community water supplies Assign one type of water source to each group, and instruct them to try to <i>sell</i> their water source by discussing the advantages and disadvantages of their assigned water source. CS1, CS2, CS3, CS4, T1, T2, T3, T4, T5, R1, R2, R3, R4, R5, W1, W2, W3, W4, W5	i. Use the <i>Water Advertisement Grading Rubric (4.4)</i> to evaluate student understanding on this indicator. See the <i>Feed Conversion Worksheet (4.5)</i> for an example.	
j. Calculate a feed conversion ratio for a given animal. (DOK 2)	j. Define the concept of feed conversion, and discuss its importance in animal production. Demonstrate the formula for calculating feed conversion ratios. Provide students with data for several examples, and have them calculate a conversion ratio, or give them a ratio, and have them calculate how many pounds of feed it will take to get an animal to a certain weight. (See the <i>Feed Conversion Worksheet (4.5)</i> for an example.) CS2, CS4, T3, T4, M1, M3, M4	j. Grade worksheet on feed conversion ratios for accuracy.	
k. Discuss the nutritional needs of newborn: needs for growth, nutritional needs for maintenance, gestation, and lactating. (DOK 1)	k. Assign students to work in groups of two or three to choose a particular breed of domestic animals. Instruct the students to research the animal to find details and photos or graphics of that particular animal at birth. The students should begin to compile a PowerPoint presentation on the animal breed to include the care and nutritional needs of their assigned animal at birth. CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T4, T6, R1, R2,	k. Use the <i>Animal Nutrition PowerPoint Rubric (4.6)</i> to evaluate student mastery.	

R4, R5, W2, W4, W5

Students should continue building their PowerPoint presentation begun with indicator a by adding information of the animal breed and its nutritional requirements as young animals grow into maturity. They should also include information on how to care for these animals at different stages in life. CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T4, T6, R1, R2, R4, R5, W2, W4, W5

Instruct students to continue their research on the assigned animal breed and include information in their presentation on care, management, and nutritional needs of the animal as it ages and maintains its quality of life. CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T4, T6, R1, R2, R4, R5, W2, W4, W5

Students are to continue their research on the assigned animal breed and include information in their presentation on reproductive processes and nutritional requirements for the animals as they prepare for reproduction or are pregnant. CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T4, T6, R1, R2, R4, R5, W2, W4, W5

Instruct students to finalize their research on the assigned animal breed and include information in the presentation on the nutritional needs for lactating females in this breed. CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T4, T6, R1, R2, R4, R5, W2, W4, W5

Competency 2: Assess the effects of hormones on animal growth. AS.04, ZO2, ZO3

Suggested Enduring Understandings

1. The endocrine system forms chemical substances called hormones, which influence animal growth.
2. Minerals play a major role in maintaining the health and development of an animal.
3. Fat-soluble and water soluble vitamins are necessary for animal growth and development.

Suggested Essential Questions

1. Which hormone producing glands have an effect on animal growth?
2. What are the minerals that affect the health and development of an animal?
3. Where do animals get the vitamins they need for growth and development?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. List and discuss the major hormone	a. Introduce the competency by explaining the difference in growth rate and body structure of	a. Use a written test to evaluate student

producing glands and their effect on growth. (DOK 1)	bulls and steers. Discuss the different hormones in the animal's body and how each affects growth. CS1, CS2	understanding.
b. Identify issues with consumers on the use of hormones in food animal production. (DOK 2)	b. Have students research news stories associated with hormones in food animal production, and summarize the advantages and concerns over their use in an article summary. CS1, CS2, CS4, T1, T2, T3, T4, T6, R1, R2, R4, R5, W2, W4, W5	b. Use the <i>Consumer Issues Article Rubric (4.7)</i> to evaluate student mastery.
c. Discuss the role and functions of macro and micro minerals in the normal growth and development of an animal. (DOK 1)	c. Have students compile a list of minerals and identify which are macro and which are micro. Associate each mineral with the growth and development of an animal including effects of shortages and surpluses of each mineral. CS1, CS2, CS4, T3, W4, W5	c. Use the <i>Grading Checklist for Lists of Vitamins and Minerals (4.8)</i> to evaluate student mastery.
d. Identify the major fat soluble and water soluble vitamin groups in animal feeds and their most common sources. (DOK 1)	d. Have students compile a listing of vitamins and identify which are fat soluble and which are water soluble. Identify how each aids the growth and development of the animal and common sources of each. CS1, CS2, CS4, T3, W4, W5	d. Use the <i>Grading Checklist for Lists of Vitamins and Minerals (4.8)</i> to evaluate student mastery.
e. Identify the major minerals in animal feeds and their most common sources. (DOK 1)	e. On the list compiled for indicator a, instruct students to add information on the source of the mineral for each major mineral listed. CS1, CS2, CS4, T3, W4, W5	e. Use the <i>Grading Checklist for Lists of Vitamins and Minerals (4.8)</i> to evaluate student mastery.

Standards

Agriculture, Food, and Natural Resources Standards

- AS.04. Apply principles of animal nutrition to ensure the proper growth, development, reproduction, and economic production of animals.

Academic Standards

- AQ 2 Develop an understanding of physical and chemical properties of water and aquatic environments.
BIOI 3 Investigate and evaluate the interaction between living organisms and their environment.
BIOII 4 Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.
BIOII 5 Develop an understanding of organism classification.
ZO 2 Develop an understanding of levels of organization and animal classification.
ZO 3 Differentiate among animal life cycles, behaviors, adaptations, and relationships.
ZO 4 Demonstrate an understanding of the principles of animal genetic diversity and evolution.

21st Century Learning Skills

- CS1 Flexibility & Adaptability
CS2 Initiative & Self-Direction
CS3 Social & Cross-Cultural Skills
CS4 Productivity & Accountability
CS5 Leadership & Responsibility

NETS for Students

- T1 Creativity and Innovation
T2 Communication and Collaboration
T3 Research and Information Fluency
T4 Critical Thinking, Problem Solving, and Decision Making
T6 Technology Operations and Concepts

ACT College Readiness Standards

- M1 Basic Operations and Applications
M3 Numbers: Concepts and Properties
M4 Expressions, Equations, and Inequalities
R1 Main Ideas and Author's Approach
R2 Supporting Details
R3 Sequential, Comparative, and Cause–Effect Relationships
R4 Meaning of Words
R5 Generalizations and Conclusions
S1 Interpretation of Data
W1 Expressing Judgments
W2 Focusing on the Topic
W3 Developing a Position
W4 Organizing Ideas
W5 Using Language

Suggested References

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For additional references, activities, and web resources, please refer to: Information and Computer Technology B.R.I.D.G.E. Web site: <http://www.rcu.blackboard.com> (Available only to registered users).

Science of Agricultural Animals

Unit 5: Animal Reproduction

20 Hours

Competency 1: Examine the process of fertilization and conception in animal production. AS.02, AS.04, AS.05, ZO 3

Suggested Enduring Understandings

1. Most domesticated animals are raised for breeding offspring in order to make a profit for the animal producer.
2. Male and female sex cells each have distinct characteristics.
3. Controlling the breeding process for animals plays a key role in the success of the conception rate.
4. Sexual reproduction involves each parent providing half of its genetic material to create offspring.

Suggested Essential Questions

1. How does an animal producer manage the animal herd's reproduction cycles to insure the maximum profit available?
2. What are the differences in the male and female sex cells?
3. Why do producers need to control the breeding process for domesticated animals?
4. How does the reproductive process occur in different species of animals?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe the importance of reproduction and reproductive efficiency to animal enterprises. (DOK 3)	a. Lead a discussion on the role of reproduction in a profitable animal enterprise. Ask students to discuss the benefits of having an animal that reproduces every 12 months versus every 16 months. Using a teacher-made chart, show the loss of income over time that results from poor reproductive efficiency. CS1, CS2, T4, S1	a. Use a written test to evaluate student understanding.
b. Identify male and female sex cells. (DOK 1)	b. Using graphics or photos obtained from the textbook or Internet pertaining to animal reproductive cells, describe the anatomy of the male and female sex cells. Discuss the physical differences and the role that each plays in the reproduction process. CS1, T2, S3	b. Use a written test to evaluate student understanding.
c. Describe the mating and breeding process in animals. (DOK 2)	c. After a class discussion on the general process of mating between male and female animals, assign each student to research and write a report on a particular species of animal and find out the specific details of how the male and female animal in that breed mate. The students should also include in their written reports information on the rate of conception for that particular conception, the risks involved with breeding and conception, the number of offspring produced per birth, and the gestation period. CS1, CS2, CS3, CS4, CS5, T1, T2, T3, S1,	c. Use the <i>Animal Insemination Report Rubric (5.1)</i> to evaluate student mastery.

S2, S3

d. Describe the process of fertilization. (DOK 1)	d. Have students prepare a series of drawings showing how the sperm and egg unite to form an embryo. CS1, CS2, CS3, CS4, CS5, T1, M5, S3	d. Evaluate the drawings for accuracy and completeness.

Competency 2: Examine the reproduction process. AS.02, AS.04, AS.05, ZO 2, ZO 3

Suggested Enduring Understandings

1. Male and female animals are uniquely designed for the reproduction process.
2. The mammalian reproductive cycle involves estrus, ovulation, fertilization, gestation, and parturition.
3. The gestation period varies for different species.
4. The reproductive organs in poultry serve to produce eggs.
5. Eggs can be produced that have not been fertilized.
6. The egg incubation period varies for different types of poultry.
7. Eggs intended for hatching require special care and handling.
8. Mississippi farm-raised fish eggs are deposited by a variety of methods in various locations depending on the species of fish.
9. Different species of Mississippi farm-raised fish require unique conditions in order to spawn.
10. Mississippi farm-raised fish eggs can be incubated in both natural and artificial settings.
11. Small fish (Mississippi farm-raised) have to be protected during the early stages of life in order to survive and grow into a marketable size.

Suggested Essential Questions

1. What are the differences between the male and female reproductive systems?
2. How are the mammalian reproductive cycles distinguished?
3. What is the gestation period for cows, horses, sheep, pigs, and goats?
4. How is an egg formed?
5. How can an egg be produced by chicken that has not been fertilized?
6. How long does it take for an egg to hatch?
7. What conditions must exist for an egg to hatch successfully?
8. How and where do Mississippi farm-raised fish lay eggs?
9. Are all Mississippi farm-raised fish eggs fertilized when they are deposited?
10. Do Mississippi farm-raised fish eggs need to be incubated?
11. How do the parent fish (Mississippi farm-raised) protect their young once they are hatched?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify the male and female reproduction organs, and discuss the function of each. (DOK 1)	a. Prior to teaching this unit, have students read the chapter on <i>The Reproduction Process</i> in the text (Herren, 2007). Use the Animal Reproduction PowerPoint presentation to illustrate and discuss reproductive anatomy and physiology in female mammals. If possible, obtain male and female reproductive organs from a local slaughter house, and perform a	a. Use a written test to evaluate student understanding.

dissection for students to observe. ^{CS, T2, S1}		
b. Identify the phases of the female mammalian reproductive cycle. (DOK 2)	b. Discuss the phases of the female reproductive cycle from ovulation to birth. Identify behavioral and physiological signs of estrus in female animals. ^{CS1, CS2, CS4}	b. Use a written test to evaluate student understanding.
c. Calculate the expected birth date for a given species based on conception date. (DOK 3)	c. Have students prepare a time line showing the estrus cycle for different species of animals. Identify the gestation periods for different species, and have students use a spreadsheet to calculate the expected birth date based on breeding date and the expected date of next estrus if the animal does not conceive. ^{CS1, CS2, CS4, T4, T6, M1, M2}	c. Evaluate the time line and spreadsheet for accuracy and completeness.
d. Identify and describe the purpose and/or function of the reproductive organs in poultry. (DOK 2)	d. Have students label a drawing of the male and female reproductive system of a chicken. Have students list the function of each part. ^{CS1, CS2, CS4}	d. Evaluate the drawings for accuracy and completeness.
e. Describe the reproductive process in poultry. (DOK 1)	e. Using slides 44–50 of the Animal Reproduction and Genetics PowerPoint presentation, illustrate and discuss the reproductive process in chickens, including the difference between a fertilized and unfertilized egg. ^{CS1, CS2, CS4}	e. Use a written test to evaluate student performance.
f. Indicate incubation period and conditions required by various species. (DOK 3)	f. Have students compile a chart showing key factors in incubating different species of poultry (chickens, turkeys, and quail), including length of incubation period, recommended temperature and humidity, special considerations, and so forth. Also, the chart should summarize procedures and conditions for hatching and caring for new born birds. ^{CS1, CS2, CS4, T2, T3, M2, M5}	f. Evaluate the chart for accuracy and completeness.
g. Describe procedures and conditions for hatching eggs and caring for newly hatched birds. (DOK 4)	g. Set up an incubator with fertilized duck, chicken, goose, or turkey eggs. Assign students to monitor the incubator, adjusting temperature and humidity as needed during the development of the eggs. Have students complete the <i>Incubator Data Chart</i> (5.4). Once the eggs hatch, assign groups of students to care for the newly hatched birds. ^{CS1, CS2, CS4, T3, T6 S1, S2, S3}	g. Evaluate student performance using the <i>Poultry Hatching Checklist</i> (5.4), and check the <i>Incubator Data Chart</i> (5.4) for accuracy and completeness.
h. Describe the general process of spawning and incubation with	h. Use the video Catfish from Rathburn to describe the process and conditions needed for spawning, hatching, and caring for fry. ^{CS1, CS2, CS4}	h. Use a written test to evaluate student understanding.

Mississippi farm-raised fish. (DOK 2)		
i. Indicate conditions for spawning of a species common in the local area. (DOK 2)	i. Assign students in groups of two to three to research a species of Mississippi farm-raised fish that is common to the local area. The students should create a multimedia presentation showing the spawning and incubation process for the assigned fish species. They will present their findings to the class. CS1, CS2, CS4, T2, T4, T6, W2, W4, W5	i. Use the <i>Multimedia Presentation Rubric (5.3)</i> to evaluate student mastery.
j. Apply procedures for the care for newly-hatched fry. (DOK 4)	j. Set up an aquaculture tank in the laboratory, and stock it with fingerlings from a local supplier. Demonstrate the care, management, and feeding requirements for the fry, and assign students a rotating work schedule to care for the fry. CS1, CS2, CS4, S1, S2, S3	j. Use the <i>Catfish Fry Management Rubric and Data Sheet (5.5)</i> to evaluate student mastery.

Competency 3: Examine reproductive methods. AS.02, AS.04, AS.05, ZO 2, ZO 3

Suggested Enduring Understandings

1. Animals can be bred naturally or artificially.
2. Artificial insemination can be used to produce healthier and faster growing animals.
3. The process of embryo transfer is a reproductive method where superior animals can be chosen to breed offspring with highly desirable characteristics.

Suggested Essential Questions

1. What artificial methods can be used to successfully breed animals?
2. Why does artificial insemination improve the health and growth rate of animals?
3. How does the process of embryo transfer work?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Observe and describe the artificial insemination method of breeding. (DOK 2)	a. Have students watch the video Cow to observe the process of artificial insemination in cattle. If possible, take students to a local breeder to observe the process, or invite the breeder to speak to the class on the process and its advantages and limitations. Have students summarize their findings from the video and the breeder in a one-page written report. CS1, CS2, CS4, W2, W4, W5	a. Use the <i>Artificial Insemination Report Rubric (5.1)</i> to evaluate student mastery.
b. Describe the process of embryo transfer. (DOK 2)	b. Have students watch the video Embryo Transfer to observe the process. If possible, obtain samples of frozen semen and embryos from a local veterinarian, a breeding company, or the local university. Thaw the samples, and have students examine them under the microscope to look for damaged or low-quality sperm or embryos. Explain how the process of embryo transfer works in the breeding	b. Use a written test to evaluate student performance.

industry. CS1, CS2, CS4, T6		
c. Observe and describe the procedure for collecting and processing semen. (DOK 2)	c. Have students watch the Bull, Freezing Bull Semen I , and Freezing Bull Semen II videos on the <i>Learning Reproduction in Farm Animals</i> Web site. Discuss the costs of collecting and freezing semen, as well as the price of buying frozen semen. Have students research factors that would affect the cost and value of frozen semen from different types of animals. Instruct students to write a written report on their findings. CS1, CS2, CS4, T3, T6, W2, W4, W5	c. Use the <i>Semen Collection and Processing Procedures Report Rubric (5.2)</i> to evaluate student mastery.

Standards

Agriculture, Food, and Natural Resources Standards

- AS.02 Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics.
- AS.04 Apply principles of animal nutrition to ensure the proper growth, development, reproduction, and economic production of animals.
- AS.05 Evaluate and select animals based on scientific principles of animal production.

Academic Standards

- ZO 2 Develop an understanding of levels of organization and animal classification.
- ZO 3 Differentiate among animal life cycles, behaviors, adaptations, and relationships.

21st Century Learning Skills

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS4 Productivity & Accountability

NETS for Students

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- M1 Basic Operations and Applications
- M2 Probability, Statistics, and Data Analysis
- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- S1 Interpretation of Data
- S2 Scientific Investigation
- S3 Evaluation of Models, Inferences, and Experimental Results
- W2 Focusing on the Topic
- W4 Organizing Ideas
- W5 Using Language

Suggested References

Animal reproduction and genetics. (n.d.). (PowerPoint). June 9, 2010, from www.clevelandcountyschools.org/schools/chs/agriculture/ans1_repro.ppt

CEV Video. (n.d.). *CEV pathway: Animal systems pathway* [DVD]. Lubbock, TX: Author.

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Herren, R. (2007). *The science of animal agriculture* (3rd ed.). Albany, NY: Delmar Publishers.

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Merck Company, Inc. (n.d.). *The Merck veterinary manual – Reproductive system: Introduction*. Retrieved June 9, 2010, from http://www.merckvetmanual.com/mvm/index.jsp?cfile=htm/bc/toc_110100.htm

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Science of Agricultural Animals

Unit 6: Animal Evaluation

20 Hours

Competency 1: Evaluate market animals. AS.05, ZO 2, ZO 3, ZO 4

Suggested Enduring Understandings

1. The value of a market animal can be determined by its physical appearance.
2. In order to effectively evaluate an animal, knowledge of the external anatomy of the animal is necessary.
3. Market animals are bred for the cuts and quality of meat that will come from the animal.
4. When evaluating an animal, the type of animal is to be considered, as well as the muscle finish, carcass quality, balance, and style.
5. Valid reasons must be provided when ranking the quality of a class of market animals.

Suggested Essential Questions

1. What physical characteristics are used to evaluate a market animal?
2. Which anatomical characteristics are evaluated on an animal?
3. What are the major wholesale cuts of meat on an animal?
4. How do you evaluate an animal for quality?
5. What type of reasoning should be given for ranking a class of market animals?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Explain the importance of market animal evaluation. (DOK 1)	a. Prior to teaching this competency, have students read the appropriate chapter on Selection and Judging of the species from the text (Gillespie & Flanders, 2010). Discuss the basis for determining the value of a market animal based on its appearance, conformation, and yield of high value wholesale meat cuts. CS1, CS2	a. Use a written test to evaluate student understanding.
b. Label the external parts of an animal (beef, swine, goat, chicken, and lamb). (DOK 1)	b. Have students label a drawing of different species of market animals showing the major external parts. CS1, CS2	b. Grade the labeled drawings.
c. Identify the wholesale meat cuts on a market animal (beef, pork, goat, and lamb). (DOK 1)	c. Have students label a drawing of different species of market animals showing the major wholesale meat cuts on the carcass. CS1, CS2 T1, T2	c. Grade the labeled drawings of cuts of meat.
d. List the main points to consider when visually evaluating a market animal	d. Teachers should concentrate on evaluation of one species of animal for this competency. In most cases, this will be beef animals, but dairy cattle, swine, or sheep may be selected as well.	d. Use a written test to evaluate student understanding.

(type, muscle, finish, carcass merit, yield, quality, balance, and style). (DOK 2)	Provide students with a list of terms associated with market animal evaluation, and discuss/illustrate each term. Discuss the steps in evaluating a market animal. CS1, CS2	
e. Evaluate classes of market animals, and present reasons for each class. (DOK 3)	e. Provide students with the proper format placing a class of animals and presenting oral reasons. See the publication Oral Reasons for a procedure for taking notes and giving oral reasons. Using live animals (if possible) or a series of slides or video, have students judge and place a class of market animals and provide oral reasons to justify their placings. CS1, CS2, CS4	e. Use the <i>Livestock Placing and Oral Reasons Rubric (6.1)</i> to evaluate student mastery.

Competency 2: Investigate the selection of breeding animals. AS.05, ZO 2, ZO 3, ZO 4

Suggested Enduring Understandings

1. When selecting an animal for breeding purposes, the animal must be evaluated for soundness, growth capacity, breed, and sex characteristics.
2. Performance records and Expected Progeny Difference (EPD) scores are now being used to select breeding animals.
3. When ranking a class of breeding animals, valid reasons must be given for the ranking.

Suggested Essential Questions

1. How are breeding characteristics evaluated?
2. How is information from performance records and EPDs used to select a breeding animal?
3. What type of reasoning can be given for ranking a class of breeding animals?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Apply points to consider when selecting a breeding animal (structural soundness, growth, capacity, breed, and sex characteristics). (DOK 3)	a. Teachers should select beef cattle as the animal class to be used in teaching this competency. Other species can also be taught based on the instructor's preference. Discuss the characteristics that are most desirable in breeding stock for this class. Using a set of pictures or a video showing different animals, illustrate and discuss these characteristics. CS1, CS2	a. Use a written test to evaluate student understanding.
b. Use performance records and Expected Progeny Differences (EPDs) in selecting breeding animals. (DOK 3)	b. Discuss the concept of EPDs, and show examples of EPD data. Demonstrate the procedure for using this data, and provide students with a worksheet to allow them to select animals for breeding purposes. CS1, CS2 M1, M2, M3, M5, S1, S2	b. Grade student worksheet.
c. Evaluate classes of breeding animals, and present reasons for each	c. Using live animals (if possible) or a videotape or multimedia presentation, have students judge, place, and give reasons on a class of breeding animals. CS1, CS2, CS4, S1, S2	c. Use the <i>Livestock Placing and Oral Reasons Rubric (6.1)</i> to evaluate

class. (DOK 3)	student mastery.

Standards

Agriculture, Food, and Natural Resources Standards

AS.05 Evaluate and select animals based on scientific principles of animal production.

Academic Standards

ZO 2 Develop an understanding of levels of organization and animal classification.

ZO 3 Differentiate among animal life cycles, behaviors, adaptations, and relationships.

ZO 4 Demonstrate an understanding of the principles of animal genetic diversity and evolution.

21st Century Learning Skills

CS1 Flexibility & Adaptability

CS2 Initiative & Self-Direction

CS4 Productivity & Accountability

NETS for Students

T1 Creativity and Innovation

T2 Communication and Collaboration

ACT College Readiness Standards

M1 Basic Operations and Applications

M2 Probability, Statistics, and Data Analysis

M3 Numbers: Concepts and Properties

M5 Graphical Representations

S1 Interpretation of Data

S2 Scientific Investigation

Suggested References

CEV Video. (n.d.). *CEV pathway: Animal systems pathway* [DVD]. Lubbock, TX: Author.

CEV Multimedia, Inc. (n.d.). *Livestock judging*. [DVD]. Lubbock, TX, Author.

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Texas Cooperative Extension Service. (n.d.). *Approach to placing a market steer class*. Retrieved June 15, 2010, from <http://animalscience.tamu.edu/images/pdf/beef/beef-approach-to-placing.pdf>

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Science of Agricultural Animals

Unit 7: Production Management

10 Hours

Competency 1: Examine basic concepts of animal health to include disease prevention, control, and treatment. AS.03, AS.06, ZO 2

Suggested Enduring Understandings

1. Knowing the signs of good health is a first step in recognizing and diagnosing signs of poor health in an animal.
2. A disease is an infectious agent that results in decreased health in an animal. Diseases may be caused by bacteria, viruses, protozoa, injury, genetics, poor nutrition, or toxins.
3. Many factors contribute to an animal's ability to resist diseases including age, genetic background, stocking density, and natural immunity.
4. Environmental conditions such as temperature, humidity, air quality, and light can have a direct effect on animal health.
5. The white blood cells play an important role in helping animals stay healthy and fight diseases by either killing or digesting harmful organisms or substances in the body.
6. Vaccines, when properly administered, cause an animal to develop an immunity against a specific disease.
7. Proper nutrition, sanitation, vaccination, and observation/isolation of unhealthy animals promote animal health.
8. A herd or flock health plan includes knowledge of signs of good health, vaccinations and medication regimes, proper sanitation methods, parasite control, and prompt treatment and isolation of unhealthy animals.

Suggested Essential Questions

1. What are the signs of a healthy animal?
2. What is a disease, and what causes diseases?
3. What practices promote animal health?
4. How is a health plan developed for an animal enterprise?
5. What factors contribute to an animal's health and ability to resist diseases?
6. How do environmental conditions affect animal health?
7. What is the role of the white blood cells in helping the body to fight disease?
8. How do vaccines help an animal develop immunity?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe the signs of good health in animals. (DOK 1)	a. Prior to teaching this competency, have the students read the chapter on <i>Animal Health</i> in the text (Burton & Cooper, 2007). Using the PowerPoint presentation Animal Health , identify and describe the signs of healthy and signs of unhealthy animals, including	a. Use a written test to evaluate student understanding.

measurement of vital signs in different animals. CS 1, CS2, CS4, W2, W4, W5		
b. Define disease, and describe the major causes of diseases. (DOK 1)	b. Use the Animal Health PowerPoint presentation to define what a disease is, and discuss with the students the different vectors and causes of diseases. CS1, CS2, CS4	b. Use a written test to evaluate student understanding.
c. Describe how factors such as age, genetic background, stocking density, and natural immunity affect animal health and resistance to diseases. (DOK 1)	c. Invite a local producer to speak to the class regarding factors that contribute to disease resistance and immunity. Have students take notes and summarize major points in their electronic notebooks or journals. CS1, CS2, CS4, T6, W2, W4, W5	c. Use a written test to evaluate student understanding.
d. Examine the effects of environment conditions on animal health. (DOK 1)	d. Discuss with the class how environmental conditions such as temperature, humidity, air quality, and light affect animal health. CS1, CS2, CS4	d. Use a written test to evaluate student understanding.
e. Discuss the role and functions white blood cells in development of natural immunity. (DOK 1)	e. Have students watch the video White Blood Cells: Leucocytes and answer the questions in the <i>White Blood Cells Assignment (7.2)</i> . CS1, CS2, CS4, T6, W2, W4, W5	e. Evaluate the assignment for accuracy and completeness.
f. Describe how vaccinations prevent disease. (DOK 1)	f. Discuss the two types of vaccines (live bacteria and killed bacteria) and how these medications lead to development of immunity against a specific disease in an animal. Have students conduct a search to identify vaccinations that are commonly given to dogs, cattle, swine, and chickens. CS1, CS2, CS4, T4, T6, W2, W4, W5	f. Evaluate results of student search for accuracy and completeness.
g. Discuss practices that promote animal health. (DOK 1)	g. Use the Animal Health PowerPoint presentation to describe procedures for promoting animal health. CS1, CS2, CS4	g. Use a written test to evaluate student understanding.
h. Define the terms biosecurity and bioterrorism, and discuss their relationship to animal health programs. (DOK 1)	h. Using the PowerPoint presentations Biosecurity and Bioterrorism , define the two terms, and discuss how they relate to animal health programs. CS 1, CS2, CS4	h. Use a written test to evaluate student understanding.
i. Develop a plan for maintaining and	i. Divide the class into groups of three or four students, and assign each group a different	i. Use the <i>Animal Health Plan Rubric</i>

protecting animal health in a herd or flock. (DOK 3)

animal species to be produced. Have students search the Internet and other sources and compile a plan for maintaining and protecting animal health. CS 1, CS2, CS4, S1, S2, S3, T3, T4, T6, R2, R4, R5 W2, W3, W4, W5

(7.1) to evaluate student mastery.

Competency 2: Examine the role of pathogens in animal health to include parasites and plant toxins.

AS.03, ZO 2

Suggested Enduring Understandings

1. The most common pathogens are bacteria, viruses, protozoa, and toxins. These pathogens can be delivered by ingestion, physical contact, or inhalation.
2. Animal diseases are classified as contagious, infectious, genetic, and nutritional. Each type of disease involves a different type of treatment or response.
3. Internal and external parasites harm animals by robbing their bodies of nutrients, causing blood loss, reducing food intake, and in general weakening an animal and making it more susceptible to disease.
4. The major internal parasites of animals are roundworms, tapeworms, and flukes. The major external parasites are flies, ticks, mites, lice, and fungi.
5. Plant toxins affect animals by affecting different organ systems in the animal.
6. Medicine may be given to animals by injection, pills or boluses, drenches, powders, pastes, infusions, and application to the skin.

Suggested Essential Questions

1. What are the most common animal pathogens? How are they transmitted, controlled, and treated?
2. What are the different types or classes of animal disease?
3. How are medications delivered to animals?
4. How do internal and external parasites cause harm to an animal?
5. What are the major internal and external parasites of animals, and how do they affect the animal?
6. How do plant toxins affect an animal?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify common animal pathogens, and discuss their method of entry, control, and treatment. (DOK 1)	a. Use the PowerPoint presentation Animal Diseases to lead a discussion of the different pathogens (bacteria, viruses, protozoa, toxins, etc.) and how they enter and affect the body, as well as how they are controlled and treated. Have students summarize the findings and record in their electronic notebooks or journals. CS1, CS2, CS4, T6, W4, W5	a. Use a written test to evaluate student understanding.
b. Classify common diseases of animals. (DOK 1)	b. Use the PowerPoint presentation Animal Diseases to present information on the different types of diseases (contagious, noninfectious, genetic, and nutritional). Lead a discussion on how these types differ in the way	b. Use a written test to evaluate student understanding.

they affect an animal and in the way they are treated and controlled. CS1, CS2, CS4:		
c. Describe how internal and external parasites cause harm to animals. (DOK 1)	c. Prior to teaching this competency, have the students read the chapter on <i>Parasites of Agricultural Animals</i> from the text (Herren, 2007). Use the PowerPoint presentation Integrated Parasite Management as a means to discuss internal and external parasites and the damage they cause animals. (Note: This PowerPoint is devoted to parasites of sheep and goats, but many of the points it makes are applicable to other species.) CS1, CS2, CS4	c. Use a written test to evaluate student understanding.
d. Classify internal and external parasites, and examine their life cycle and the harm they cause animals. (DOK 1)	d. Lead a discussion to identify and describe the life cycle of the major internal parasites (roundworms, tapeworms, and flukes) and external parasites (ticks, fleas, lice, mites, fungi, and flies). CS1, CS2, CS4	d. Use a written test to evaluate student understanding.
e. Examine ways in which plant toxins affect animal health. (DOK 2)	e. Use slides 24–26 of the PowerPoint presentation Animal Health as a means of discussing the most common plant toxins and their method of control. Assign a specific plant toxin to each student, and have him or her conduct a search and prepare a one-paragraph essay on the nature of the toxin, its effects on animals, and its control or treatment. CS1, CS2, CS4, T4, T6, R2, R4, W2, W4, W5	e. Evaluate student paragraphs for content accuracy and completeness.
f. Discuss methods for delivering medicine to animals. (DOK 1)	f. Have a local veterinarian or veterinary technician speak to the class of the different means for delivering medications, vaccines, and vermifuges to animals. Ask him or her to bring the equipment that is used and describe its use. Have students use the <i>Guest Speaker Summary Form (7.3)</i> to summarize the major methods used and associate each method with the necessary equipment and/or techniques. CS1, CS2, CS4, E1, E2, E3, E4, E5, E6, W1, W2, W3, W4, W5	f. Evaluate student summaries for accuracy and completeness.

Standards

AFNR Industry Standards

- AS.03. Provide for proper health care for animals.
- AS.06. Prepare and implement animal handling procedures for the safety of animals, producers, and consumers of animal products.

Applied Academic Credit Standards

Zoology

- ZO 2 Develop an understanding of levels of organization and animal classification.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS3 Social & Cross-Cultural Skills
- CS4 Productivity & Accountability
- CS5 Leadership & Responsibility

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T5 Digital Citizenship
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- E1 Topic Development in Terms of Purpose and Focus
- E2 Organization, Unity, and Coherence
- E3 Word Choice in Terms of Style, Tone, Clarity, and Economy
- E4 Sentence Structure and Formation
- E5 Conventions of Usage
- E6 Conventions of Punctuation
- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R3 Sequential, Comparative, and Cause–Effect Relationships
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- S1 Interpretation of Data
- S2 Scientific Investigation
- S3 Evaluation of Models, Inferences, and Experimental Results
- W1 Expressing Judgments
- W2 Focusing on the Topic
- W3 Developing a Position
- W4 Organizing Ideas
- W5 Using Language

Suggested References

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- Biosecurity*. (n.d.). (PowerPoint). Retrieved June 9, 2010, from http://aged.ces.uga.edu/Browseable_Folders/Power_Points/Animal%20Science/Animal_Health/Animal%20Health_Biosecurity.ppt
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Science of Agricultural Animals

Unit 8: Marketing

5 Hours

Competency 1: Identify and describe facility and equipment, and develop a production management plan needs for various animal enterprises. AS.06, AS.07, PST.04, BIOII 4, ZO 3

Suggested Enduring Understandings

1. Most animals require some type of facility and equipment for proper management.
2. Facility design must take into account the natural behavior of the animal to be housed, safety for the animal and humans, sanitation, and environmental controls.
3. In today's market and economy, careful management is absolutely essential to success and profitability.
4. Records of animal breeding and productivity are necessary for evaluating animal performance and decision making and planning.
5. An animal production management plan includes goals, a calendar of activities, a list of equipment materials and facilities needed, and an estimated income and expenses budget.

Suggested Essential Questions

1. What are the general needs for facilities and equipment for successful animal management?
2. What factors must be taken into account in designing and equipping an animal facility?
3. What are practices are critical for successful management of an animal enterprise?
4. How are records of animal breeding and production kept?
5. What should be included in an enterprise production management plan?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Discuss general facility needs for different classes of animals. (DOK 1)	a. Assign each student a different class of animals (beef brood cows, feeder calves, swine farrowing operations, feeder pigs, broilers, layers, goats, sheep, dogs, etc.). Have the student search the Internet and other sources to determine the general facility and equipment needs of the animal as related to shelter, feeding, birthing, watering, and so forth. Have each student compile a list of facilities and equipment needed for the animal and describe its purpose or use. CS1, CS2, CS4, T3, T4, T6, R2, R4,R5, W2, W4, W5	a. Evaluate list for completeness and accuracy.
b. Identify and describe factors to consider in designing and equipping an animal facility.	b. Discuss factors to take into consideration in designing facilities for animals including the animals' natural behavior, safety for the animal and workers, sanitation, environmental controls (temperature, humidity, and air quality), and space requirements for each	b. Use a written test to evaluate student understanding.

(DOK 1)	animal to use the facility. ^{CS1, CS2, CS4}	
c. Design a facility for a given animal enterprise to include an equipment list. (DOK 1)	c. Have students draw a plan for a facility for a given animal and a list of equipment and fixtures that should be included. ^{CS1, CS2, CS4, T1, T4, T6, R2, R4, R5, W2, W4, W5}	c. Use the <i>Animal Facility Plan Rubric (8.1)</i> to evaluate student mastery.
d. Explore critical practices in managing an animal enterprise. (DOK 1)	d. Based on previous discussions in the class, have students brainstorm critical practices that must be included in a management plan for an animal enterprise. These could include facility, equipment, and housing needs; feeds and nutrition; selection of animals for breeding; breeding practices and timing; record keeping; health planning; and marketing. ^{CS1, CS2, CS4}	d. Use a written test to evaluate student understanding.
e. Design a record keeping system for maintaining breeding and production records of animals. (DOK 3)	e. Ask students if they know the definition of the word pedigree or if they know what makes a registered quarter horse different from a regular horse. Lead into a discussion on how breeding records are used to establish the value of many animals and how bloodlines can be used to improve traits within a breed. Discuss with the students the different types of records that are kept on animals, including pedigree, individual animal breeding, performance, health, and production records. Have students search the Internet and other sources to see examples of breeding and production records for different animals. Using a spreadsheet or database program, have students design and present a record keeping form for an animal. ^{CS1, CS2, CS4, T1, T3, T4, T6, R1, R2, R4, R5, W2, W4, W5}	e. Use the <i>Breed Record Form Rubric (8.2)</i> to evaluate the student mastery.
f. Develop a production management plan for a given animal enterprise. (DOK 4)	f. Introduce the students to the concept of a management plan for an animal enterprise. Define and discuss the major components of a management plan. Divide the class into groups of two to three students, and assign each student a specific animal enterprise. Have the groups use the Internet and other resources to identify components of a management plan related to their enterprise and develop a plan for their animal. ^{CS1, CS2, CS4, T1, T2, T3, T4, T6, R1, R2, R4, R5, W2, W4, W5}	f. Use the <i>Production Management Plan Rubric (8.3)</i> to evaluate student performance on this indicator.

Competency 2: Analyze marketing practices for animals and livestock product. ^{ABS.06}

Suggested Enduring Understandings

1. Meat animals are marketed in a wide variety of ways from sale at local auctions to contract sales to major companies and processors.
2. Companion animals such as dogs and cats are usually sold to the public through local advertising or to major pet store companies.
3. Laboratory animals are usually sold in lots to labs under a contract.

Suggested Essential Questions

1. What practices are used to market meat animals? What are their advantages and limitations?
2. How are companion animals marketed?
3. How are laboratory animals marketed?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe and analyze marketing practices for meat animals (cattle, swine, sheep, etc.). (DOK 1)	a. Prior to teaching this competency, have students read the chapter on Marketing in Agriscience in the text (Cooper & Burton, 2007). Have a livestock buyer or auction operator speak to the class regarding markets and marketing practices for meat animals in the local area. Have students use the <i>Guest Speaker Summary Form (8.4)</i> to record important points regarding local market practices for meat animals. Compare costs of the various marketing methods to determine the most cost efficient method of marketing. CS1, CS2, CS4, T6, W2, W4, W5	a. Use a written test to evaluate student understanding.
b. Describe and analyze marketing practices for companion animals. (DOK 1)	b. Have students visit a local pet store and search for companion animals for sale through the Internet, newspapers, and other local advertising magazines. Ask students to investigate how the price of a dog or cat is determined. Lead a classroom discussion on marketing practices for companion animals. Summarize major points on the LCD projector, and have students enter into their electronic notebooks or journals. CS1, CS2, CS4, T6, W2, W4, W5	b. Use a written test to evaluate student understanding.
c. Describe and analyze marketing practices for laboratory animals. (DOK 1)	c. Have students visit laboratory animal breeding sites on the Internet and collect information on the cost of laboratory animals. Lead a class discussion on laboratory animal marketing practices. Use the LCD projector to summarize major points, and have students record these points in their electronic notebooks or journals. CS1, CS2, CS4, T6, W2, W4, W5	c. Use a written test to evaluate student understanding.

Standards

AFNR Industry Standards

- AS.06. Prepare and implement animal handling procedures for the safety of animals, producers, and consumers of animal products.
- AS.07. Select animal facilities and equipment that provide for the safe and efficient production, housing, and handling of animals
- PST.04. Plan, build, and maintain agricultural structures.

Applied Academic Credit Standards

Biology II

- BIOII 4 Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.

Zoology

- ZO 3 Differentiate among animal life cycles, behaviors, adaptations, and relationships.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS4 Productivity & Accountability

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- R2 Supporting Details
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- W2 Focusing on the Topic
- W4 Organizing Ideas
- W5 Using Language

Suggested References

- Bicundo, J., Burris, R., Laurent, K., Akers, J., & Turner L. (n.d.). *Handling beef cattle*. Retrieved June 9, 2010, from <http://www.uky.edu/Ag/AnimalSciences/pubs/kybeefbook03.pdf>
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- Swine Facilities*. (n.d). Retrieved June 9, 2010, from <http://www.tifton.uga.edu/eng/handbook/SECTJ.htm>

Science of Agricultural Animals

Unit 9: Companion Animal Care

5 Hours

Competency 1: Examine the types, care, and management of companion and service animals. AS.01, ZO 1, ZO 2

Suggested Enduring Understandings

1. Knowledge of the domestication history and distinguishing characteristics of companion animals are useful when working with the animals.
2. The raising, training, care, and feeding of companion animals offers rewarding careers to qualified individuals and has economic impact on local communities and the nation as a whole.
3. Approved practices for the care, feeding, and breeding of companion animals should be carefully followed.

Suggested Essential Questions

1. What are the distinguishing characteristics of the different types of companion animals?
2. How do companion animals make an economic impact on a community and the nation as a whole?
3. What are some of the approved practices for breeding, raising, feeding, and marketing companion animals?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe the history of domestication and characteristics of companion and service animals. (DOK 2)	a. Introduce this competency by asking students to name their favor pet. Ask them why this pet was their favorite, and lead into a discussion on the benefits that companion animals offer to people. Assign each student a specific breed or type of companion animal, and tell them that they are going to become the class expert on that breed or animal. Students may volunteer to become an expert on a specific animal. Have the students begin their study of the animal by searching for information on the history of the animal, when it was domesticated, and where it came from. Have students find information describing distinguishing characteristics of the animal and its life cycle. Have students summarize their findings in a paragraph. CS1, CS2, CS4, T1, T2, T3, T4, T6, E1, E2, E3, E4, E5, E6, R1, R2, R4, R5, W2, W4, W5	a. Use the <i>Companion Animal Multimedia Presentation Rubric (9.1)</i> to evaluate student mastery.
b. Examine the economic impact of companion and service animals. (DOK 2)	b. Continue the study of companion animals by asking students how much money is spent on their pet every year, including feed, accessories, veterinary care, and so forth. Have students investigate the economic impact of their chosen or assigned animal to include average cost of a young animal, number of	b. Use the <i>Companion Animal Multimedia Presentation Rubric (9.1)</i> to evaluate student

	animals sold each year, and estimated expenses for upkeep of the animal. Have the students summarize their findings in a table to identify the average cost of keeping an animal for 1 year. Point out that the pet industry does affect the economy and offers rewarding careers. CS1, CS2, CS4, T1, T2, T3, T4, T6, E1, E2, E3, E4, E5, E6, R1, R2, R4, R5, W2, W4, W5	mastery.
c. Investigate approved practices in care, feeding, and housing of companion and service animals. (DOK 3)	c. Ask the students to identify different practices that are used in the care, feeding, and housing of their pets. Have them continue to investigate and research approved practices for their assigned or chosen animal, including environmental factors, nutrition and diet, health care practices and concerns, and breeding and birthing practices. Have the students summarize their findings in a fact sheet. Have the students compile their findings into a PowerPoint presentation including representative pictures of male and female, adult and young animals. Have the students deliver their presentations to the class. CS1, CS2, CS4, T1, T2, T3, T4, T6, E1, E2, E3, E4, E5, E6, R1, R2, R4, R5, W2, W4, W5	c. Use the <i>Companion Animal Multimedia Presentation Rubric (9.1)</i> to evaluate student mastery.

Standards

AFNR Industry Standards

- AS.01 Examine the components, historical development, global implications, and future trends of the animal systems industry.

Applied Academic Credit Standards

Zoology

- ZO 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
ZO 2 Develop an understanding of levels of organization and animal classification.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
CS2 Initiative & Self-Direction
CS4 Productivity & Accountability

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
T2 Communication and Collaboration
T3 Research and Information Fluency
T4 Critical Thinking, Problem Solving, and Decision Making
T6 Technology Operations and Concepts

ACT College Readiness Standards

- E1 Topic Development in Terms of Purpose and Focus
E2 Organization, Unity, and Coherence
E3 Word Choice in Terms of Style, Tone, Clarity, and Economy
E4 Sentence Structure and Formation
E5 Conventions of Usage
E6 Conventions of Punctuation
R1 Main Ideas and Author's Approach
R2 Supporting Details
R4 Meaning of Words
R5 Generalizations and Conclusions
W2 Focusing on the Topic
W4 Organizing Ideas
W5 Using Language

Suggested References

Burton, L. (2010). *Agriscience fundamentals and applications* (5th ed.). Albany, NY: Delmar.

CEV Video. (n.d.). *CEV pathway: Animal systems pathway* [DVD]. Lubbock, TX: Author.

Gillespie, J.R., & Flanders, F.B. (2010). *Modern livestock and poultry production* (8th ed.). Albany, NY: Delmar Publishers.

Herren, R. (2007). *The science of animal agriculture* (3rd ed.). Albany, NY: Delmar Publishers.

Herren, R. (2007). *The science of animal agriculture lab manual* (3rd ed.). Albany, NY: Delmar Publishers.

Student Competency Profile

Student Name: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Introduction to Animal Agriculture

- _____ 1. Investigate the nature of large animal agriculture and its associated enterprises.
- _____ 2. Examine consumer concerns and their effect on animal production.
- _____ 3. Explore concepts of animal welfare and behavior.

Unit 2: Experiential Learning (SAE)

- _____ 1. Plan and implement an experiential learning program.
- _____ 2. Maintain records and documentation of experiential learning activities, projects, and enterprises.

Unit 3: Animals as Living Organisms

- _____ 1. Examine the characteristics of life and living organisms.
- _____ 2. Examine the anatomy and physiology of animals.
- _____ 3. Investigate the importance of heredity and genetics.

Unit 4: Animal Growth and Nutrition

- _____ 1. Examine the role of nutrition in animal growth at health different life stages.
- _____ 2. Assess the effects of hormones on animal growth.

Unit 5: Animal Reproduction

- _____ 1. Examine the process of fertilization and conception in animal production.
- _____ 2. Examine the reproduction process.
- _____ 3. Examine reproductive methods.

Unit 6: Animal Evaluation

- _____ 1. Evaluation of market animals.
- _____ 2. Investigate the selection of breeding animals.

Unit 7: Production Management

- _____ 1. Examine basic concepts of animal health to include disease prevention, control, and treatment.
- _____ 2. Examine the role of pathogens in animal health to include parasites and plant toxins.

Unit 8: Marketing

- _____ 1. Identify and describe facility and equipment, and develop a production management plan needs for various animal enterprises.
- _____ 2. Analyze marketing practices for animals and livestock product.

Unit 9: Companion Animal Care

- _____ 1. Examine the types, care, and management of companion and service animals.

Appendix A: Suggested Assignments, Rubrics, and Checklists

Name: _____

Date: _____

Period: _____

Breeds of Livestock Assignment (1.1)

Using the Internet and other resources, identify and describe the following breeds of animals.

1. Holstein

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

2. Jersey

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

3. Guernsey

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

4. Hereford

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

5. Angus

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

6. Brahman

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

7. Charolais

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

8. Santa Gertrudis

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

9. Shorthorn

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

10. Texas Longhorn

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

11. American Landrace

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

12. Hampshire

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

13. Duroc

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

14. Poland China

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

15. Suffolk

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

16. Hampshire

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

17. Boer

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

18. Nubian

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

19. Cornish

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

20. White Leghorn

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

21. White Plymouth Rock

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

22. American Quarter Horse

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

23. Arabian

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

24. Standardbred

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

25. Tennessee Walking Horse

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

26.

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

27.

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

28.

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

29.

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

Name: _____

Date: _____

Period: _____

Animal Welfare Fact Sheet Rubric (1.2)

Criteria	Possible Points	Points Earned
1. Statement of the Issue: The fact sheet stated the issues to be addressed in a comprehensive detailed manner.	25	
2. Animal Rights Concerns: The fact sheet stated the concerns of the animal rights activists in an objective clear manner.	25	
3. Animal Welfare Response: The fact sheet stated the responses to the concerns in an objective clear manner.	25	
4. Grammar, Spelling, Punctuation, etc.	25	
TOTAL SCORE	100	

Name: _____

Date: _____

Period: _____

21st Century Life and Career Skills (1.3)

Today's life and work environments require far more than thinking skills and content knowledge. The ability to navigate the complex life and work environments in the globally competitive information age requires students to pay rigorous attention to developing adequate life and career skills.

CS1 Global Awareness

1. Using 21st century skills to understand and address global issues
2. Learning from and working collaboratively with individuals representing diverse cultures, religions, and lifestyles in a spirit of mutual respect and open dialogue in personal, work, and community contexts
3. Understanding other nations and cultures, including the use of non-English languages

CS2 Financial, Economic, Business, and Entrepreneurial Literacy

1. Knowing how to make appropriate personal economic choices
2. Understanding the role of the economy in society
3. Using entrepreneurial skills to enhance workplace productivity and career options

CS3 Civic Literacy

1. Participating effectively in civic life through knowing how to stay informed and understanding governmental processes
2. Exercising the rights and obligations of citizenship at local, state, national, and global levels
3. Understanding the local and global implications of civic decisions

CS4 Health Literacy

1. Obtaining, interpreting, and understanding basic health information and services and using such information and services in ways that enhance health
2. Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance, and stress reduction
3. Using available information to make appropriate health-related decisions
4. Establishing and monitoring personal and family health goals
5. Understanding national and international public health and safety issues

CS5 Environmental Literacy

1. Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water, and ecosystems.
2. Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.).
3. Investigate and analyze environmental issues, and make accurate conclusions about effective solutions.
4. Take individual and collective action towards addressing environmental challenges (e.g., participating in global actions, designing solutions that inspire action on environmental issues).

CSS2-Learning and Innovation Skills

CS6 Creativity and Innovation

1. Think Creatively

2. Work Creatively with Others
3. Implement Innovations

CS7 Critical Thinking and Problem Solving

1. Reason Effectively
2. Use Systems Thinking
3. Make Judgments and Decisions
4. Solve Problems

CS8 Communication and Collaboration

1. Communicate Clearly
2. Collaborate with Others

CSS3-Information, Media and Technology Skills

CS9 Information Literacy

1. Access and Evaluate Information
2. Use and Manage Information

CS10 Media Literacy

1. Analyze Media
2. Create Media Products

CS11 ICT Literacy

1. Apply Technology Effectively

CSS4-Life and Career Skills

CS12 Flexibility and Adaptability

1. Adapt to change
2. Be Flexible

CS13 Initiative and Self-Direction

1. Manage Goals and Time
2. Work Independently
3. Be Self-directed Learners

CS14 Social and Cross-Cultural Skills

1. Interact Effectively with others
2. Work Effectively in Diverse Teams

CS15 Productivity and Accountability

1. Manage Projects
2. Produce Results

CS16 Leadership and Responsibility

1. Guide and Lead Others
2. Be Responsible to Others

Name: _____

Date: _____

Period: _____

21st Century Life and Career Skills Rubric (1.4)

The following scale can be used to assess application of each of the Life and Career Skills of students.

Superior	(18–20 points) The student consistently demonstrates all aspects of this skill in classroom and laboratory activities.
Exceptional	(15–17 points) The student consistently demonstrates most of the aspects of this skills in classroom and laboratory activities but lapses at times on one to two of the indicators.
Adequate	(12–14 points) The students demonstrates knowledge of the skill during classroom and laboratory activities but lapses on three or more indicators from time to time.
Improving	(9–11 points) The student is vaguely aware of the skill but shows only marginal evidence of being able to apply it in the classroom or laboratory.
Minimal	(0–8 points) The student consistently fails to demonstrate knowledge or application of the skill.

Skill	Comments	Score
Flexibility and Adaptability		
Initiative & Self-Direction		
Social & Cross-Cultural Skills		
Productivity & Accountability		
Leadership & Responsibility		
TOTAL SCORE		

Name: _____

Date: _____

Period: _____

PowerPoint Presentation on Animal Careers Rubric (1.5)

	Exemplary 4 points	Accomplished 3 points	Developing 2 points	Beginning 1 point	Score
Content	Provided detailed information on skills required, education and training, salaries and benefits, and occupational outlook	Provided general information on skills required, education and training, salaries and benefits, and occupational outlook	Provided limited information on skills required, education and training, salaries and benefits, and occupational outlook	Did not provide information on all required topics	
Accuracy and Reliability	All information was accurate and reliable.	All information was generally accurate and reliable.	All information was generally accurate and somewhat reliable.	Information was inaccurate and/or unreliable.	
References	Cited four or more references	Cited three references	Cited two references	Cited only one reference	
Grammar, Spelling, Punctuation, etc.	No mistakes	One to two minor mistakes	Three to four minor mistakes or one major error	More than four minor mistakes or two or more major errors	
Visual Aids	Attractive, accurate, and grammatically correct	Adequate, mostly accurate, and few grammatical errors	Poorly planned, somewhat accurate, and some grammatical errors	Weak, inaccurate, and many grammatical errors	
Length	Appropriate length	Slightly too long or short	Moderately too long or short	Extremely too long or short	
				TOTAL	

Comments:

Name: _____

Date: _____

Period: _____

Taxonomy of Common Domestic Animals Assignment (1.6)

Taxonomy of Common Domestic Animals

Identify the class, order, family, genus, and species of each of the following domestic animals:

Animal	Class	Order	Family	Genus	Species
Hereford Cattle					
Leghorn Chickens					
Brahman Cattle					
Quarter Horses					
Border Collie Dogs					
Persian Cats					
Landrace Hogs					
Canaries					
Dorset Sheep					

Name: _____

Date: _____

Period: _____

Rubric for Experiential Learning Planning and Record Keeping (2.1)

Scoring Criteria				
	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Long-range and short-term goals reflect the educational and career goals of the student.				
The SAE plan/training agreement reflects growth in student skill and proficiency.				
Records accurately reflect all SAE accomplishments of the student over the year.				
Records are maintained on a timely basis.				
Journals or calendars are maintained on a timely basis and serve as the source for record keeping.				
Hours and earnings are recorded based on activities.				
A summary of all activities is provided at the end of each grading period.				
Financial records are maintained accurately.				
Financial records are summarized at the end of the year.				

Name: _____

Date: _____

Period: _____

Common Life Processes (3.1)

Process	Features and Functions
Digestion	
Respiration	
Growth	
Movement	
Excretion	
Reproduction	
Sensitivity	

How are life processes related to each other in a normal, healthy animal?

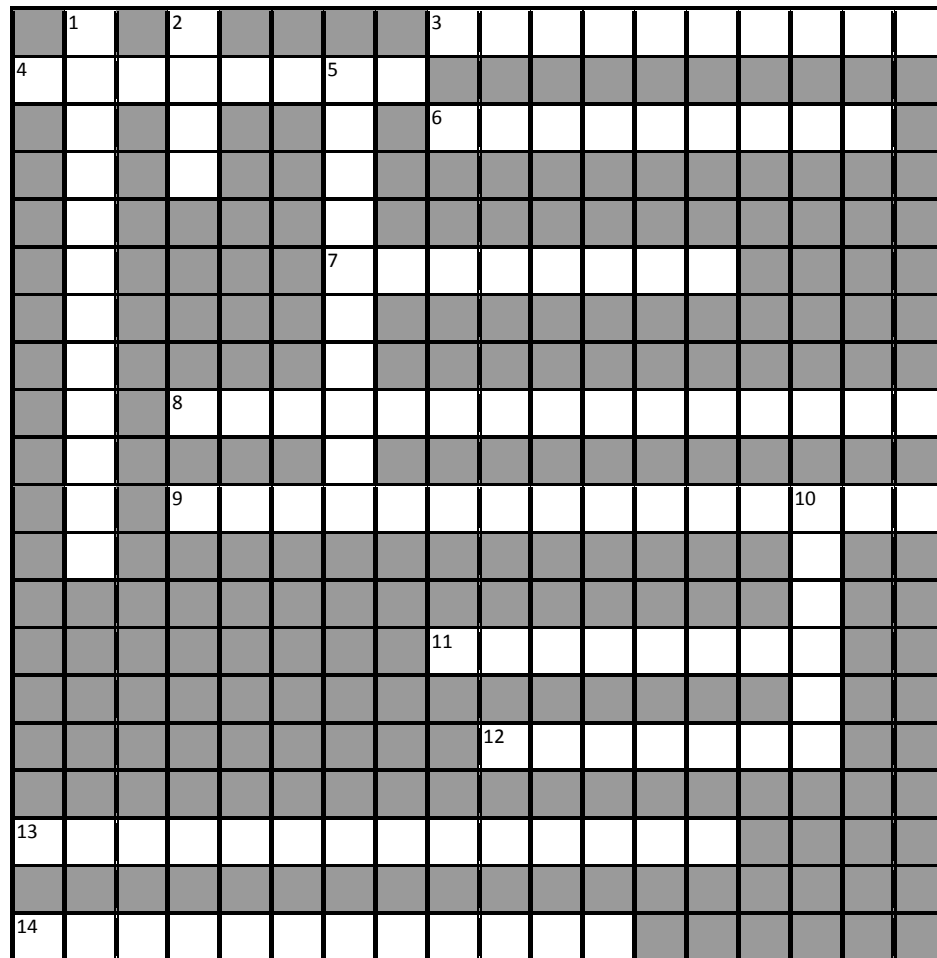
What would happen to an animal if one of the life processes failed?

Name: _____

Date: _____

Period: _____

Genetics and Heredity Crossword Puzzle (3.2)



ACROSS	DOWN
3. A pair of genes that call for a specific characteristic that is identical	1. The portion of differences in animals that is transmitted from parent to offspring
4. The science that deals with the processes of inheritance	2. The basic unit of inheritance
6. The observable characteristics of an animal	5. A linear arrangement of genes
7. An accident of heredity where an animal has different characteristics from what the genetic code intended	10. An alternative form of a gene
8. A gene that is neither dominant nor recessive	
9. A distinguishing characteristic that is passed from parent to offspring	
11. The genetic makeup of the animal	
12. An animal reproductive cell (sperm or egg)	
13. A gene that is masked by the characteristics of another gene	

Name: _____

Date: _____

Period: _____

Genetic Engineering Essay Rubric (3.3)

	Exemplary 4 Points	Accomplished 3 Points	Developing 2 Points	Beginning 1 Point	Score
Content	Covers all major points in detail	Covers most major points in general	Covers some major points	Does not cover major points	
Grammar	Correct and effective use of grammar and mechanics	Occasional errors in use of grammar and mechanics	Problems in use of grammar and mechanics	Repeated errors in use of grammar and mechanics	
Organization	Ideas flow smoothly and logically with clarity and coherence	Logical order and appropriate sequencing of ideas with adequate transition	Some evidence of an organizational plan or strategy	Lacks organization	
TOTAL					

Name: _____

Date: _____

Period: _____

Nutritional Informational Booklet Rubric (4.1)

	Exemplary 4 Points	Accomplished 3 Points	Developing 2 Points	Beginning 1 Point	Score
Title Page	The booklet has a creative, easy to understand, and relevant title page.	The booklet has a creative and relevant title page.	The booklet has a relevant title page.	The booklet has a cover page with very little information.	
Required Content	The booklet includes information on all six essential nutrients as well as additional information.	All six essential nutrients are included on the booklet.	All but one of the required essential nutrients are included in the booklet.	Several required content elements were missing.	
Photographs or Graphics	All six essential nutrient informational pages included a photo or graphic.	Five of the six essential nutrient informational pages included a photo or graphic.	Four of the six essential elements had a graphic or photograph.	Only one or none of the pages included a graphic.	
Attractiveness	The booklet is exceptionally attractive in terms of design, layout, and neatness.	The booklet is attractive in terms of design, layout, and neatness.	The booklet is acceptably attractive though it may be a bit messy.	The booklet is distractingly messy or very poorly designed.	
Grammar	There are no grammatical or mechanical mistakes in the booklet.	There are one to two grammatical or mechanical mistakes in the booklet.	There are three to four grammatical or mechanical mistakes in the booklet.	There are more than four grammatical or mechanical mistakes in the booklet.	

Name:
Date:
Period:

Oral Presentation on Animal Rations Rubric (4.2)

Assign groups of two to three students to determine nutritional requirements for a specific animal, and then use nutritional tables to determine a ration. Instruct students to balance the ratio using the Pearson square method. Instruct the groups to make an oral presentation to show the class the assigned animal's ration.

	Exemplary 4 points	Accomplished 3 points	Developing 2 points	Beginning 1 point	Score
Content	Clear, appropriate, and correct information was presented on the assigned animal's nutritional needs.	Mostly clear, appropriate, and correct information was presented on the assigned animal's nutritional needs.	Somewhat confusing, incorrect, or flawed information was presented on the assigned animal's nutritional needs.	Confusing, incorrect, or flawed information was presented on the assigned animal's nutritional needs.	
Clarity on Balancing the Ration	Logical, interesting sequence of information was used in balancing the ration.	Logical sequence of information was used in balancing the ration.	Unclear sequence of information was used in balancing the ration.	No sequence of information was used in balancing the ration.	
Presentation	Clear voice and precise pronunciation	Clear voice and mostly correct pronunciation	Low voice and incorrect pronunciation	Mumbling and incorrect pronunciation	
Visual Aids	Attractive, accurate, and grammatically correct	Adequate, mostly accurate, and few grammatical errors	Poorly planned, somewhat accurate, and some grammatical errors	Weak, inaccurate, and many grammatical errors	
Eye Contact	Maintains eye contact, seldom looking at notes	Maintains eye contact most of time but frequently returns to notes	Occasionally uses eye contact but reads most of information	No eye contact because reading information	
				TOTAL	

Name: _____

Date: _____

Period: _____

Grading Checklist for Digestive System Diagrams (4.3)

	Possible Points	Points Earned
1. The ruminant digestive system diagram was properly labeled.	20	
2. The monogastric digestive system was properly labeled.	20	
3. The avian, or chicken, digestive system was properly labeled.	20	
4. A list of at least five similarities between the various types was made.	20	
5. A list of at least five differences between the various types was made.	20	
TOTAL SCORE	100	

Name: _____

Date: _____

Period: _____

Water Advertisement Grading Rubric (4.4)

Scoring Criteria				
The brochure did the following:	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Featured an attractive design that included color and graphics				
Highlighted the advantages of the water source in a clear concise manner				
Compared the water source to other water sources in a manner that clearly showed its superiority				
Used appropriate language, sentence structure, grammar, and spelling				
Contained facts and figures that were accurate and reliable				
Listed references for more information				

Notes:

Name: _____

Date: _____

Period: _____

Feed Conversion Worksheet (4.5)

Given the following information, calculate the feed conversion ratio for each animal.

1. A steer weights 240 lb when placed in a feedlot. If the animal eats 6,500 lb of feedstuffs and is sold at a weight of 1,050 lb, what would the feed conversion ratio be?

2. If it takes 15 lb of feed to grow a 1-day-old chick into a 6 ½-lb broiler, what is the feed conversion ratio? (Assume the chick weight is not significant.)

3. Feeder pigs are usually weaned when they are around 50 lb in weight and sold for slaughter at 220 lb. If it takes 630 lb of feed to grow each pig, what is the feed conversion ratio?

4. Catfish are usually stocked as fingerlings. If 10-in. fingerlings weigh approximately ¼ lb each and it takes 2 lb of feed to grow them to 1 ½-lb market fish, what is the feed conversion ratio?

5. If a 50-lb feeder lamb requires 625 lb of feed to reach a market weight of 125 lb, what is the feed conversion ratio?

Given the following information, calculate the amount of feed that will be needed to do the following.

1. Feed 100 head of feeder cattle from an average weight of 400 lb to an average weight of 1,000 lb if the feed conversion ratio is 8.3 : 1.

2. Feed 3,000 1-day-old chicks to a weight of 6 lb each if the feed conversion ratio is 2.2 : 1.

Name: _____

Date: _____

Period: _____

Animal Nutrition PowerPoint Rubric (4.6)

	Exemplary	Accomplished	Developing	Beginning	Score
	4 points	3 points	2 points	1 point	
Content	All six topics were addressed in the presentation with additional detail and information.	All six topics were addressed in the presentation.	Somewhat confusing, incorrect, or flawed. Did not address all of the topics very effectively	Confusing, incorrect, or flawed. Did not address the assigned topic at all	
Clarity	Logical, interesting sequence was followed.	Logical sequence was followed.	Unclear sequence	No sequence at all	
Presentation	Clear voice and precise pronunciation	Clear voice and mostly correct pronunciation	Low voice and incorrect pronunciation	Mumbling and incorrect pronunciation	
Visual Aids	Attractive, accurate, grammatically correct, included photos or graphics in all slides	Adequate, mostly accurate, few grammatical errors, included photos or graphics in most of the slides	Poorly planned, somewhat accurate, some grammatical errors, very few photos or graphics added	Weak, inaccurate, many grammatical error, little or no photos or graphics	
Length	Appropriate length	Slightly too long or short	Moderately too long or short	Extremely too long or short	
Participation	Well-balanced participation by all group members	All group members have significant participation.	Most group members participate.	One main speaker with little participation from other group members	
Total Score:					

Name: _____

Date: _____

Period: _____

Consumer Issues Article Rubric (4.7)

Scoring Criteria				
The student does the following:	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Accurately summarizes the main point of the article				
Provides interesting, supportive, and complete statements				
Demonstrates that the writer comprehends the topic of the article				
Uses accurate spelling				
Uses correct grammar				
Demonstrates proper punctuation				
Prepares paragraphs that emphasize appropriate points				
Demonstrates correct sentence structure				
Demonstrates correct paragraphing				
Documents sources and references clearly and accurately				
Total Score:				

Name: _____

Date: _____

Period: _____

Grading Checklist for Lists of Vitamins and Minerals (4.8)

	Possible Points	Points Earned
1. The list of minerals necessary for animal growth and development was complete and each mineral was labeled as macro or micro.	25	
2. The effects of surpluses and deficiencies of each mineral were identified.	15	
3. The source of each major mineral is listed.	10	
4. A complete list of vitamins was provided, and each was labeled fat soluble or water soluble.	25	
5. Common sources of each vitamin were listed.	10	
6. The list of vitamins included how each aided in the growth and development of animals.	15	
TOTAL SCORE	100	

Name: _____

Date: _____

Period: _____

Artificial Insemination Report Rubric (5.1)

	Exemplary 4 points	Accomplished 3 points	Developing 2 points	Beginning 1 point	Score
Topic	Very detailed information was given on artificial insemination for the given animal.	Detailed information was given on artificial insemination for the assigned animal.	General information was provided on artificial insemination.	Limited information was provided.	
Content	Clear thesis and focus that remains apparent; all required information was present.	Thesis and focus remain apparent; most of the required information was included.	It addresses subject matter with minimal support; some of the required information was included.	Does not focus on topic; required information was not included.	
Grammar	Correct and effective use of grammar and mechanics	Occasional errors in use of grammar and mechanics	Problems in use of grammar and mechanics	Repeated errors in use of grammar and mechanics	
Organization	Ideas flow smoothly and logically with clarity and coherence.	Logical order and appropriate sequencing of ideas with adequate transition	Some evidence of an organizational plan or strategy	Lacks organization	
Total Score:					

Name: _____

Date: _____

Period: _____

Semen Collection and Processing Procedures Report Rubric (5.2)

	Exemplary 4 points	Accomplished 3 points	Developing 2 points	Beginning 1 point	Score
Content	All major procedures were described in accurate detail.	All major procedures were described in general.	Most major procedures were addressed.	Several major features were not included in the report.	
Grammar	Correct and effective use of grammar and mechanics	Occasional errors in use of grammar and mechanics	Problems in use of grammar and mechanics	Repeated errors in use of grammar and mechanics	
Organization	Ideas flow smoothly and logically with clarity and coherence.	Logical order and appropriate sequencing of ideas with adequate transition	Some evidence of an organizational plan or strategy	Lacks organization	
Total Score:					

Name: _____

Date: _____

Period: _____

Multimedia Presentation Assessment (5.3)

	Exemplary 4 points	Accomplished 3 points	Developing 2 points	Beginning 1 point	Score
Content	Clear, appropriate, and correct	Mostly clear, appropriate, and correct	Somewhat confusing, incorrect, or flawed	Confusing, incorrect, or flawed	
Clarity	Logical, interesting sequence	Logical sequence	Unclear sequence	No sequence	
Presentation	Clear voice and precise pronunciation	Clear voice and mostly correct pronunciation	Low voice and incorrect pronunciation	Mumbling and incorrect pronunciation	
Visual Aids	Attractive, accurate, grammatically correct	Adequate, mostly accurate, few grammatical errors	Poorly planned, somewhat accurate, some grammatical errors	Weak, inaccurate, many grammatical errors	
Length	Appropriate length	Slightly too long or short	Moderately too long or short	Extremely too long or short	
Participation	Well-balanced participation by all group members	All group members have significant participation	Most group members participate	One main speaker with little participation from other group members	
Eye Contact	Maintains eye contact, seldom looking at notes	Maintains eye contact most of time but frequently returns to notes	Occasionally uses eye contact but reads most of information	No eye contact because reading information	
Total Score:					

Name: _____

Date: _____

Period: _____

Poultry Hatchery Rubric and Incubator Data Chart (5.4)

Rate the student's ability to perform the following welding procedures using the following scale:

4– Can perform consistently and accurately without need of any supervision or direction

3– Can perform consistently and accurately with minimum supervision or direction

2–Can perform consistently and accurately with moderate supervision or direction

1–Cannot perform consistently or accurately without direct supervision

- _____ 1. Student cleaned and prepared incubator for hatching.
- _____ 2. Student set temperature and humidity controls to recommended setting and verified that readings were accurate.
- _____ 3. Student inspected eggs for cracks or other defects and placed eggs in the incubator in the correct position.
- _____ 4. Student checked eggs during the incubation process using an egg candler and removed eggs that were not showing normal embryo development. Eggs were turned either manually or automatically three to five times each day.
- _____ 5. As chicks hatched, they were removed from the incubator when they were dry and placed in a brooder or other cage and kept at the recommended temperature.
- _____ 6. Student checked chicks daily and provided feed and water beginning 48 hr after hatching.

Incubator Data Chart

Day	Date	Turner Works ¹			Temperature		Wet Bulb	Water Checked	Candling	Remarks
		1	2	3	Room	Incubator				
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19		XXX	XXX	XXX						
20		XXX	XXX	XXX						
21		XXX	XXX	XXX						

¹Check egg turner at least three times a day except days 19–21.

Name: _____

Date: _____

Period: _____

Catfish Fry Management Rubric and Data Sheet (5.5)

Rate the student's ability to perform the following welding procedures using the following scale:

4– Can perform consistently and accurately without need of any supervision or direction

3– Can perform consistently and accurately with minimum supervision or direction

2–Can perform consistently and accurately with moderate supervision or direction

1–Cannot perform consistently or accurately without direct supervision

- _____ 1. Student checked water temperature and made adjustments to maintain a temperature of 78° - 82°F.
- _____ 2. Student checked water pH and made adjustments to maintain a pH of 7.0 or higher.
- _____ 3. Student checked dissolved oxygen level of water and made adjustments to maintain a level of 4.0 ppm or higher.
- _____ 4. Student checked salinity level of water and made adjustments to maintain a level of less than 0.5 ppm.
- _____ 5. Student checked calcium hardness level of the water and made adjustments to maintain a level of at least 5 ppm.
- _____ 6. Student checked ammonium level of water and made adjustments to maintain a level of less than 0.05 ppm.
- _____ 7. Student feed the fry as per the assigned schedule.
- _____ 8. Student maintained the aquarium and its accessories as per posted procedures.

Catfish Fry Data Chart

Day	Date	Temp.	Ph	DO	Salinity	Hard- ness	Ammonium	Feeding	Tank Maint.	Remarks
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19		XXX	XXX	XXX						
20		XXX	XXX	XXX						
21		XXX	XXX	XXX						

Name: _____

Date: _____

Period: _____

Livestock Placing and Oral Reasons Rubric (6.1)

	Exemplary	Accomplished	Developing	Beginning	Score
Placing	Placed all animals in the correct order (50 pts)	Placed three of the four animals in the correct order (40 pts)	Placed two of the four animals in the correct order (20 pts)	Placed only one of the four animals in the correct order (10 pts)	
Oral Reasons Accuracy	All statements were correct. (10 pts)	Only one or two inaccurate statements were made. (7 pts)	Three to four inaccurate statements were made. (4 pts)	Five or more inaccurate statements were made. (1 pt)	
Completeness	All major differences among the animals were presented. (10 pts)	One or two major differences were not presented. (7 pts)	Three or four major differences were not presented. (4 pts)	Five or more major differences were not presented. (1 pt)	
Presentation and Delivery	Reasons were logical, voice was clear and strong, and correct grammar was used. (10 pts)	Reasons were logical, but voice and grammar could have been better. (7 pts)	Reasons were mostly logical, and voice and grammar were weak. (4 pts)	Reasons were not logical; voice and grammar were very weak. (1 pt)	
Length	The presentation took 2–2½ min. (10 pts)	The presentation took 1½–2 min or 2½ - 3 min. (7 pts)	The presentation took ½–1½ min or 3–3½ min. (4 pts)	The presentation took less than 30 sec or more than 3½ min. (1 pt)	
Terminology	Correct terminology was used throughout the presentation. (10 pts)	One or two incorrect terms were used in the presentation. (7 pts)	Three or four incorrect terms were used in the presentation. (4 pts)	Five or more incorrect terms were used in the presentation. (1 pts)	
TOTAL					

Name: _____

Date: _____

Period: _____

Animal Health Plan Rubric (7.1)

Rate each of the following components/criteria:	Possible Points	Points Earned
Described characteristics of a healthy animal	15	
Described procedures for evaluating health of new animals brought into the enterprise	15	
Described procedures for maintaining sanitation and environmental conditions for optimum health	15	
Described a vaccination schedule	15	
Described procedures for treating and controlling parasites	15	
Described procedures for isolating and treating animals that appear to be unhealthy	15	
Used proper grammar, vocabulary, punctuation, etc.	10	
TOTAL SCORE	100	

Name: _____

Date: _____

Period: _____

White Blood Cells Assignment (7.2)

Watch the video *White Blood Cells*, and answer the following questions:

1. What are leucocytes, and what function do they perform within the blood?
2. What are lymphocytes, and what function do they perform within the blood?
3. What is an antigen, and what function does it perform within the blood?
4. Where are most blood cells created?
5. What is a T-cell, and how does it function within the blood?

Name: _____

Date: _____

Period: _____

Guest Speaker Summary Form (7.3)

Name of Speaker: _____

1. List five main ideas expressed in the presentation.

1. _____

2. _____

4. _____

5. _____

2. Write a brief summary relating the topics of the presentation to your life.

[illegible]

Name: _____

Date: _____

Period: _____

Animal Facility Plan Rubric (8.1)

	Exemplary	Accomplished	Developing	Beginning	Score
Design	The overall design of the facility shows great detail related to the natural behavior of the animal to be housed.	The overall design of the facility shows moderate detail related to the natural behavior of the animal.	The overall design of the facility shows some detail related to the natural behavior of the animal.	The overall design of the facility shows limited detail related to the natural behavior of the animal.	
Pens and Cages	Pens and cages for the facility are appropriately sized and constructed of high-quality materials to protect animals and workers.	Pens and cages for the facility are appropriately sized and constructed of materials that should protect animals and workers.	Pens and cages for the facility are somewhat appropriate in size and constructed of materials that should protect animals and workers.	Pens and cages for the facility are not appropriate in size and/or not constructed of materials that should protect animals and workers.	
Other Equipment	Other equipment and accessories (watering and feed troughs, squeezes and restraining devices, lighting, heating, ventilation, etc.) are sufficient for the animals to be handled and placed for efficient use.	Other equipment and accessories are somewhat sufficient for the animals to be handled and placed for efficient use.	Other equipment and accessories are limited for the animals to be handled and placed for efficient use.	Other equipment is not sufficient for the animals to be handled and/or not efficiently placed.	
Written Description	The written description of the facility is highly detailed and provides a detailed list of all materials and equipment needed.	The written description of the facility provides is general in nature and provides a detailed list of almost all materials and equipment needed.	The written description of the facility is limited in detail and provides a partial list of all materials and equipment needed.	The written description of the facility is very limited and the detailed list of all materials and equipment needed is very brief or inadequate.	
Drawing	The drawing is neat and to scale and provides a clear illustration of the total facility layout.	The drawing is neat and provides a good illustration of the total facility layout. No scale is provided.	The drawing provides a limited illustration of the total facility layout.	The drawing does not match the written description.	
TOTAL					

Name: _____

Date: _____

Period: _____

Breeding Record Form Rubric (8.2)

Criteria	Maximum Possible Points	Points Earned
1. The form provides means for entering information and pictures that positively identify the animal or group of animals (poultry) (breed, gender, birth date, color, identification number/tattoo, breed registration number picture, etc.).	15	
2. The form provides means for entering the pedigree (ancestrage) of the animal.	15	
3. The form provides means for entering production records on the animal (growth rate, offspring, milk production, egg production, etc.).	15	
4. The form provides means for entering health information about the animal (vaccinations, diseases, treatments, injuries, etc.).	15	
5. The form provides a calendar for recording and planning activities in the animal's life (weaning date, breeding dates, delivery dates, etc.).	15	
6. The form provides a means for entering income received and expenses incurred for the animal (sales of offspring or products, feed expenses, health expenses, overhead expenses, etc.).	15	
7. The form is free from grammatical errors and is designed in a user-friendly manner.	10	
TOTAL SCORE	100	

Name: _____

Date: _____

Period: _____

Animal Enterprise Production Management Plan Rubric (8.3)

Criteria	Maximum Possible Points	Points Earned
1. The plan clearly defines production goals for the enterprises.	15	
2. The plan clearly identifies equipment, facilities, land, and other resources that will be needed to conduct the enterprise.	15	
3. The plan includes a calendar of production related activities that must be performed.	20	
4. The plan includes an estimated income and expense budget for the enterprise.	20	
5. The plan includes details on how products from the enterprise will be marketed.	15	
6. The plan is free of grammatical errors.	15	
TOTAL SCORE	100	

Name: _____

Date: _____

Period: _____

Guest Speaker Summary Form (8.4)

Name of Speaker: _____

1. List five main ideas expressed in the presentation.

1. _____

2. _____

4. _____

5. _____

2. Write a brief summary relating the topics of the presentation to your life.

[illegible]

Name: _____

Date: _____

Period: _____

Companion Animal Multimedia Presentation Rubric (9.1)

	Exemplary	Accomplished	Developing	Beginning	Score
History and Characteristics	Described the history of the animal, its origin, distinguishing characteristics and life cycle in detail (50 pts)	Described the history of the animal, its origin, distinguishing characteristics and life cycle in moderate detail (40 pts)	Described the history of the animal, its origin, distinguishing characteristics and life cycle in general (20 pts)	Described the history of the animal, its origin, distinguishing characteristics and life cycle in limited detail (10 pts)	
Economic Impact	Provided specific details based on documented research (10 pts)	Provided general details based on limited research (7 pts)	Provided brief details based on research (4 pts)	Provided limited details without citing sources (1 pt)	
Approved Practices	Provided specific details on all major approved practices (10 pts)	Provided specific details on most approved practices (7 pts)	Provided general details on most approved practices (4 pts)	Provided limited or no details on most practices (1 pt)	
Presentation and Delivery	Presentation was clear, interesting, and informative. Graphics and slides captured all major points. (10 pts)	Presentation was clear, interesting, and informative. Graphics and slides captured most major points. (7 pts)	Presentation was unclear on some points. Graphics and slides were omitted on some points. (4 pts)	Presentation was not well organized and unclear. Graphics and slides were insufficient for support. (1 pt)	
Sources	At least five valid and reliable sources were cited. (10 pts)	At least four valid and reliable sources were cited. (7 pts)	At least three valid and reliable sources were cited. (4 pts)	Less than three sources were cited, or some sources could not be determined to be valid and reliable. (1 pt)	
Grammar, Spelling, Syntax, etc.	No errors were present. (10 pts)	One or two minor errors were present. (7 pts)	One major error and/or three to four minor errors were present. (4 pts)	More than one major error or more than four minor errors were present. (1 pt)	
TOTAL					

Appendix B: 21st Century Skills Standards

CSS1-21st Century Themes

CS1 Global Awareness

1. Using 21st century skills to understand and address global issues
2. Learning from and working collaboratively with individuals representing diverse cultures, religions, and lifestyles in a spirit of mutual respect and open dialogue in personal, work, and community contexts
3. Understanding other nations and cultures, including the use of non-English languages

CS2 Financial, Economic, Business and Entrepreneurial Literacy

1. Knowing how to make appropriate personal economic choices
2. Understanding the role of the economy in society
3. Using entrepreneurial skills to enhance workplace productivity and career options

CS3 Civic Literacy

1. Participating effectively in civic life through knowing how to stay informed and understanding governmental processes
2. Exercising the rights and obligations of citizenship at local, state, national, and global levels
3. Understanding the local and global implications of civic decisions

CS4 Health Literacy

1. Obtaining, interpreting, and understanding basic health information and services and using such information and services in ways that enhance health
2. Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance, and stress reduction
3. Using available information to make appropriate health-related decisions
4. Establishing and monitoring personal and family health goals
5. Understanding national and international public health and safety issues

CS5 Environmental Literacy

1. Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water, and ecosystems
2. Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.)
3. Investigate and analyze environmental issues, and make accurate conclusions about effective solutions
4. Take individual and collective action towards addressing environmental challenges (e.g., participating in global actions, designing solutions that inspire action on environmental issues)

CSS2-Learning and Innovation Skills

CS6 Creativity and Innovation

1. Think Creatively
2. Work Creatively with Others
3. Implement Innovations

CS7 Critical Thinking and Problem Solving

1. Reason Effectively
2. Use Systems Thinking
3. Make Judgments and Decisions
4. Solve Problems

CS8 Communication and Collaboration

1. Communicate Clearly
2. Collaborate with Others

CSS3-Information, Media and Technology Skills

CS9 Information Literacy

1. Access and Evaluate Information
2. Use and Manage Information

CS10 Media Literacy

1. Analyze Media
2. Create Media Products

CS11 ICT Literacy

1. Apply Technology Effectively

CSS4-Life and Career Skills

CS12 Flexibility and Adaptability

1. Adapt to change
2. Be Flexible

CS13 Initiative and Self-Direction

1. Manage Goals and Time
2. Work Independently
3. Be Self-directed Learners

CS14 Social and Cross-Cultural Skills

1. Interact Effectively with others
2. Work Effectively in Diverse Teams

CS15 Productivity and Accountability

1. Manage Projects
2. Produce Results

CS16 Leadership and Responsibility

1. Guide and Lead Others
2. Be Responsible to Others

Appendix C: MS Academic Standards

MISSISSIPPI SCIENCE FRAMEWORK COMPETENCIES

Marine and Aquatic Science

- AQ 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- AQ 2 Develop an understanding of physical and chemical properties of water and aquatic environments.
- AQ 3 Apply an understanding of the diverse organisms found in aquatic environments.
- AQ 4 Draw conclusions about the relationships between human activity and aquatic organisms.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- Formulate questions that can be answered through research and experimental design. (DOK 3)
- Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
- Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
- Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. Develop an understanding of physical and chemical properties of water and aquatic environments.

- Analyze the physical and chemical properties of water, and justify why it is essential to living organisms. (DOK 1)
- Explain the causes and characteristics of tides. (DOK 1)
- Research, create diagrams, and summarize principles related to waves and current characteristics and formation. (DOK 2)
- Compare and contrast the physical and chemical parameters of dissolved O₂, pH, temperature, salinity, and results obtained through analysis of different water column depths/zones. (DOK 2)
- Investigate the causes and effects of erosion and discuss conclusions. (DOK 2)
- Describe and differentiate among the major geologic features of specific aquatic environments. (DOK 1)
 - Plate tectonics
 - Rise, slope, elevation, and depth
 - Formation of dunes, reefs, barrier/volcanic islands, and coastal/flood plains
 - Watershed formation as it relates to bodies of freshwater
- Compare and contrast the unique abiotic and biotic characteristics of selected aquatic ecosystems. (DOK 2)
 - Barrier island, coral reef, tidal pool, and ocean
 - River, stream, lake, pond, and swamp
 - Bay, sound, estuary, and marsh

3. Apply an understanding of the diverse organisms found in aquatic environments.

- Analyze and explain the diversity and interactions among aquatic life. (DOK 3)
 - Adaptations of representative organisms for their aquatic environments

- Relationship of organisms in food chains/webs within aquatic environments
- b. Research, calculate, and interpret population data. (DOK 2)
- c. Research and compare reproductive processes in aquatic organisms. (DOK 2)
- d. Differentiate among characteristics of planktonic, nektonic, and benthic organisms. (DOK 1)
- e. Explore the taxonomy of aquatic organisms, and use dichotomous keys to differentiate among the organisms. (DOK 2)
- f. Research and explain the symbiotic relationships in aquatic ecosystems. (DOK 3)
- 4. **Draw conclusions about the relationships between human activity and aquatic organisms.**
 - a. Describe the impact of natural and human activity on aquatic ecosystems, and evaluate the effectiveness of various solutions to environmental problems. (DOK 3)
 - Sources of pollution in aquatic environments and methods to reduce the effects of the pollution
 - Effectiveness of a variety of methods of environmental management and stewardship
 - Effects of urbanization on aquatic ecosystems and the effects of continued expansion
 - b. Research and cite evidence of the effects of natural phenomena such as hurricanes, floods, or drought on aquatic habitats and organisms. (DOK 3)
 - c. Discuss the advantages and disadvantages involved in applications of modern technology in aquatic science. (DOK 2)
 - Careers related to aquatic science
 - Modern technology within aquatic science (e.g., mariculture and aquaculture)
 - Contributions of aquatic technology to industry and government

Biology I

BIOI 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BIOI 2	Describe the biochemical basis of life, and explain how energy flows within and between the living systems.
BIOI 3	Investigate and evaluate the interaction between living organisms and their environment.
BIOI 4	Analyze and explain the structures and function of the levels of biological organization.
BIOI 5	Demonstrate an understanding of the molecular basis of heredity.
BIOI 6	Demonstrate an understanding of principles that explain the diversity of life and biological evolution.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
 - a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
 - d. Formulate questions that can be answered through research and experimental design. (DOK 3)
 - e. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 2)
 - f. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
 - g. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - h. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
 - i. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. Describe the biochemical basis of life, and explain how energy flows within and between the living systems.

- a. Explain and compare with the use of examples the types of bond formation (e.g., covalent, ionic, hydrogen, etc.) between or among atoms. (DOK 2)
 - Subatomic particles and arrangement in atoms
 - Importance of ions in biological processes
- b. Develop a logical argument defending water as an essential component of living systems (e.g., unique bonding and properties including polarity, high specific heat, surface tension, hydrogen bonding, adhesion, cohesion, and expansion upon freezing). (DOK 2)
- c. Classify solutions as acidic, basic, or neutral, and relate the significance of the pH scale to an organism's survival (e.g., consequences of having different concentrations of hydrogen and hydroxide ions). (DOK 2)
- d. Compare and contrast the structure, properties, and principle functions of carbohydrates, lipids, proteins, and nucleic acids in living organisms. (DOK 2)
 - Basic chemical composition of each group
 - Building components of each group (e.g., amino acids, monosaccharides, nucleotides, etc.)
 - Basic functions (e.g., energy, storage, cellular, heredity) of each group
- e. Examine the life processes to conclude the role enzymes play in regulating biochemical reactions. (DOK 2)
 - Enzyme structure
 - Enzyme function, including enzyme-substrate specificity and factors that affect enzyme function (pH and temperature)
- f. Describe the role of adenosine triphosphate (ATP) in making energy available to cells. (DOK 1)
 - ATP structure
 - ATP function
- g. Analyze and explain the biochemical process of photosynthesis and cellular respiration, and draw conclusions about the roles of the reactant and products in each. (DOK 3)
 - Photosynthesis and respiration (reactants and products)
 - Light-dependent reactions and light independent reactions in photosynthesis, including requirements and products of each
 - Aerobic and anaerobic processes in cellular respiration, including products each and energy differences

3. Investigate and evaluate the interaction between living organisms and their environment.

- a. Compare and contrast the characteristics of the world's major biomes (e.g., deserts, tundra, taiga, grassland, temperate forest, tropical rainforest). (DOK 2)
 - Plant and animal species
 - Climate (temperature and rainfall)
 - Adaptations of organisms
- b. Provide examples to justify the interdependence among environmental elements. (DOK 2)
 - Biotic and abiotic factors in an ecosystem (e.g., water, carbon, oxygen, mold, leaves)
 - Energy flow in ecosystems (e.g., energy pyramids and photosynthetic organisms to herbivores, carnivores, and decomposers)
 - Roles of beneficial bacteria
 - Interrelationships of organisms (e.g., cooperation, predation, parasitism, commensalism, symbiosis, and mutualism)
- c. Examine and evaluate the significance of natural events and human activities on major ecosystems (e.g., succession, population growth, technology, loss of genetic diversity, consumption of resources). (DOK 2)

4. Analyze and explain the structures and function of the levels of biological organization.

- a. Differentiate among plant and animal cells and eukaryotic and prokaryotic cells. (DOK 2)
 - Functions of all major cell organelles and structures (e.g., nucleus, mitochondrion, rough ER, smooth ER, ribosomes, Golgi bodies, vesicles, lysosomes, vacuoles, microtubules,

- microfilaments, chloroplast, cytoskeleton, centrioles, nucleolus, chromosomes, nuclear membrane, cell wall, cell membrane [active and passive transport], cytosol)
- Components of mobility (e.g., cilia, flagella, pseudopodia)
- b. Differentiate between types of cellular reproduction. (DOK 1)
 - Main events in the cell cycle and cell mitosis (including differences in plant and animal cell divisions)
 - Binary fission (e.g., budding, vegetative propagation, etc.)
 - Significance of meiosis in sexual reproduction
 - Significance of crossing over
- c. Describe and differentiate among the organizational levels of organisms (e.g., cells, tissues, organs, systems, types of tissues.) (DOK 1)
- d. Explain and describe how plant structures (vascular and nonvascular) and cellular functions are related to the survival of plants (e.g., movement of materials, plant reproduction). (DOK 1)
- 5. **Demonstrate an understanding of the molecular basis of heredity.**
 - a. Analyze and explain the molecular basis of heredity and the inheritance of traits to successive generations by using the Central Dogma of Molecular Biology. (DOK 3)
 - Structures of DNA and RNA
 - Processes of replication, transcription, and translation
 - Messenger RNA codon charts
 - b. Utilize Mendel's laws to evaluate the results of monohybrid Punnett squares involving complete dominance, incomplete dominance, codominance, sex linked, and multiple alleles (including outcome percentage of both genotypes and phenotypes). (DOK 2)
 - c. Examine inheritance patterns using current technology (e.g., pedigrees, karyotypes, gel electrophoresis). (DOK 2)
 - d. Discuss the characteristics and implications of both chromosomal and gene mutations. (DOK 2)
 - Significance of nondisjunction, deletion, substitutions, translocation, frame shift mutation in animals
 - Occurrence and significance of genetic disorders such as sickle cell anemia, Tay-Sachs disorder, cystic fibrosis, hemophilia, Down syndrome, color blindness
- 6. **Demonstrate an understanding of principles that explain the diversity of life and biological evolution.**
 - a. Draw conclusions about how organisms are classified into a hierarchy of groups and subgroups based on similarities that reflect their evolutionary relationships. (DOK 2)
 - Characteristics of the six kingdoms
 - Major levels in the hierarchy of taxa (e.g., kingdom, phylum/division, class, order, family, genus, and species)
 - Body plans (symmetry)
 - Methods of sexual reproduction (e.g., conjugation, fertilization, pollination)
 - Methods of asexual reproduction (e.g., budding, binary fission, regeneration, spore formation)
 - b. Critique data (e.g., comparative anatomy, Biogeography, molecular biology, fossil record, etc.) used by scientists (e.g., Redi, Needham, Spallanzani, Pasteur) to develop an understanding of evolutionary processes and patterns. (DOK 3)
 - c. Research and summarize the contributions of scientists (including Darwin, Malthus, Wallace, Lamarck, and Lyell) whose work led to the development of the theory of evolution. (DOK 2)
 - d. Analyze and explain the roles of natural selection, including the mechanisms of speciation (e.g., mutations, adaptations, geographic isolation) and applications of speciation (e.g., pesticide and antibiotic resistance). (DOK 3)
 - e. Differentiate among chemical evolution, organic evolution, and the evolutionary steps along the way to aerobic heterotrophs and photosynthetic autotrophs. (DOK 2)

Biology II

BIOII 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BIOII 2	Describe and contrast the structures, functions, and chemical processes of the cell.
BIOII 3	Investigate and discuss the molecular basis of heredity.
BIOII 4	Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.
BIOII 5	Develop an understanding of organism classification.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- Use current technologies such as CD-ROM, DVD, Internet, and on-line data search to explore current research related to a specific topic. (DOK 3)
- Clarify research questions and design laboratory investigations. (DOK 3)
- Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
- Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. Describe and contrast the structures, functions, and chemical processes of the cell.

- Relate the structure and function of a selectively permeable membrane to its role in diffusion and osmosis. (DOK 2)
- Summarize how cell regulation controls and coordinates cell growth and division. (DOK 2)
- Analyze and describe the function of enzymes in biochemical reactions. (DOK 2)
 - The impact of enzymatic reactions on biochemical processes
 - Factors that affect enzyme function (e.g., pH, concentration, temperature, etc.)
- Differentiate between photosynthesis and cellular respiration. (DOK 2)
 - Cellular sites and major pathways of anaerobic and aerobic respiration (with reactants, products, and ATP per monosaccharide)
 - Cellular respiration with respect to the sites at which they take place, the reactions involved, and the energy input and output in each stage (e.g., glycolysis, Krebs cycle, electron transport chain)
 - Pigments, absorption, reflection of light, and light-dependent and light-independent reactions of photosynthesis
 - Oxidation and reduction reactions

3. Investigate and discuss the molecular basis of heredity.

- Explain how the process of meiosis clarifies the mechanism underlying Mendel's conclusions about segregation and independent assortment on a molecular level. (DOK 1)
- Research and explain how major discoveries led to the determination of DNA structure. (DOK 2)
- Relate gene expression (e.g., replication, transcription, translation) to protein structure and function. (DOK 2)
 - Translation of a messenger RNA strand into a protein
 - Processing by organelles so that the protein is appropriately packaged, labeled, and eventually exported by the cell
 - Messenger RNA codon charts to determine the effects of different types of mutations on amino acid sequence and protein structure (e.g., sickle cell anemia resulting from base substitution mutation)
 - Gene expression regulated in organisms so that specific proteins are synthesized only when they are needed by the cell (e.g., allowing cell specialization)
- Assess the potential implications of DNA technology with respect to its impact on society. (DOK 3)

- Modern DNA technologies (e.g., polymerase chain reaction (PCR), gene splicing, gel electrophoresis, transformation, recombinant DNA) in agriculture, medicine, and forensics
- e. Develop a logical argument defending or refuting bioethical issues arising from applications of genetic technology (e.g., the human genome project, cloning, gene therapy, stem cell research). (DOK 3)
- 4. **Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.**
 - a. Explain the history of life on earth, and infer how geological changes provide opportunities and constraints for biological evolution. (DOK 2)
 - Main periods of the geologic timetable of earth's history
 - Roles of catastrophic and gradualistic processes in shaping planet Earth
 - b. Provide support for the argument based upon evidence from anatomy, embryology, biochemistry, and paleontology that organisms descended with modification from common ancestry. (DOK 2)
 - c. Identify and provide supporting evidence for the evolutionary relationships among various organisms using phylogenetic trees and cladograms. (DOK 2)
 - d. Formulate a scientific explanation based on fossil records of ancient life-forms, and describe how new species could originate as a result of geological isolation and reproductive isolation. (DOK 2)
 - e. Compare and contrast the basic types of selection (e.g., disruptive, stabilizing, directional, etc.). (DOK 2)
 - f. Cite examples to justify behaviors that have evolved through natural selection (e.g., migration, parental care, use of tools, etc.). (DOK 1)
 - g. Research and explain the contributions of 19th century scientists (e.g., Malthus, Wallace, Lyell, and Darwin) on the formulation of ideas about evolution. (DOK 2)
 - h. Develop a logical argument describing ways in which the influences of 20th century science have impacted the development of ideas about evolution (e.g., synthetic theory of evolution, molecular biology). (DOK 3)
 - i. Analyze changes in an ecosystem resulting from natural causes (succession), changes in climate, human activity (pollution and recycling), or introduction of nonnative species. (DOK 2)
- 5. **Develop an understanding of organism classification.**
 - a. Classify organisms according to traditional Linnaean classification characteristics (e.g., cell structure, biochemistry, anatomy, fossil record, methods of reproduction) and the cladistic approach. (DOK 2)
 - b. Categorize organisms according to the characteristics that distinguish them as Bacteria, Archaea, or Eucarya. (DOK 1)
 - Bacteria, fungi, and protists
 - Characteristics of invertebrates (e.g., habitat, reproduction, body plan, locomotion) as related to phyla (e.g., Porifera, Cnidarians, Nematoda, Annelida, Platyhelminthes, and Arthropoda) and classes (e.g., Insecta, Crustacea, Arachnida, Mollusca, Echinodermata)
 - Characteristics of vertebrates (e.g., habitat, reproduction, body plan, locomotion) as related to classes (e.g., Agnatha, Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, Mammalia)
 - Nomenclature of various types of plants (e.g., Bryophyta, Tracheophyta, Gymnospermae, Angiospermae, Monocotyledonae, Dicotyledonae, vascular plants, nonvascular plants)

Botany

BO 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BO 2	Distinguish among the characteristics of botanical organization, structure, and function.
BO 3	Demonstrate an understanding of plant reproduction.
BO 4	Draw conclusions about the factors that affect the adaptation and survival of plants.
BO 5	Relate an understanding of plant genetics to its uses in modern living.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols

- Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
 - b. Formulate questions that can be answered through research and experimental design. (DOK 3)
 - c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
 - d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
 - e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
 - g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
2. **Distinguish among the characteristics of botanical organization, structure, and function.**
- a. Relate plant cell structures to their functions (e.g., major organelles, cell wall components, photosynthetic chemical reactions, plant pigments, plant tissues, roots, stems, leaves, flowers). (DOK 1)
 - b. Differentiate the characteristics found in various plant divisions. (DOK 2)
 - Differences and similarities of nonvascular plants
 - Characteristics of seed-bearing and non-seed bearing vascular plants relative to taxonomy
 - Major vegetative structures and their modifications in angiosperms and gymnosperms
 - c. Compare and contrast leaf modifications of gymnosperms and angiosperms (e.g., needles, overlapping scales, simple leaves, compound leaves, evergreen trees, and deciduous trees). (DOK 2)
 - d. Apply the modern classification scheme utilized in naming plants to identify plant specimens. (DOK 2)
 - Classification scheme used in botany
 - Classification of native Mississippi plants
 - e. Use inquiry to investigate and discuss the physical and chemical processes of plants. (DOK 3)
 - Relationships among photosynthesis, cellular respiration, and translocation
 - Importance of soil type and soil profiles to plant survival
 - Mechanism of water movement in plants
 - Effects of environmental conditions for plant survival
 - Tropic responses of a plant organ to a given stimulus
3. **Demonstrate an understanding of plant reproduction.**
- a. Compare and contrast reproductive structures (e.g., cones, flowers). (DOK 2)
 - b. Differentiate among the vegetative organs of monocots, herbaceous dicots, and woody dicots. (DOK 1)
 - c. Differentiate between the structures and processes of sexual and asexual reproduction in plants. (DOK 1)
 - Reproductive structures, their modifications, and the mechanisms involved in plant reproduction
 - Functions of flower parts, seeds, cones
 - Spore production in bryophytes and ferns
 - d. Explain and provide examples of the concept of alternation of generations and its examples. (DOK 2)
 - e. Categorize types of fruits and methods of seed distribution in plants. (DOK 1)
 - f. Research and compare various methods of plant propagation. (DOK 2)
4. **Draw conclusions about the factors that affect the adaptation and survival of plants.**
- a. List and assess several adaptations of plants to survive in a given biome. (DOK 2)
 - b. Design and conduct an experiment to determine the effects of environmental factors on photosynthesis. (DOK 3)
 - c. Explain how natural selection and the evolutionary consequences (e.g., adaptation or extinction) support scientific explanations for similarities of ancient life-forms in the fossil record and molecular similarities present in living organisms. (DOK 2)
 - d. Research factors that might influence or alter plant stability, and propose actions that may reduce the negative impacts of human activity. (DOK 2)
5. **Relate an understanding of plant genetics to its uses in modern living.**
- a. Research, prepare, and present a position relating to issues surrounding the current botanical trends involving biotechnology. (DOK 3)

- b. Apply an understanding of the principles of plant genetics to analyze monohybrid and dihybrid crosses, and predict the potential effects the crosses might have on agronomy and agriculture. (DOK 3)
- c. Discuss the effects of genetic engineering of plants on society. (DOK 2)
- d. Describe the chemical compounds extracted from plants, their economical importance, and the impact on humans. (DOK 3)
 - Plant extracts, their function, and origin
 - Impact of the timber industry on local and national economy

Chemistry I

- CHI 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- CHI 2 Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.
- CHI 3 Develop an understanding of the periodic table.
- CHI 4. Analyze the relationship between microscopic and macroscopic models of matter.
- CHI 5 Compare factors associated with acid/base and oxidation/reduction reactions.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
- b. Clarify research questions and design laboratory investigations. (DOK 3)
- c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
- e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.

- a. Describe and classify matter based on physical and chemical properties and interactions between molecules or atoms. (DOK 1)
 - Physical properties (e.g., melting points, densities, boiling points) of a variety of substances
 - Substances and mixtures
 - Three states of matter in terms of internal energy, molecular motion, and the phase transitions between them
- b. Research and explain crucial contributions and critical experiments of Dalton, Thomson, Rutherford, Bohr, de Broglie, and Schrödinger, and describe how each discovery contributed to the current model of atomic and nuclear structure. (DOK 2)
- c. Develop a model of atomic and nuclear structure based on theory and knowledge of fundamental particles. (DOK 2)
 - Properties and interactions of the three fundamental particles of the atom
 - Laws of conservation of mass, constant composition, definite proportions, and multiple proportions
- d. Write appropriate equations for nuclear decay reactions, describe how the nucleus changes during these reactions, and compare the resulting radiation with regard to penetrating ability. (DOK 1)
 - Three major types of radioactive decay (e.g., alpha, beta, gamma) and the properties of the emissions (e.g., composition, mass, charge, penetrating power)
 - The concept of half-life for a radioactive isotope (e.g., carbon-14 dating) based on the principle that the decay of any individual atom is a random process
- e. Compare the properties of compounds according to their type of bonding. (DOK 1)

- Covalent, ionic, and metallic bonding
- Polar and nonpolar covalent bonding
- Valence electrons and bonding atoms
- f. Compare different types of intermolecular forces, and explain the relationship between intermolecular forces, boiling points, and vapor pressure when comparing differences in properties of pure substances. (DOK 1)
- g. Develop a three-dimensional model of molecular structure. (DOK 2)
 - Lewis dot structures for simple molecules and ionic compounds
 - Valence shell electron pair repulsion theory (VSEPR)

3. Develop an understanding of the periodic table.

- a. Calculate the number of protons, neutrons, and electrons in individual isotopes using atomic numbers and mass numbers, write electron configurations of elements and ions following the Aufbau principle, and balance equations representing nuclear reactions. (DOK 1)
- b. Analyze patterns and trends in the organization of elements in the periodic table, and compare their relationship to position in the periodic table. (DOK 2)
 - Atomic number, atomic mass, mass number, and number of protons, electrons, and neutrons in isotopes of elements
 - Average atomic mass calculations
 - Chemical characteristics of each region
 - Periodic properties (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius)
- c. Classify chemical reactions by type. (DOK 2)
 - Single displacement, double displacement, synthesis (combination), decomposition, disproportionation, combustion, or precipitation
 - Products (given reactants) or reactants (given products) for each reaction type
 - Solubility rules for precipitation reactions and the activity series for single and double displacement reactions
- d. Use stoichiometry to calculate the amount of reactants consumed and products formed. (DOK 3)
 - Difference between chemical reactions and chemical equations
 - Formulas and calculations of the molecular (molar) masses
 - Empirical formula given the percent composition of elements
 - Molecular formula given the empirical formula and molar mass

4. Analyze the relationship between microscopic and macroscopic models of matter.

- a. Calculate the number of protons, neutrons, and electrons in individual isotopes using atomic numbers and mass numbers, write electron configurations of elements and ions following the Aufbau principle, and balance equations representing nuclear reactions. (DOK 1)
- b. Analyze patterns and trends in the organization of elements in the periodic table, and compare their relationship to position in the periodic table. (DOK 2)
 - Atomic number, atomic mass, mass number, and number of protons, electrons, and neutrons in isotopes of elements
 - Average atomic mass calculations
 - Chemical characteristics of each region
 - Periodic properties (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius)
- c. Classify chemical reactions by type. (DOK 2)
 - Single displacement, double displacement, synthesis (combination), decomposition, disproportionation, combustion, or precipitation
 - Products (given reactants) or reactants (given products) for each reaction type
 - Solubility rules for precipitation reactions and the activity series for single and double displacement reactions
- d. Use stoichiometry to calculate the amount of reactants consumed and products formed. (DOK 3)
 - Difference between chemical reactions and chemical equations

- Formulas and calculations of the molecular (molar) masses
 - Empirical formula given the percent composition of elements
 - Molecular formula given the empirical formula and molar mass
5. **Compare factors associated with acid/base and oxidation/reduction reactions.**
- a. Analyze and explain acid/base reactions. (DOK 2)
 - Properties of acids and bases, including how they affect indicators and the relative pH of the solution
 - Formation of acidic and basic solutions
 - Definition of pH in terms of the hydronium ion concentration and the hydroxide ion concentration
 - The pH or pOH from the hydrogen ion or hydroxide ion concentrations of solution
 - How a buffer works and examples of buffer solutions
 - b. Classify species in aqueous solutions according to the Arrhenius and Bronsted-Lowry definitions respectively, and predict products for aqueous neutralization reactions. (DOK 2)
 - c. Analyze a reduction/oxidation reaction (REDOX) to assign oxidation numbers (states) to reaction species, and identify the species oxidized and reduced, the oxidizing agent, and reducing agent. (DOK 2)

Organic Chemistry

- ORGC 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ORGC 2 Demonstrate an understanding of the properties, structure, and function of organic compounds.
- ORGC 3 Discuss the versatility of polymers and the diverse application of organic chemicals.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
 - b. Formulate questions that can be answered through research and experimental design. (DOK 3)
 - c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
 - d. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
 - e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - f. Recognize and analyze alternative explanations for experimental results, and make predictions based on observations and prior knowledge. (DOK 3)
 - g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
2. **Demonstrate an understanding of the properties, structure, and function of organic compounds.**
- a. Apply International Union of Pure and Applied Chemistry (IUPAC) nomenclature, and differentiate the structure of aliphatic, aromatic, and cyclic hydrocarbon compounds. (DOK 1)
 - Structures of hydrocarbon compounds
 - Isomerism in hydrocarbon compounds
 - b. Relate structure to physical and chemical properties of hydrocarbon. (DOK 1)
 - c. Apply principles of geometry and hybridization to organic molecules. (DOK 2)
 - Lewis structures for organic molecules
 - Bond angles
 - Hybridization (as it applies to organic molecules)
 - d. Write, complete, and classify common reactions for aliphatic, aromatic, and cyclic hydrocarbons. (DOK 1)
 - e. Construct, solve, and explain equations representing combustion reactions, substitution reactions, dehydrogenation reactions, and addition reactions. (DOK 2)
 - f. Classify functional groups (e.g., alcohols, ethers, aldehydes, ketones, carboxylic acids, esters, amines, amides, and nitriles) by their structure and properties. (DOK 2)

- Structural formulas from functional group names and vice versa
- Chemical and physical properties of compounds containing functional groups
- Equations representing the transformation of one functional group into another

3. Discuss the versatility of polymers and the diverse application of organic chemicals.

- a. Describe and classify the synthesis, properties, and uses of polymers. (DOK 2)
 - Common polymers
 - Synthesis of polymers from monomers by addition or condensation
 - Condensations of plastics according to their commercial types
 - Elasticity and other polymer properties
- b. Develop a logical argument supporting the use of organic chemicals and their application in industry, drug manufacture, and biological chemistry. (DOK 1)
 - Common uses of polymers and organic compounds in medicine, drugs, and personal care products
 - Compounds that have the property to dye materials
 - Petrochemical production
 - Biologically active compounds in terms of functional group substrate interaction
- c. Research and summarize the diversity, applications, and economics of industrial chemicals (solvents, coatings, surfactants, etc.). (DOK 3)

Earth and Space Science

E1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
E2	Develop an understanding of the history and evolution of the universe and earth.
E3	Discuss factors that are used to explain the geological history of earth.
E4	Demonstrate an understanding of earth systems relating to weather and climate.
E5	Apply an understanding of ecological factors to explain relationships between earth systems.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers.
- b. Formulate questions that can be answered through research and experimental design. (DOK 3)
- c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
- f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
- g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. Develop an understanding of the history and evolution of the universe and earth.

- a. Summarize the origin and evolution of the universe. (DOK 2)
 - Big bang theory
 - Microwave background radiation
 - The Hubble constant
 - Evidence of the existence of dark matter and dark energy in the universe and the history of the universe
- b. Differentiate methods used to measure space distances, including astronomical unit, light-year, stellar parallax, Cepheid variables, and the red shift. (DOK 1)

- c. Interpret how gravitational attraction played a role in the formation of the planetary bodies and how the fusion of hydrogen and other processes in “ordinary” stars and supernovae lead to the formation of all other elements. (DOK 2)
 - d. Summarize the early evolution of the earth, including the formation of Earth’s solid layers (e.g., core, mantle, and crust), the distribution of major elements, the origin of internal heat sources, and the initiation of plate tectonics. (DOK 2)
 - How the decay of radioactive isotopes is used to determine the age of rocks, earth, and the solar system
 - How Earth acquired its initial oceans and atmosphere
3. **Discuss factors which are used to explain the geological history of earth.**
- a. Develop an understanding of how plate tectonics create certain geological features, materials, and hazards. (DOK 1)
 - Plate tectonic boundaries (e.g., divergent, convergent, and transform)
 - Modern and ancient geological features to each kind of plate tectonic boundary
 - Production of particular groups of igneous and metamorphic rocks and mineral resources
 - Sedimentary basins created and destroyed through time
 - b. Compare and contrast types of mineral deposits/groups (e.g., oxides, carbonates, halides, sulfides, sulfates, silicates, phosphates). (DOK 2)
 - c. Categorize minerals and rocks by determining their physical and/or chemical characteristics. (DOK 2)
 - d. Justify the causes of certain geological hazards (e.g., earthquakes, volcanoes, tsunamis) to their effects on specific plate tectonic locations. (DOK 2)
 - e. Interpret and explain how rock relationships and fossils are used to reconstruct the geologic history of the earth. (DOK 2)
 - f. Apply principles of relative age (e.g., superposition, original horizontality, crosscutting relations, and original lateral continuity) to support an opinion related to earth’s geological history. (DOK 3)
 - Types of unconformity (e.g., disconformity, angular unconformity, nonconformity)
 - Geological timetable
 - g. Apply the principle of uniformitarianism to relate sedimentary rock associations and their fossils to the environments in which the rocks were deposited. (DOK 2)
 - h. Compare and contrast the relative and absolute dating methods (e.g., the principle of fossil succession, radiometric dating, and paleomagnetism) for determining the age of the earth. (DOK 1)
4. **Demonstrate an understanding of earth systems relating to weather and climate.**
- a. Explain the interaction of earth systems that affect weather and climate. (DOK 1)
 - Latitudinal variations in solar heating
 - The effects of Coriolis forces on ocean currents, cyclones, anticyclones, ocean currents, topography, and air masses (e.g., warm fronts, cold fronts, stationary fronts, and occluded fronts).
 - b. Interpret the patterns in temperature and precipitation that produce the climate regions on earth, and relate them to the hazards associated with extreme weather events and climate change (e.g., hurricanes, tornadoes, El Niño/La Niña, global warming). (DOK 2)
 - c. Justify how changes in global climate and variation in earth/sun relationships contribute to natural and anthropogenic (human-caused) modification of atmospheric composition. (DOK 2)
 - d. Summarize how past and present actions of ice, wind, and water contributed to the types and distributions of erosional and depositional features in landscapes. (DOK 1)
 - e. Research and explain how external forces affect earth’s topography. (DOK 2)
 - How surface water and groundwater act as the major agents of physical and chemical weathering
 - How soil results from weathering and biological processes
 - Processes and hazards associated with both sudden and gradual mass wasting
5. **Apply an understanding of ecological factors to explain relationships between earth systems.**
- a. Draw conclusions about how life on earth shapes earth systems and responds to the interaction of earth systems (lithosphere, hydrosphere, atmosphere, and biosphere). (DOK 3)
 - Nature and distribution of life on earth, including humans, to the chemistry and availability of water
 - Distribution of biomes (e.g., terrestrial, freshwater, and marine) to climate regions through time

- Geochemical and ecological processes (e.g., rock, hydrologic, carbon, nitrogen) that interact through time to cycle matter and energy and how human activity alters the rates of these processes (e.g., fossil fuel formation and combustion, damming and channeling of rivers)
- b. Interpret the record of shared ancestry (fossils), evolution, and extinction as related to natural selection. (DOK 2)
- c. Identify the cause and effect relationships of the evolutionary innovations that most profoundly shaped earth systems. (DOK 1)
 - Photosynthesis and the atmosphere
 - Multicellular animals and marine environments
 - Land plants and terrestrial environments
- d. Cite evidence about how dramatic changes in earth's atmosphere influenced the evolution of life. (DOK 1)

Environmental Science

- ES 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ES 2 Develop an understanding of the relationship of ecological factors that affect an ecosystem.
- ES 3 Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Formulate questions that can be answered through research and experimental design. (DOK 3)
- c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
- f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
- g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK3)

2. Develop an understanding of the relationship of ecological factors that affect an ecosystem.

- a. Compare ways in which the three layers of the biosphere change over time and their influence on an ecosystem's ability to support life. (DOK 2)
- b. Explain the flow of matter and energy in ecosystems. (DOK 2)
 - Interactions between biotic and abiotic factors
 - Indigenous plants and animals and their roles in various ecosystems
 - Biogeochemical cycles within the environment
- c. Predict the impact of the introduction, removal, and reintroduction of an organism on an ecosystem. (DOK 3)
- d. Develop a logical argument explaining the relationships and changes within an ecosystem. (DOK 2)
 - How a species adapts to its niche
 - Process of primary and secondary succession and its effects on a population
 - How changes in the environment might affect organisms
- e. Explain the causes and effects of changes in population dynamics (e.g., natural selection, exponential growth, predator/prey relationships) to carrying capacity and limiting factors. (DOK 2)
- f. Research and explain how habitat destruction leads to the loss of biodiversity. (DOK 2)

- g. Compare and contrast the major biomes of the world's ecosystems, including location, climate, adaptations and diversity. (DOK 1)
- 3. **Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.**
 - a. Summarize the effects of human activities on resources in the local environments. (DOK 2)
 - Sources, uses, quality, and conservation of water
 - Renewable and nonrenewable resources
 - Effects of pollution (e.g., water, noise, air, etc.) on the ecosystem
 - b. Research and evaluate the impacts of human activity and technology on the lithosphere, hydrosphere, and atmosphere, and develop a logical argument to support how communities restore ecosystems. (DOK 3)
 - c. Research and evaluate the use of renewable and nonrenewable resources, and critique efforts to conserve natural resources and reduce global warming in the United States including (but not limited) to Mississippi. (DOK 3)

Genetics

- G 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- G 2 Analyze the structure and function of the cell and cellular organelles.
- G 3 Apply the principles of heredity to demonstrate genetic understandings.

1. Use critical thinking and scientific problem solving in designing and performing biological research and experimentation. (L, P, E)

- a. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
- b. Clarify research questions and design laboratory investigations. (DOK 3)
- c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for pie, bar, and line graphs) to draw conclusions and make inferences. (DOK 3)
- e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. Review the structure and function of the cell as it applies to genetics. (L)

- a. Cite evidence to illustrate how the structure and function of cells are involved in the maintenance of life. (DOK 2)
- b. Describe how organic components are integral to biochemical processes. (DOK 2)
- c. Differentiate among the processes by which plants and animals reproduce. (DOK 1)
 - Cell cycle and mitosis
 - Meiosis, spermatogenesis, and oogenesis
- d. Explain the significance of the discovery of nucleic acids. (DOK 1)
- e. Analyze and explain the structure and function of DNA and RNA in replication, transcription, translation and DNA repair. (DOK 2)
- f. Cite examples to compare the consequences of the different types of mutations. (DOK 1)
- g. Draw conclusions about the importance and potential impacts of the process of gene transfer used in biotechnology. (DOK 3)

3. Analyze the structure and function of DNA and RNA molecules. (L, P)

- a. Cite evidence that supports the significance of Mendel's concept of "particulate inheritance" to explain the understanding of heredity. (DOK 1)
- b. Apply classical genetics principles to solve basic genetic problems. (DOK 2)

- Genes and alleles, dominance, recessiveness, the laws of segregation, and independent assortment
- Inheritance of autosomal and sex-linked traits
- Inheritance of traits influenced by multiple alleles and traits with polygenetic inheritance
- Chromosomal theory of inheritance
- c. Apply population genetic concepts to summarize variability of multicellular organisms. (DOK 2)
 - Genetic variability
 - Hardy-Weinberg formula
 - Migration and genetic drift
 - Natural selection in humans
- d. Distinguish and explain the applications of various tools and techniques used in DNA manipulation. (DOK 1)
 - Steps in genetic engineering experiments
 - Use of restriction enzymes
 - Role of vectors in genetic research
 - Use of transformation techniques
- e. Research and present a justifiable explanation the practical uses of biotechnology (e.g., chromosome mapping, karyotyping, and pedigrees). (DOK 2)
- f. Develop and present a scientifically-based logical argument for or against moral and ethical issues related to genetic engineering. (DOK 3)
- g. Research genomics (human and other organisms), and predict benefits and medical advances that may result from the use of genome projects. (DOK 2)

Geology

GE1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
GE2	Develop an understanding of plate tectonics and geochemical and ecological processes that affect earth.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Formulate questions that can be answered through research and experimental design. (DOK 3)
- c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
- f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
- g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. Develop an understanding of plate tectonics and geochemical and ecological processes that affect earth.

- a. Differentiate the components of the earth's atmosphere and lithosphere. (DOK 1)
- b. Research and summarize explanations of how earth acquired its initial atmosphere and oceans. (DOK 2)
- c. Compare the causes and effects of internal and external components that shape earth's topography. (DOK 2)
 - Physical weathering (e.g., atmospheric, glacial, etc.)
 - Chemical weathering agents (e.g., acid precipitation, carbon dioxide, oxygen, water, etc.)

- d. Develop an understanding of how plate tectonics create certain geologic features, materials, and hazards. (DOK 2)
 - Types of crustal movements and the resulting landforms (e.g., seafloor spreading, paleomagnetic measurements, and orogenesis)
 - Processes that create earthquakes and volcanoes
 - Asthenosphere
- e. Summarize the theories of plate development and continental drift, and describe the causes and effects involved in each. (DOK 2)
- f. Develop a logical argument to explain how geochemical and ecological processes (e.g., rock, hydrologic, carbon, nitrogen) interact through time to cycle matter and energy and how human activity alters the rates of these processes (e.g., fossil fuel formation and combustion, damming, and channeling of rivers). (DOK 2)
- g. Interpret how the earth's geological time scale relates to geological history, landforms, and life-forms. (DOK 2)
- h. Research and describe different techniques for determining relative and absolute age of the earth (e.g., index of fossil layers, superposition, radiometric dating, etc.). (DOK 1)
- i. Summarize the geological activity of the New Madrid fault line, and compare and contrast it to geological activity in other parts of the world. (DOK 2)
- j. Identify and differentiate the major geological features in Mississippi (e.g., Delta, Coastal Areas, etc.). (DOK 1)
- k. Evaluate an emergency preparedness plan for natural disasters associated with crustal movement. (DOK 3)

Physical Science

PS 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
PS 2	Describe and explain how forces affect motion.
PS 3	Demonstrate an understanding of general properties and characteristics of waves.
PS 4	Develop an understanding of the atom.
PS 5	Investigate and apply principles of physical and chemical changes in matter.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Use appropriate laboratory safety symbols and procedures to design and conduct a scientific investigation. (DOK 2)
 - Safety symbols and safety rules in all laboratory activities
 - Proper use and care of the compound light microscope
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Identify questions that can be answered through scientific investigations. (DOK 3)
- c. Identify and apply components of scientific methods in classroom investigations. (DOK 3)
 - Predicting, gathering data, drawing conclusions
 - Recording outcomes and organizing data from a variety of sources (e.g., scientific articles, magazines, student experiments, etc.)
 - Critically analyzing current investigations/problems using periodicals and scientific scenarios
- d. Interpret and generate graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures and data to draw conclusions about the validity of research. (DOK 3)
- f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- g. Communicate effectively to present and explain scientific results, using appropriate terminology and graphics. (DOK 3)

2. Describe and explain how forces affect motion.

- a. Demonstrate and explain the basic principles of Newton's three laws of motion including calculations of acceleration, force, and momentum. (DOK 2)

- Inertia and distance-time graphs to determine average speed
 - Net force (accounting for gravity, friction, and air resistance) and the resulting motion of objects
 - Effects of the gravitational force on objects on Earth and effects on planetary and lunar motion
 - Simple harmonic motion (oscillation)
 - b. Explain the connection between force, work, and energy. (DOK 2)
 - Force exerted over a distance (results in work done)
 - Force-distance graph (to determine work)
 - Network on an object that contributes to change in kinetic energy (work-to-energy theorem)
 - c. Describe (with supporting details and diagrams) how the kinetic energy of an object can be converted into potential energy (the energy of position) and how energy is transferred or transformed (conservation of energy). (DOK 2)
 - d. Draw and assess conclusions about charges and electric current. (DOK 2)
 - Static/current electricity and direct current/alternating current
 - Elements in an electric circuit that are in series or parallel
 - Conductors and insulators
 - Relationship between current flowing through a resistor and voltage flowing across a resistor
 - e. Cite evidence and explain the application of electric currents and magnetic fields as they relate to their use in everyday living (e.g., the application of fields in motors and generators and the concept of electric current using Ohm's law). (DOK 2)
- 3. Demonstrate an understanding of general properties and characteristics of waves.**
- a. Differentiate among transverse, longitudinal, and surface waves as they propagate through a medium (e.g., string, air, water, steel beam). (DOK 1)
 - b. Compare properties of waves (e.g., superposition, interference, refraction, reflection, diffraction, Doppler effect), and explain the connection among the quantities (e.g., wavelength, frequency, period, amplitude, and velocity). (DOK 2)
 - c. Classify the electromagnetic spectrum's regions according to frequency and/or wavelength, and draw conclusions about their impact on life. (DOK 2)
 - The emission of light by electrons when moving from higher to lower levels
 - Energy (photons as quanta of light)
 - Additive and subtractive properties of colors
 - Relationship of visible light to the color spectrum
 - d. Explain how sound intensity is measured and its relationship to the decibel scale. (DOK 1)
- 4. Develop an understanding of the atom.**
- a. Cite evidence to summarize the atomic theory. (DOK 1)
 - Models for atoms
 - Hund's rule and Aufbau process to specify the electron configuration of elements
 - Building blocks of matter (e.g., proton, neutron, and electron) and elementary particles (e.g., positron, mesons, neutrinos, etc.)
 - Atomic orbitals (s, p, d, f) and their basic shapes
 - b. Explain the difference between chemical and physical changes, and demonstrate how these changes can be used to separate mixtures and compounds into their components. (DOK 2)
 - c. Research the history of the periodic table of the elements, and summarize the contributions that led to the atomic theory. (DOK 2)
 - Contributions of scientists (e.g., John Dalton, J.J. Thomson, Ernest Rutherford, Newton, Einstein, Neils, Bohr, Louis de Broglie, Erwin Schrödinger, etc.)
 - Technology (e.g., X-rays, cathode-ray tubes, spectroscopes)
 - Experiments (e.g., gold-foil, cathode-ray, etc.)
 - d. Utilize the periodic table to predict and explain patterns and draw conclusions about the structure, properties, and organization of matter. (DOK 2)
 - Atomic composition and valence electron configuration (e.g., atomic number, mass number of protons, neutrons, electrons, isotopes, and ions)
 - Periodic trends using the periodic table (e.g., valence, reactivity, atomic radius)

- Average atomic mass from isotopic abundance
- Solids, liquids, and gases
- Periodic properties of elements (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius) and how they relate to position in the periodic table

5. Investigate and apply principles of physical and chemical changes in matter.

- Write chemical formulas for compounds comprising monatomic and polyatomic ions. (DOK 1)
- Balance chemical equations. (DOK 2)
- Classify types of chemical reactions (e, g., composition, decomposition, single displacement, double displacement, combustion, acid/base reactions). (DOK 2)

Physics I

PHYI 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
PHYI 2	Develop an understanding of concepts related to forces and motion.
PHYI 3	Develop an understanding of concepts related to work and energy.
PHYI 4	Discuss the characteristics and properties of light and sound.
PHYI 5	Apply an understanding of magnetism, electric fields, and electricity.
PHYI 6	Analyze and explain concepts of nuclear physics.

1. Investigate and apply principles of physical and chemical changes in matter.

- Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
- Clarify research questions, and design laboratory investigations. (DOK 3)
- Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
- Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. Develop an understanding of concepts related to forces and motion.

- Use inquiry to investigate and develop an understanding of the kinematics and dynamics of physical bodies. (DOK 3)
 - Vector and scalar quantities
 - Vector problems (solved mathematically and graphically)
 - Vector techniques and free-body diagrams to determine the net force on a body when several forces are acting on it
 - Relations among mass, inertia, and weight
- Analyze, describe, and solve problems by creating and utilizing graphs of one-dimensional motion (e.g., position, distance, displacement, time, speed, velocity, acceleration, the special case of free fall). (DOK 2)
- Analyze real-world applications to draw conclusions about Newton's three laws of motion. (DOK 2)
- Apply the effects of the universal gravitation law to graph and interpret the force between two masses, acceleration due to gravity, and planetary motion. (DOK 2)
 - Situations where g is constant (falling bodies)
 - Concept of centripetal acceleration undergoing uniform circular motion
 - Kepler's third law
 - Oscillatory motion and the mechanics of waves

3. Develop an understanding of concepts related to work and energy.

- Explain and apply the conservation of energy and momentum. (DOK 2)

- Concept of work and applications
 - Concept of kinetic energy, using the elementary work-energy theorem
 - Concept of conservation of energy with simple examples
 - Concepts of energy, work, and power (qualitatively and quantitatively)
 - Principles of impulse in inelastic and elastic collisions
- b. Analyze real-world applications to draw conclusions about mechanical potential energy (the energy of configuration). (DOK 3)
- c. Apply the principles of impulse, and compare conservation of momentum and conservation of kinetic energy in perfectly inelastic and elastic collisions. (DOK 1)
- d. Investigate and summarize the principles of thermodynamics. (DOK 2)
- How heat energy is transferred from higher temperature to lower temperature until equilibrium is reached
 - Temperature and thermal energy as related to molecular motion and states of matter
 - Problems involving specific heat and heat capacity
 - First and second laws of thermodynamics as related to heat engines, refrigerators, and thermal efficiency
- e. Develop the kinetic theory of ideal gases and explain the concept of Carnot efficiency. (DOK 2)
- 4. Discuss the characteristics and properties of light and sound.**
- a. Describe and model the characteristics and properties of mechanical waves. (DOK 2)
- Simple harmonic motion
 - Relationships among wave characteristics such as velocity, period, frequency, amplitude, phase, and wavelength
 - Energy of a wave in terms of amplitude and frequency.
 - Standing waves and waves in specific media (e.g., stretched string, water surface, air, etc.)
- b. Differentiate and explain the Doppler effect as it relates to a moving source and to a moving observer. (DOK 1)
- c. Explain the laws of reflection and refraction, and apply Snell's law to describe the relationship between the angles of incidence and refraction. (DOK 2)
- d. Use ray tracing and the thin lens equation to solve real-world problems involving object distance from lenses. (DOK 2)
- e. Investigate and draw conclusions about the characteristics and properties of electromagnetic waves. (DOK 2)
- 5. Apply an understanding of magnetism, electric fields, and electricity.**
- a. Analyze and explain the relationship between electricity and magnetism. (DOK 2)
- Characteristics of static charge and how a static charge is generated
 - Electric field, electric potential, current, voltage, and resistance as related to Ohm's law
 - Magnetic poles, magnetic flux and field, Ampère's law and Faraday's law
 - Coulomb's law
- b. Use schematic diagrams to analyze the current flow in series and parallel electric circuits, given the component resistances and the imposed electric potential. (DOK 2)
- c. Analyze and explain the relationship between magnetic fields and electrical current by induction, generators, and electric motors. (DOK 2)
- 6. Analyze and explain concepts of nuclear physics.**
- a. Analyze and explain the principles of nuclear physics. (DOK 1)
- The mass number and atomic number of the nucleus of an isotope of a given chemical element
 - The conservation of mass and the conservation of charge
 - Nuclear decay
- b. Defend the wave-particle duality model of light, using observational evidence. (DOK 3)
- Quantum energy and emission spectra
 - Photoelectric and Compton effects

Spatial Information Science

- SP 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- SP 2 Develop an understanding of geographic information systems.

1. Demonstrate the basic concepts of global positioning systems (GPS). (E)

- Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
- Clarify research questions, and design laboratory investigations. (DOK 3)
- Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, and theory development). (DOK 3)
- Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences). (DOK 3)
- Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBLs, etc.). (DOK 3)

2. Demonstrate the basic concepts of remote sensing. (E, P)

- Describe the characteristics of the electromagnetic spectrum.
- Using images and graphs, interpret the absorption/reflection spectrum.
- Distinguish between passive vs. active sensor systems.
- Analyze the effects of changes in spatial, temporal, and spectral resolution.
- Analyze the effects on images due to changes in scale.
- Identify the types of sensor platforms.

Zoology

- ZO 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ZO 2 Develop an understanding of levels of organization and animal classification.
- ZO 3 Differentiate among animal life cycles, behaviors, adaptations, and relationships.
- ZO 4 Demonstrate an understanding of the principles of animal genetic diversity and evolution.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- Formulate questions that can be answered through research and experimental design. (DOK 3)
- Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
- Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
- Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. Develop an understanding of levels of organization and animal classification.

- Explain how organisms are classified, and identify characteristics of major groups. (DOK 1)
 - Levels of organization of structures in animals (e.g., cells, tissues, organs, and systems)

- Characteristics used to classify organisms (e.g., cell structure, biochemistry, anatomy, fossil record, and methods of reproduction)
 - b. Identify and describe characteristics of the major phyla. (DOK 1)
 - Symmetry and body plan
 - Germ layers and embryonic development
 - Organ systems (e.g., digestive, circulatory, excretory, and reproductive)
 - Locomotion and coordination
 - c. Distinguish viruses from bacteria and protists, and give examples. (DOK 1)
 - d. Differentiate among the characteristics of bacteria, archaea, and eucarya. (DOK 1)
 - Phylogenic sequencing of the major phyla
 - Invertebrate characteristics (e.g., habitat, reproduction, body plan, locomotion) of the following phyla: Porifera, Cnidarians, Nematoda, Annelida, Platyhelminthes, Arthropoda, Insecta, Crustacea, Arachnida, Mollusca [Bivalvia and Gastropoda], and Echinodermata
 - Vertebrate characteristics (e.g., habitat, reproduction, body plan, locomotion) of the following classes: Agnatha, Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, and Mammalia
- 3. Differentiate among animal life cycles, behaviors, adaptations, and relationships.**
- a. Describe life cycles, alternation of generations, and metamorphosis of various animals, and evaluate the advantages and disadvantages of asexual and sexual reproduction. (DOK 1)
 - b. Describe and explain concepts of animal behavior, and differentiate between learned and innate behavior. (DOK 1)
 - Division of labor within a group of animals
 - Communication within animals groups
 - Degree of parental care given in animal groups
 - c. Evaluate the unique protective adaptations of animals as they relate to survival. (DOK 2)
 - d. Compare and contrast ecological relationships, and make predictions about the survival of populations under given circumstances. (DOK 3)
 - Terrestrial and aquatic ecosystems
 - Herbivores, carnivores, omnivores, decomposers and other feeding relationships
 - Symbiotic relationships such as mutualism, commensalisms, and parasitism
 - e. Contrast food chains and food webs. (DOK 2)
- 4. Demonstrate an understanding of the principles of animal genetic diversity and evolution.**
- a. Categorize and explain sources of genetic variation on the cellular level (e.g., mutations, crossing over, and nondisjunction) and the population level (e.g., nonrandom mating, migration, etc.). (DOK 2)
 - Relationship between natural selection and evolution
 - Mutations, crossing over, nondisjunction
 - Nonrandom mating, migration, etc.
 - Effects of genetic drift on evolution
 - b. Develop a logical argument defending or refuting issues related to genetic engineering of animals. (DOK 3)

Appendix D: ACT College Readiness Standards

English

E1 Topic Development in Terms of Purpose and Focus

- Identify the basic purpose or role of a specified phrase or sentence.
- Delete a clause or sentence because it is obviously irrelevant to the essay.
- Identify the central idea or main topic of a straightforward piece of writing.
- Determine relevancy when presented with a variety of sentence-level details.
- Identify the focus of a simple essay, applying that knowledge to add a sentence that sharpens that focus or to determine if an essay has met a specified goal.
- Delete material primarily because it disturbs the flow and development of the paragraph.
- Add a sentence to accomplish a fairly straightforward purpose such as illustrating a given statement.
- Apply an awareness of the focus and purpose of a fairly involved essay to determine the rhetorical effect and suitability of an existing phrase or sentence or to determine the need to delete plausible but irrelevant material.
- Add a sentence to accomplish a subtle rhetorical purpose such as to emphasize, to add supporting detail, or to express meaning through connotation.
- Determine whether a complex essay has accomplished a specific purpose.
- Add a phrase or sentence to accomplish a complex purpose, often expressed in terms of the main focus of the essay.

E2 Organization, Unity, and Coherence

- Use conjunctive adverbs or phrases to show time relationship in simple narrative essays (e.g., *then, this time, etc.*).
- Select the most logical place to add a sentence in a paragraph.
- Use conjunctive adverbs or phrases to express straightforward logical relationships (e.g., *first, afterward, in response*).
- Decide the most logical place to add a sentence in an essay.
- Add a sentence that introduces a simple paragraph.
- Determine the need for conjunctive adverbs or phrases to create subtle logical connections between sentences (e.g., *therefore, however, in addition*).
- Rearrange the sentences in a fairly uncomplicated paragraph for the sake of logic.
- Add a sentence to introduce or conclude the essay or to provide a transition between paragraphs when the essay is fairly straightforward.
- Make sophisticated distinctions concerning the logical use of conjunctive adverbs or phrases, particularly when signaling a shift between paragraphs.
- Rearrange sentences to improve the logic and coherence of a complex paragraph.
- Add a sentence to introduce or conclude a fairly complex paragraph.
- Consider the need for introductory sentences or transitions, basing decisions on a thorough understanding of both the logic and rhetorical effect of the paragraph and essay.

E3 Word Choice in Terms of Style, Tone, Clarity, and Economy

- Revise sentences to correct awkward and confusing arrangements of sentence elements.
- Revise vague nouns and pronouns that create obvious logic problems.
- Delete obviously synonymous and wordy material in a sentence.
- Revise expressions that deviate from the style of an essay.
- Delete redundant material when information is repeated in different parts of speech (e.g., *alarmingly startled*).
- Use the word or phrase most consistent with the style and tone of a fairly straightforward essay.
- Determine the clearest and most logical conjunction to link clauses.
- Revise a phrase that is redundant in terms of the meaning and logic of the entire sentence.
- Identify and correct ambiguous pronoun references.
- Use the word or phrase most appropriate in terms of the content of the sentence and tone of the essay.
- Correct redundant material that involves sophisticated vocabulary and sounds acceptable as conversational English (e.g., *an aesthetic viewpoint* versus *the outlook of an aesthetic viewpoint*).
- Correct vague and wordy or clumsy and confusing writing containing sophisticated language.
- Delete redundant material that involves subtle concepts or that is redundant in terms of the paragraph as a whole.

E4 Sentence Structure and Formation

- Use conjunctions or punctuation to join simple clauses.
- Revise shifts in verb tense between simple clauses in a sentence or between simple adjoining sentences.
- Determine the need for punctuation and conjunctions to avoid awkward sounding sentence fragments and fused sentences.
- Decide the appropriate verb tense and voice by considering the meaning of the entire sentence.
- Recognize and correct marked disturbances of sentence flow and structure (e.g., participial phrase fragments, missing or incorrect relative pronouns, dangling or misplaced modifiers).
- Revise to avoid faulty placement of phrases and faulty coordination and subordination of clauses in sentences with subtle structural problems.
- Maintain consistent verb tense and pronoun person on the basis of the preceding clause or sentence.
- Use sentence-combining techniques, effectively avoiding problematic comma splices, run-on sentences, and sentence fragments, especially in sentences containing compound subjects or verbs.
- Maintain a consistent and logical use of verb tense and pronoun person on the basis of information in the paragraph or essay as a whole.
- Work comfortably with long sentences and complex clausal relationships within sentences, avoiding weak conjunctions between independent clauses and maintaining parallel structure between clauses.

E5 Conventions of Usage

- Solve such basic grammatical problems as how to form the past and past participle of irregular but commonly used verbs and how to form comparative and superlative adjectives.
- Solve such grammatical problems as whether to use an adverb or adjective form, how to ensure straightforward subject–verb and pronoun–antecedent agreement, and which preposition to use in simple contexts.
- Recognize and use the appropriate word in frequently confused pairs such as *there* and *their*, *past* and *passed*, and *led* and *lead*.
- Use idiomatically appropriate prepositions, especially in combination with verbs (e.g., *long for*, *appeal to*).
- Ensure that a verb agrees with its subject when there is some text between the two.
- Ensure that a pronoun agrees with its antecedent when the two occur in separate clauses or sentences.
- Identify the correct past and past participle forms of irregular and infrequently used verbs, and form present–perfect verbs by using *have* rather than *of*.
- Correctly use reflexive pronouns, the possessive pronouns *its* and *your*, and the relative pronouns *who* and *whom*.

- Ensure that a verb agrees with its subject in unusual situations (e.g., when the subject–verb order is inverted or when the subject is an indefinite pronoun).
- Provide idiomatically and contextually appropriate prepositions following verbs in situations involving sophisticated language or ideas.
- Ensure that a verb agrees with its subject when a phrase or clause between the two suggests a different number for the verb.

E6 Conventions of Punctuation

- Delete commas that create basic sense problems (e.g., between verb and direct object).
- Provide appropriate punctuation in straightforward situations (e.g., items in a series).
- Delete commas that disturb the sentence flow (e.g., between modifier and modified element).
- Use commas to set off simple parenthetical phrases.
- Delete unnecessary commas when an incorrect reading of the sentence suggests a pause that should be punctuated (e.g., between verb and direct object clause).
- Use punctuation to set off complex parenthetical phrases.
- Recognize and delete unnecessary commas based on a careful reading of a complicated sentence (e.g., between the elements of a compound subject or compound verb joined by *and*).
- Use apostrophes to indicate simple possessive nouns.
- Recognize inappropriate uses of colons and semicolons.
- Use commas to set off a nonessential/nonrestrictive appositive or clause.
- Deal with multiple punctuation problems (e.g., compound sentences containing unnecessary commas and phrases that may or may not be parenthetical).
- Use an apostrophe to show possession, especially with irregular plural nouns.
- Use a semicolon to indicate a relationship between closely related independent clauses.
- Use a colon to introduce an example or an elaboration.

Math

M1 Basic Operations and Applications

- Perform one-operation computation with whole numbers and decimals.
- Solve problems in one or two steps using whole numbers.
- Perform common conversions (e.g., inches to feet or hours to minutes).
- Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent.
- Solve some routine two-step arithmetic problems.
- Solve routine two-step or three-step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and computing with a given average.
- Solve multistep arithmetic problems that involve planning or converting units of measure (e.g., feet per second to miles per hour).
- Solve word problems containing several rates, proportions, or percentages.
- Solve complex arithmetic problems involving percent of increase or decrease and problems requiring integration of several concepts from pre-algebra and/or pre-geometry (e.g., comparing percentages or averages, using several ratios, and finding ratios in geometry settings).

M2 Probability, Statistics, and Data Analysis

- Calculate the average of a list of positive whole numbers.
- Perform a single computation using information from a table or chart.
- Calculate the average of a list of numbers.
- Calculate the average, given the number of data values and the sum of the data values.
- Read tables and graphs.
- Perform computations on data from tables and graphs.

- Use the relationship between the probability of an event and the probability of its complement.
- Calculate the missing data value, given the average and all data values but one.
- Translate from one representation of data to another (e.g., a bar graph to a circle graph).
- Determine the probability of a simple event.
- Exhibit knowledge of simple counting techniques.*
- Calculate the average, given the frequency counts of all the data values.
- Manipulate data from tables and graphs.
- Compute straightforward probabilities for common situations.
- Use Venn diagrams in counting.*
- Calculate or use a weighted average.
- Interpret and use information from figures, tables, and graphs.
- Apply counting techniques.
- Compute a probability when the event and/or sample space is not given or obvious.
- Distinguish between mean, median, and mode for a list of numbers.
- Analyze and draw conclusions based on information from figures, tables, and graphs.
- Exhibit knowledge of conditional and joint probability.

M3 Numbers: Concepts and Properties

- Recognize equivalent fractions and fractions in lowest terms.
- Recognize one-digit factors of a number.
- Identify a digit's place value.
- Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor.
- Find and use the least common multiple.
- Order fractions.
- Work with numerical factors.
- Work with scientific notation.
- Work with squares and square roots of numbers.
- Work problems involving positive integer exponents.*
- Work with cubes and cube roots of numbers.*
- Determine when an expression is undefined.*
- Exhibit some knowledge of the complex numbers.†
- Apply number properties involving prime factorization.
- Apply number properties involving even and odd numbers and factors and multiples.
- Apply number properties involving positive and negative numbers.
- Apply rules of exponents.
- Multiply two complex numbers.†
- Draw conclusions based on number concepts, algebraic properties, and/or relationships between expressions and numbers.
- Exhibit knowledge of logarithms and geometric sequences.
- Apply properties of complex numbers.

M4 Expressions, Equations, and Inequalities

- Exhibit knowledge of basic expressions (e.g., identify an expression for a total as $b + g$).
- Solve equations in the form $x + a = b$, where a and b are whole numbers or decimals.
- Substitute whole numbers for unknown quantities to evaluate expressions.
- Solve one-step equations having integer or decimal answers.
- Combine like terms (e.g., $2x + 5x$).
- Evaluate algebraic expressions by substituting integers for unknown quantities.
- Add and subtract simple algebraic expressions.
- Solve routine first-degree equations.

- Perform straightforward word-to-symbol translations.
- Multiply two binomials.*
- Solve real-world problems using first-degree equations.
- Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions).
- Identify solutions to simple quadratic equations.
- Add, subtract, and multiply polynomials.*
- Factor simple quadratics (e.g., the difference of squares and perfect square trinomials).*
- Solve first-degree inequalities that do not require reversing the inequality sign.*
- Manipulate expressions and equations.
- Write expressions, equations, and inequalities for common algebra settings.
- Solve linear inequalities that require reversing the inequality sign.
- Solve absolute value equations.
- Solve quadratic equations.
- Find solutions to systems of linear equations.
- Write expressions that require planning and/or manipulating to accurately model a situation.
- Write equations and inequalities that require planning, manipulating, and/or solving.
- Solve simple absolute value inequalities.

M5 Graphical Representations

- Identify the location of a point with a positive coordinate on the number line.
- Locate points on the number line and in the first quadrant.
- Locate points in the coordinate plane.
- Comprehend the concept of length on the number line.*
- Exhibit knowledge of slope.*
- Identify the graph of a linear inequality on the number line.*
- Determine the slope of a line from points or equations.*
- Match linear graphs with their equations.*
- Find the midpoint of a line segment.*
- Interpret and use information from graphs in the coordinate plane.
- Match number line graphs with solution sets of linear inequalities.
- Use the distance formula.
- Use properties of parallel and perpendicular lines to determine an equation of a line or coordinates of a point.
- Recognize special characteristics of parabolas and circles (e.g., the vertex of a parabola and the center or radius of a circle).†
- Match number line graphs with solution sets of simple quadratic inequalities.
- Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$.
- Solve problems integrating multiple algebraic and/or geometric concepts.
- Analyze and draw conclusions based on information from graphs in the coordinate plane.

M6 Properties of Plane Figures

- Exhibit some knowledge of the angles associated with parallel lines.
- Find the measure of an angle using properties of parallel lines.
- Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90° , 180° , and 360°).
- Use several angle properties to find an unknown angle measure.
- Recognize Pythagorean triples.*
- Use properties of isosceles triangles.*
- Apply properties of 30° - 60° - 90° , 45° - 45° - 90° , similar, and congruent triangles.
- Use the Pythagorean theorem.
- Draw conclusions based on a set of conditions.

- Solve multistep geometry problems that involve integrating concepts, planning, visualization, and/or making connections with other content areas.
- Use relationships among angles, arcs, and distances in a circle.

M7 Measurement

- Estimate or calculate the length of a line segment based on other lengths given on a geometric figure.
- Compute the perimeter of polygons when all side lengths are given.
- Compute the area of rectangles when whole number dimensions are given.
- Compute the area and perimeter of triangles and rectangles in simple problems.
- Use geometric formulas when all necessary information is given.
- Compute the area of triangles and rectangles when one or more additional simple steps are required.
- Compute the area and circumference of circles after identifying necessary information.
- Compute the perimeter of simple composite geometric figures with unknown side lengths.*
- Use relationships involving area, perimeter, and volume of geometric figures to compute another measure.
- Use scale factors to determine the magnitude of a size change.
- Compute the area of composite geometric figures when planning or visualization is required.

M8 Functions

- Evaluate quadratic functions, expressed in function notation, at integer values.
- Evaluate polynomial functions, expressed in function notation, at integer values.†
- Express the sine, cosine, and tangent of an angle in a right triangle as a ratio of given side lengths.†
- Evaluate composite functions at integer values.†
- Apply basic trigonometric ratios to solve right-triangle problems.†
- Write an expression for the composite of two simple functions.†
- Use trigonometric concepts and basic identities to solve problems.†
- Exhibit knowledge of unit circle trigonometry.†
- Match graphs of basic trigonometric functions with their equations.

Notes

- Students who score in the 1–12 range are most likely beginning to develop the knowledge and skills assessed in the other ranges.
- Standards followed by an asterisk (*) apply to the PLAN and ACT Mathematics tests only.
- Standards followed by a dagger (†) apply to the ACT Mathematics test only.

Reading

R1 Main Ideas and Author's Approach

- Recognize a clear intent of an author or narrator in uncomplicated literary narratives.
- Identify a clear main idea or purpose of straightforward paragraphs in uncomplicated literary narratives.
- Infer the main idea or purpose of straightforward paragraphs in uncomplicated literary narratives.
- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in uncomplicated passages.
- Identify a clear main idea or purpose of any paragraph or paragraphs in uncomplicated passages.
- Infer the main idea or purpose of straightforward paragraphs in more challenging passages.
- Summarize basic events and ideas in more challenging passages.
- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in more challenging passages.
- Infer the main idea or purpose of more challenging passages or their paragraphs.
- Summarize events and ideas in virtually any passage.

- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in virtually any passage.
- Identify clear main ideas or purposes of complex passages or their paragraphs.

R2 Supporting Details

- Locate basic facts (e.g., names, dates, events) clearly stated in a passage.
- Locate simple details at the sentence and paragraph level in uncomplicated passages.
- Recognize a clear function of a part of an uncomplicated passage.
- Locate important details in uncomplicated passages.
- Make simple inferences about how details are used in passages.
- Locate important details in more challenging passages.
- Locate and interpret minor or subtly stated details in uncomplicated passages.
- Discern which details, though they may appear in different sections throughout a passage, support important points in more challenging passages.
- Locate and interpret minor or subtly stated details in more challenging passages.
- Use details from different sections of some complex informational passages to support a specific point or argument.
- Locate and interpret details in complex passages.
- Understand the function of a part of a passage when the function is subtle or complex.

R3 Sequential, Comparative, and Cause—Effect Relationships

- Determine when (e.g., first, last, before, after) or if an event occurred in uncomplicated passages.
- Recognize clear cause—effect relationships described within a single sentence in a passage.
- Identify relationships between main characters in uncomplicated literary narratives.
- Recognize clear cause—effect relationships within a single paragraph in uncomplicated literary narratives.
- Order simple sequences of events in uncomplicated literary narratives.
- Identify clear relationships between people, ideas, and so forth in uncomplicated passages.
- Identify clear cause—effect relationships in uncomplicated passages.
- Order sequences of events in uncomplicated passages.
- Understand relationships between people, ideas, and so forth in uncomplicated passages.
- Identify clear relationships between characters, ideas, and so forth in more challenging literary narratives.
- Understand implied or subtly stated cause—effect relationships in uncomplicated passages.
- Identify clear cause—effect relationships in more challenging passages.
- Order sequences of events in more challenging passages.
- Understand the dynamics between people, ideas, and so forth in more challenging passages.
- Understand implied or subtly stated cause—effect relationships in more challenging passages.
- Order sequences of events in complex passages.
- Understand the subtleties in relationships between people, ideas, and so forth in virtually any passage.
- Understand implied, subtle, or complex cause—effect relationships in virtually any passage.

R4 Meaning of Words

- Understand the implication of a familiar word or phrase and of simple descriptive language.
- Use context to understand basic figurative language.
- Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in uncomplicated passages.
- Use context to determine the appropriate meaning of virtually any word, phrase, or statement in uncomplicated passages.
- Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in more challenging passages.

- Determine the appropriate meaning of words, phrases, or statements from figurative or somewhat technical contexts.
- Determine, even when the language is richly figurative and the vocabulary is difficult, the appropriate meaning of context-dependent words, phrases, or statements in virtually any passage.

R5 Generalizations and Conclusions

- Draw simple generalizations and conclusions about the main characters in uncomplicated literary narratives.
- Draw simple generalizations and conclusions about people, ideas, and so forth in uncomplicated passages.
- Draw generalizations and conclusions about people, ideas, and so forth in uncomplicated passages.
- Draw simple generalizations and conclusions using details that support the main points of more challenging passages.
- Draw subtle generalizations and conclusions about characters, ideas, and so forth in uncomplicated literary narratives.
- Draw generalizations and conclusions about people, ideas, and so forth in more challenging passages.
- Use information from one or more sections of a more challenging passage to draw generalizations and conclusions about people, ideas, and so forth.
- Draw complex or subtle generalizations and conclusions about people, ideas, and so forth, often by synthesizing information from different portions of the passage.
- Understand and generalize about portions of a complex literary narrative.

Science

S1 Interpretation of Data

- Select a single piece of data (numerical or non-numerical) from a simple data presentation (e.g., a table or graph with two or three variables, a food web diagram).
- Identify basic features of a table, graph, or diagram (e.g., headings, units of measurement, axis labels).
- Select two or more pieces of data from a simple data presentation.
- Understand basic scientific terminology.
- Find basic information in a brief body of text.
- Determine how the value of one variable changes as the value of another variable changes in a simple data presentation.
- Select data from a complex data presentation (e.g., a table or graph with more than three variables, a phase diagram).
- Compare or combine data from a simple data presentation (e.g., order or sum data from a table).
- Translate information into a table, graph, or diagram.
- Compare or combine data from two or more simple data presentations (e.g., categorize data from a table using a scale from another table).
- Compare or combine data from a complex data presentation.
- Interpolate between data points in a table or graph.
- Determine how the value of one variable changes as the value of another variable changes in a complex data presentation.
- Identify and/or use a simple (e.g., linear) mathematical relationship between data.
- Analyze given information when presented with new, simple information.
- Compare or combine data from a simple data presentation with data from a complex data presentation.
- Identify and/or use a complex (e.g., nonlinear) mathematical relationship between data.
- Extrapolate from data points in a table or graph.
- Compare or combine data from two or more complex data presentations.
- Analyze given information when presented with new, complex information.

S2 Scientific Investigation

- Understand the methods and tools used in a simple experiment.
- Understand the methods and tools used in a moderately complex experiment.
- Understand a simple experimental design.
- Identify a control in an experiment.
- Identify similarities and differences between experiments.
- Understand the methods and tools used in a complex experiment.
- Understand a complex experimental design.
- Predict the results of an additional trial or measurement in an experiment.
- Determine the experimental conditions that would produce specified results.
- Determine the hypothesis for an experiment.
- Identify an alternate method for testing a hypothesis.
- Understand precision and accuracy issues.
- Predict how modifying the design or methods of an experiment will affect results.
- Identify an additional trial or experiment that could be performed to enhance or evaluate experimental results.

S3 Evaluation of Models, Inferences, and Experimental Results

- Select a simple hypothesis, prediction, or conclusion that is supported by a data presentation or a model.
- Identify key issues or assumptions in a model.
- Select a simple hypothesis, prediction, or conclusion that is supported by two or more data presentations or models.
- Determine whether given information supports or contradicts a simple hypothesis or conclusion and why.
- Identify strengths and weaknesses in one or more models.
- Identify similarities and differences between models.
- Determine which model(s) is/are supported or weakened by new information.
- Select a data presentation or a model that supports or contradicts a hypothesis, prediction, or conclusion.
- Select a complex hypothesis, prediction, or conclusion that is supported by a data presentation or model.
- Determine whether new information supports or weakens a model and why.
- Use new information to make a prediction based on a model.
- Select a complex hypothesis, prediction, or conclusion that is supported by two or more data presentations or models.
- Determine whether given information supports or contradicts a complex hypothesis or conclusion and why.

Writing

W1 Expressing Judgments

- Show a little understanding of the persuasive purpose of the task, but neglect to take or to maintain a position on the issue in the prompt.
- Show limited recognition of the complexity of the issue in the prompt.
- Show a basic understanding of the persuasive purpose of the task by taking a position on the issue in the prompt but may not maintain that position.
- Show a little recognition of the complexity of the issue in the prompt by acknowledging, but only briefly describing, a counterargument to the writer's position.
- Show understanding of the persuasive purpose of the task by taking a position on the issue in the prompt.
- Show some recognition of the complexity of the issue in the prompt by doing the following:
 - Acknowledging counterarguments to the writer's position
 - Providing some response to counterarguments to the writer's position
- Show clear understanding of the persuasive purpose of the task by taking a position on the specific issue in the prompt and offering a broad context for discussion.

- Show recognition of the complexity of the issue in the prompt by doing the following:
 - Partially evaluating implications and/or complications of the issue
 - Posing and partially responding to counterarguments to the writer's position
- Show clear understanding of the persuasive purpose of the task by taking a position on the specific issue in the prompt and offering a critical context for discussion.
- Show understanding of the complexity of the issue in the prompt by doing the following:
 - Examining different perspectives
 - Evaluating implications or complications of the issue
 - Posing and fully discussing counterarguments to the writer's position

W2 Focusing on the Topic

- Maintain a focus on the general topic in the prompt through most of the essay.
- Maintain a focus on the general topic in the prompt throughout the essay.
- Maintain a focus on the general topic in the prompt throughout the essay, and attempt a focus on the specific issue in the prompt.
- Present a thesis that establishes focus on the topic.
- Maintain a focus on discussion of the specific topic and issue in the prompt throughout the essay.
- Present a thesis that establishes a focus on the writer's position on the issue.
- Maintain a clear focus on discussion of the specific topic and issue in the prompt throughout the essay.
- Present a critical thesis that clearly establishes the focus on the writer's position on the issue.

W3 Developing a Position

- Offer a little development, with one or two ideas; if examples are given, they are general and may not be clearly relevant; resort often to merely repeating ideas.
- Show little or no movement between general and specific ideas and examples.
- Offer limited development of ideas using a few general examples; resort sometimes to merely repeating ideas.
- Show little movement between general and specific ideas and examples.
- Develop ideas by using some specific reasons, details, and examples.
- Show some movement between general and specific ideas and examples.
- Develop most ideas fully, using some specific and relevant reasons, details, and examples.
- Show clear movement between general and specific ideas and examples.
- Develop several ideas fully, using specific and relevant reasons, details, and examples.
- Show effective movement between general and specific ideas and examples.

W4 Organizing Ideas

- Provide a discernible organization with some logical grouping of ideas in parts of the essay.
- Use a few simple and obvious transitions.
- Present a discernible, though minimally developed, introduction and conclusion.
- Provide a simple organization with logical grouping of ideas in parts of the essay.
- Use some simple and obvious transitional words, though they may at times be inappropriate or misleading.
- Present a discernible, though underdeveloped, introduction and conclusion.
- Provide an adequate but simple organization with logical grouping of ideas in parts of the essay but with little evidence of logical progression of ideas.
- Use some simple and obvious, but appropriate, transitional words and phrases.
- Present a discernible introduction and conclusion with a little development.
- Provide unity and coherence throughout the essay, sometimes with a logical progression of ideas.
- Use relevant, though at times simple and obvious, transitional words and phrases to convey logical relationships between ideas.
- Present a somewhat developed introduction and conclusion.

- Provide unity and coherence throughout the essay, often with a logical progression of ideas.
- Use relevant transitional words, phrases, and sentences to convey logical relationships between ideas.
- Present a well-developed introduction and conclusion.

W5 Using Language

- Show limited control of language by doing the following:
 - Correctly employing some of the conventions of standard English grammar, usage, and mechanics but with distracting errors that sometimes significantly impede understanding
 - Using simple vocabulary
 - Using simple sentence structure
 - Correctly employing some of the conventions of standard English grammar, usage, and mechanics but with distracting errors that sometimes impede understanding
 - Using simple but appropriate vocabulary
 - Using a little sentence variety, though most sentences are simple in structure
 - Correctly employing many of the conventions of standard English grammar, usage, and mechanics but with some distracting errors that may occasionally impede understanding
 - Using appropriate vocabulary
 - Using some varied kinds of sentence structures to vary pace
 - Correctly employing most conventions of standard English grammar, usage, and mechanics with a few distracting errors but none that impede understanding
 - Using some precise and varied vocabulary
 - Using several kinds of sentence structures to vary pace and to support meaning
 - Correctly employing most conventions of standard English grammar, usage, and mechanics with just a few, if any, errors
 - Using precise and varied vocabulary
 - Using a variety of kinds of sentence structures to vary pace and to support meaning

Appendix E: Pathway Content Standards

AGRICULTURE, FOOD, AND NATURAL RESOURCES (AFNR) PATHWAY CONTENT STANDARDS AND PERFORMANCE ELEMENTS

The AFNR Pathway Content Standards and Performance Elements are adapted from *National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards*. Reprinted with permission from the National Council for Agricultural Education, 1410 King Street, Suite 400, Alexandria, VA 22314. (800) 772-0939. Copyright © 2009. A complete copy of the National Standards can be downloaded from the Team Ag Ed Learning Center at <https://aged.learn.com>.

AGRIBUSINESS SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of principles and techniques for the development and management of agribusiness systems.

- ABS.01. Utilize economic principles to establish and manage an AFNR enterprise.**
 - ABS.01.01. Apply principles of capitalism in the business environment.
 - ABS.01.02. Apply principles of entrepreneurship in businesses.
- ABS.02. Utilize appropriate management planning principles in AFNR business enterprises.**
 - ABS.02.01. Compose and analyze a business plan for an enterprise.
 - ABS.02.02. Read, interpret, evaluate, and write a mission statement to guide business goals, objectives, and resource allocation.
 - ABS.02.03. Apply appropriate management skills to organize a business.
 - ABS.02.04. Recruit, train, and retain appropriate and productive human resources for business.
- ABS.03. Utilize record keeping to accomplish AFNR business objectives while complying with laws and regulations.**
 - ABS.03.01. Prepare and maintain all files needed to accomplish effective record keeping.
 - ABS.03.02. Implement appropriate inventory management practices.
- ABS.04. Apply generally accepted accounting principles and skills to manage cash budgets, credit budgets, and credit for AFNR businesses.**
 - ABS.04.01. Use accounting fundamentals to accomplish dependable bookkeeping and fiscal management.
- ABS.05. Assess accomplishment of goals and objectives by an AFNR business.**
 - ABS.05.01. Maintain and interpret financial information (income statements, balance sheets, inventory, purchase orders, accounts receivable, and cash-flow analyses) for businesses.
- ABS.06. Use industry-accepted marketing practices to accomplish AFNR business objectives.**
 - ABS.06.01. Conduct appropriate market and marketing research.
 - ABS.06.02. Develop a marketing plan.
 - ABS.06.03. Develop strategies for marketing plan implementation.
 - ABS.06.04. Develop specific tactics to market AFNR products and services.
- ABS.07. Create a production system plan.**
 - ABS.07.01. Prepare a step-by-step production plan that identifies needed resources.
 - ABS.07.02. Develop a production and operational plan.
 - ABS.07.03. Utilize appropriate techniques to determine the most likely strengths, weaknesses, and inconsistencies in a business plan, and relate these to risk management strategies.
 - ABS.07.04. Manage risk and uncertainty.

ANIMAL SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and practices to the production and management of animals.

AS.01. Examine the components, historical development, global implications, and future trends of the animal systems industry.

AS.01.01. Evaluate the development and implications of animal origin, domestication, and distribution.

AS.02. Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics.

AS.02.01. Classify animals according to hierarchical taxonomy and agricultural use.

AS.02.02. Apply principles of comparative anatomy and physiology to uses within various animal systems.

AS.02.03. Select animals for specific purposes and maximum performance based on anatomy and physiology.

AS.03. Provide for the proper health care of animals.

AS.03.01. Prescribe and implement a prevention and treatment program for animal diseases, parasites, and other disorders.

AS.03.02. Provide for the biosecurity of agricultural animals and production facilities.

AS.04. Apply principles of animal nutrition to ensure the proper growth, development, reproduction, and economic production of animals.

AS.04.01. Formulate feed rations to provide for the nutritional needs of animals.

AS.04.02. Prescribe and administer animal feed additives and growth promotants in animal production.

AS.05. Evaluate and select animals based on scientific principles of animal production.

AS.05.01. Evaluate the male and female reproductive systems in selecting animals.

AS.05.02. Evaluate animals for breeding readiness and soundness.

AS.05.03. Apply scientific principles in the selection and breeding of animals.

AS.06. Prepare and implement animal handling procedures for the safety of animals, producers and consumers of animal products.

AS.06.01. Demonstrate safe animal handling and management techniques.

AS.06.02. Implement procedures to ensure that animal products are safe.

AS.07. Select animal facilities and equipment that provide for the safe and efficient production, housing, and handling of animals.

AS.07.01. Design animal housing, equipment, and handling facilities for the major systems of animal production.

AS.07.02. Comply with government regulations and safety standards for facilities used in animal production.

AS.08. Analyze environmental factors associated with animal production.

AS.08.01. Reduce the effects of animal production on the environment.

AS.08.02. Evaluate the effects of environmental conditions on animals.

BIOTECHNOLOGY

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to biotechnology in agriculture.

- BS.01. Recognize the historical, social, cultural, and potential applications of biotechnology.**
 - BS.01.01. Distinguish major innovators, historical developments, and potential applications of biotechnology in agriculture.
 - BS.01.02. Determine regulatory issues, and identify agencies associated with biotechnology.
 - BS.01.03. Analyze the ethical, legal, social, and cultural issues relating to biotechnology.
- BS.02 Demonstrate laboratory skills as applied to biotechnology.**
 - BS.02.01. Maintain and interpret biotechnology laboratory records.
 - BS.02.02. Operate biotechnology laboratory equipment according to standard procedures.
 - BS.02.03. Demonstrate proper laboratory procedures using biological materials.
 - BS.02.04. Safely manage biological materials, chemicals, and wastes used in the laboratory.
 - BS.02.05. Perform microbiology, molecular biology, enzymology, and immunology procedures.
- BS.03. Demonstrate the application of biotechnology to Agriculture, Food, and Natural Resources (AFNR).**
 - BS.03.01. Evaluate the application of genetic engineering to improve products of AFNR systems.
 - BS.03.02. Perform biotechnology processes used in AFNR systems.
 - BS.03.03. Use biotechnology to monitor and evaluate procedures performed in AFNR systems.

ENVIRONMENTAL SERVICE SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the management of environmental service systems.

- ESS.01. Use analytical procedures to plan and evaluate environmental service systems.**
 - ESS.01.01. Analyze and interpret samples.
- ESS.02. Assess the impact of policies and regulations on environmental service systems.**
 - ESS.02.01. Interpret laws affecting environmental service systems.
- ESS.03. Apply scientific principles to environmental service systems.**
 - ESS.03.01. Apply meteorology principles to environmental service systems.
 - ESS.03.02. Apply soil science principles to environmental service systems.
 - ESS.03.03. Apply hydrology principles to environmental service systems.
 - ESS.03.04. Apply best management techniques associated with the properties, classifications, and functions of wetlands.
 - ESS.03.05. Apply chemistry principles to environmental service systems.
 - ESS.03.06. Apply microbiology principles to environmental service systems.
- ESS.04. Operate environmental service systems to manage a facility environment.**
 - ESS.04.01. Use pollution control measures to maintain a safe facility environment.
 - ESS.04.02. Manage safe disposal of all categories of solid waste.
 - ESS.04.03. Apply the principles of public drinking water treatment operations to ensure safe water at a facility.
 - ESS.04.04. Apply principles of wastewater treatment to manage wastewater disposal in keeping with rules and regulations.
 - ESS.04.05. Manage hazardous materials to assure a safe facility and to comply with applicable regulations.

ESS.05. Examine the relationships between energy sources and environmental service systems.

ESS.05.01. Compare and contrast the impact of conventional and alternative energy sources on the environment.

ESS.06. Use tools, equipment, machinery, and technology to accomplish tasks in environmental service systems.

ESS.06.01. Use technological and mathematical tools to map land, facilities, and infrastructure.

ESS.06.02. Maintain tools, equipment, and machinery in safe working order for tasks in environmental service systems.

FOOD PRODUCTS AND PROCESSING SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles, practices, and techniques in the processing, storage, and development of food products.

FPP.01. Examine components of the food industry and historical development of food products and processing.

FPP.01.01. Evaluate the significance and implications of changes and trends in the food products and processing industry.

FPP.01.02. Work effectively with industry organizations, groups, and regulatory agencies affecting the food products and processing industry.

FPP.02. Apply safety principles, recommended equipment, and facility management techniques to the food products and processing industry.

FPP.02.01. Manage operational procedures, and create equipment and facility maintenance plans.

FPP.02.02. Implement Hazard Analysis and Critical Control Point (HACCP) procedures to establish operating parameters.

FPP.02.03. Apply safety and sanitation procedures in the handling, processing, and storing of food products.

FPP.02.04. Demonstrate worker safety procedures with food product and processing equipment and facilities.

FPP.03. Apply principles of science to the food products and processing industry.

FPP.03.01. Apply principles of science to food processing to provide a safe, wholesome, and nutritious food supply.

FPP.04. Select and process food products for storage, distribution, and consumption.

FPP.04.01. Utilize harvesting, selection, and inspection techniques to obtain quality food products for processing.

FPP.04.02. Evaluate, grade, and classify processed food products.

FPP.04.03. Process, preserve, package, and present food and food products for sale and distribution.

NATURAL RESOURCE SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the management of natural resources.

NRS.01. Explain interrelationships between natural resources and humans necessary to conduct management activities in natural environments.

NRS.01.01. Apply knowledge of natural resource components to the management of natural resource systems.

- NRS01.02. Classify natural resources.
- NRS.02. Apply scientific principles to natural resource management activities.**
 - NRS.02.01. Develop a safety plan for work with natural resources.
 - NRS.02.02. Demonstrate cartographic skills to aid in developing, implementing, and evaluating natural resource management plans.
 - NRS.02.03. Measure and survey natural resource status to obtain planning data.
 - NRS.02.04. Demonstrate natural resource enhancement techniques.
 - NRS.02.05. Interpret laws related to natural resource management and protection.
 - NRS.02.06. Apply ecological concepts and principles to natural resource systems.
- NRS.03. Apply knowledge of natural resources to production and processing industries.**
 - NRS.03.01. Produce, harvest, process, and use natural resource products.
- NRS.04. Demonstrate techniques used to protect natural resources.**
 - NRS.04.01. Manage fires in natural resource systems.
 - NRS.04.02. Diagnose plant and wildlife diseases, and follow protocol to prevent their spread.
 - NRS.04.03. Manage insect infestations of natural resources.
- NRS.05. Use effective methods and venues to communicate natural resource processes to the public.**
 - NRS.05.01. Communicate natural resource information to the public.

PLANT SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the production and management of plants.

- PS.01. Apply knowledge of plant classification, plant anatomy, and plant physiology to the production and management of plants.**
 - PS.01.01. Classify agricultural plants according to taxonomy systems.
 - PS.01.02. Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.
 - PS.01.03. Apply knowledge of plant physiology and energy conversion to plant systems.
- PS.02. Prepare and implement a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.**
 - PS.02.01. Determine the influence of environmental factors on plant growth.
 - PS.02.02. Prepare growing media for use in plant systems.
 - PS.02.03. Develop and implement a fertilization plan for specific plants or crops.
- PS.03. Propagate, culture, and harvest plants.**
 - PS.03.01. Demonstrate plant propagation techniques.
 - PS.03.02. Develop and implement a plant management plan for crop production.
 - PS.03.03. Develop and implement a plan for integrated pest management.
 - PS.03.04. Apply principles and practices of sustainable agriculture to plant production.
 - PS.03.05. Harvest, handle, and store crops.
- PS.04. Employ elements of design to enhance an environment.**
 - PS.04.01. Create designs using plants.

POWER, STRUCTURAL AND TECHNICAL SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of principles and techniques for the development and management of power, structural, and technical systems.

- PST.01. Use physical science principles and engineering applications with power, structural, and technical systems to solve problems and improve performance.**
- PST.01.01. Select energy sources in power generation appropriate to the situation.
 - PST.01.02. Apply physical science laws and principles to identify, classify, and use lubricants.
 - PST.01.03. Identify and use hand and power tools and equipment for service, construction, and fabrication.
- PST.02. Design, operate, and maintain mechanical equipment, structures, biological systems, land treatment, power, and technology.**
- PST.02.01. Perform service routines to maintain power units and equipment.
 - PST.02.02. Operate, service, and diagnose the condition of power units and equipment.
- PST.03. Service and repair mechanical equipment and power systems.**
- PST.03.01. Troubleshoot and repair internal combustion engines.
 - PST.03.02. Utilize manufacturers' guidelines to service and repair the power transmission systems of equipment.
 - PST.03.03. Service and repair hydraulic and pneumatic systems.
 - PST.03.04. Troubleshoot and service electrical systems.
 - PST.03.05. Service vehicle heating and air-conditioning systems.
 - PST.03.06. Service and repair steering, suspension, traction, and vehicle performance systems.
- PST.04. Plan, build and maintain agricultural structures.**
- PST.04.01. Create sketches and plans of agricultural structures.
 - PST.04.02. Apply structural plans, specifications, and building codes.
 - PST.04.03. Examine structural requirements for materials and procedures, and estimate construction cost.
 - PST.04.05. Follow architectural and mechanical plans to construct and/or repair equipment, buildings, and facilities.
- PST.05. Apply technology principles in the use of agricultural technical systems.**
- PST.05.01. Use instruments and meters to test and monitor electrical and electronic processes.
 - PST.05.02. Prepare and/or use electrical drawings to design, install, and troubleshoot control systems.
 - PST.05.03. Use geospatial technologies in agricultural applications.

Appendix F:

National Educational Technology Standards for Students

- T1** Creativity and Innovation
- T2** Communication and Collaboration
- T3** Research and Information Fluency
- T4** Critical Thinking, Problem Solving, and Decision Making
- T5** Digital Citizenship
- T6** Technology Operations and Concepts

T1 Creativity and Innovation

Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students do the following:

- a. Apply existing knowledge to generate new ideas, products, or processes.
- b. Create original works as a means of personal or group expression.
- c. Use models and simulations to explore complex systems and issues.
- d. Identify trends and forecast possibilities.

T2 Communication and Collaboration

Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students do the following:

- a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media.
- b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats.
- c. Develop cultural understanding and global awareness by engaging with learners of other cultures.
- d. Contribute to project teams to produce original works or solve problems.

T3 Research and Information Fluency

Students apply digital tools to gather, evaluate, and use information. Students do the following:

- a. Plan strategies to guide inquiry.
- b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
- c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks.
- d. Process data and report results.

T4 Critical Thinking, Problem Solving, and Decision Making

Students use critical-thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. Students do the following:

- a. Identify and define authentic problems and significant questions for investigation.
- b. Plan and manage activities to develop a solution or complete a project.
- c. Collect and analyze data to identify solutions and/or make informed decisions.
- d. Use multiple processes and diverse perspectives to explore alternative solutions.

T5 Digital Citizenship

Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior. Students do the following:

- a. Advocate and practice safe, legal, and responsible use of information and technology.
- b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity.
- c. Demonstrate personal responsibility for lifelong learning.

- d. Exhibit leadership for digital citizenship.

T6 Technology Operations and Concepts

Students demonstrate a sound understanding of technology concepts, systems, and operations. Students do the following:

- a. Understand and use technology systems.
- b. Select and use applications effectively and productively.
- c. Troubleshoot systems and applications.
- d. Transfer current knowledge to learning of new technologies.

Science of Agricultural Plants

Program CIP: 01.1101

Ordering Information

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Finally, standards in the *Science of Agricultural Environment Curriculum Framework and Supporting Materials* are based on the following:

National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards

The National AFNR Career Cluster Content Standards were developed by the National Council on Agricultural Education to serve as a guide for what students should know or be able to do through a study of agriculture in grades 9–12 and 2-year postsecondary programs. The standards were extensively researched and reviewed by leaders in the agricultural industry, secondary and postsecondary instructors, and university specialists. The standards consist of a pathway content standard for each of the eight career pathways. For each content standard, performance elements representing major topic areas with accompanying performance indicators were developed. Measurements of assessment of the performance elements and performance indicators were developed at the basic, intermediate, and advanced levels. A complete copy of the standards can be accessed at <https://aged.learn.com>. The National AFNR Career Cluster Content Standards are copyrighted to the National Council for Agricultural Education and are used by permission.

Applied Academic Credit Benchmarks

Mississippi Department of Education 2010 Mississippi Science Framework

21st Century Skills and Information and Communication Technologies Literacy Standards

In defining 21st century learning, the Partnership for 21st Century Skills has embraced five content and skill areas that represent the essential knowledge for the 21st century: global awareness; civic engagement; financial, economic, and business literacy; learning skills that encompass problem-solving, critical-thinking, and self-directional skills; and Information and Communication Technology (ICT) literacy.

National Educational Technology Standards for Students

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ACT College Readiness Standards



The College Readiness Standards are sets of statements intended to help students understand what is expected of them in preparation for the ACT. These standards are integrated into teaching and assessment strategies throughout the curriculum framework.

Preface

Secondary vocational–technical education programs in Mississippi are faced with many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing true learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, Mississippi Code of 1972, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, ch. 487, §14; Laws, 1991, ch. 423, §1; Laws, 1992, ch. 519, §4 eff. from and after July 1, 1992; Carl D. Perkins Vocational Education Act IV, 2007; and No Child Left Behind Act of 2001).

Research Synopsis

Agricultural and Environmental Science and Technology Research

The Agricultural Sciences Career Cluster covers the broad field of occupations related to the production and use of plants and animals for food, fiber, aesthetic, and environmental purposes. According to the U.S. Department of Labor, the growing interest in worldwide standardization of agricultural equipment should result in increased employment of agricultural engineers. Job opportunities should also result from the increasing demand for agricultural products, the continued efforts for more efficient agricultural production, and the increasing emphasis on the conservation of resources. The sales of food and fiber products amounted to 5.8 billion dollars in 2005 according to USDA statistics. Additionally, the Mississippi Department of Agriculture and Commerce estimates that 30% of the state's workforce is employed in jobs relating directly or indirectly to agriculture.

Agriculture and Environmental Science and Technology will target careers at the professional and technical levels in agriculture. Students enrolled in these courses should be better prepared to pursue degrees at the community college and 4-year college levels.

Employment Projections

Data for this synopsis were compiled from employment projections prepared by the Mississippi Department of Employment Security and the U. S. Department of Labor. The National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards developed by the National Council for Agricultural Education and scholarly research articles were also reviewed as a guide for the redesign of the Agriculture and Natural Resources Cluster.

Industry Job Data – Employment Projections 2006 to 2016 for Mississippi

Note: Compiled by Mississippi Department of Employment Security and Labor Market Information Department

Occupational title	Employment, 2006	Projected employment, 2016	Change 2006– 2016		Total Projected Avg. Annual Job Openings
			Number	Percent	
Animal Breeders	9,770	9,870	100	1.0	165
Agricultural and Food Science Technicians	260	310	50	19.2	10
Agricultural Equipment Operators	1,090	1,190	100	9.2	40
Agricultural Sciences Teachers, Postsecondary	190	240	50	26.3	20

Occupational title	Employment, 2006	Projected employment, 2016	Change 2006– 2016		Total Projected Avg. Annual Job Openings
Conservation Scientists	790	890	100	12.7	30
Custodial and Caretaking Supervisors and Workers	46,920	54,110	7,190	15.3	2,320
Environmental Engineers	270	320	50	18.5	10
Environmental Engineering Technicians	50	100	50	100.0	0
Environmental Scientists and Specialists	420	470	50	11.9	10
Environmental Science and Protection Technicians	100	150	50	50.0	5
Farmworkers and Laborers, Crop, Nursery, and Greenhouse	5,160	5,810	650	12.6	225
Farmworkers, Farm and Ranch Animals	1,400	1,550	150	10.7	65
First-Line Supervisors / Managers of Farming, Fishing, and Forestry Workers	1,390	1,540	150	10.8	40
Food Processing Workers	14,920	18,320	3,400	22.8	680
Foresters	470	520	50	10.6	20
Forest and Conservation Technicians	390	440	50	12.8	15
Forest and Conservation Workers	880	980	100	11.4	30
Grounds Maintenance Workers	10,310	11,810	1,500	14.5	375

Occupational title	Employment, 2006	Projected employment, 2016	Change 2006– 2016		Total Projected Avg. Annual Job Openings
Logging Equipment Operators	3,910	4,210	300	7.7	100
Purchasing Agents and Buyers, Farm Products	80	130	50	62.5	5
Soil and Plant Scientists	430	480	50	11.6	10
Veterinarians	540	640	100	18.5	25
Veterinary Assistants and Laboratory Animal Caretakers	690	890	200	29.0	35
Veterinary Technologists and Technicians	440	540	100	22.7	15

Note: Data was retrieved from the Mississippi Department of Employment Security (2009).

Occupational Employment and Wage Estimates for Mississippi May 2006

Occupation	Employment, 2006	Avg. Hourly Wage	Average Annual Wage
Farmers and Ranchers	2,760	\$17.85	\$43,560.00
Farm Managers and Supervisors	2,640	\$23.23	\$48,360.00
Logging Equipment Operators	3,890	\$14.28	\$30,880.00
Landscaping Supervisors	2,990	\$17.93	\$40,240.00
Landscape Workers	8,560	\$10.22	\$23,010.00
Agricultural Scientists/Technicians	29,680	\$18.33	\$38,555.00

Note: Data was retrieved from the U.S. Bureau of Labor Statistics (2009).

Curriculum Content

In compiling the research for the Agricultural Sciences cluster, face-to-face and telephone interviews were conducted with representatives of agricultural employers and agricultural agencies. The following comments summarize the results of these interviews:

- While opportunities to enter farming on a full-scale commercial enterprise basis are limited, opportunities do exist and are expected to increase as current operators retire and begin to rent their land to companies and individuals. Opportunities are also expected to increase for consultants and technicians who support production enterprises by providing specialized services to producers.
- There was general agreement among all persons interviewed that all students need to better develop skills related to leadership, teamwork, communication, and work ethics, habits, and values. All respondents also indicated that a basic knowledge of economics, recordkeeping, budgeting, and business decision-making skills will be essential in today's "lean" environment.
- Opportunities for high school graduates in all fields of agriculture are limited to the basic entry-level positions. More abundant opportunities exist for students who have received advanced training at the community college or 4-year college.
- All respondents agreed that a common core of knowledge and skills existed across all three major pathways related to the following themes: leadership and personal development; principles of plant science and production; principles of soil science and air and water quality; principles of agricultural power, structures, and technology; and principles of economics and management. A sixth theme, principles of animal science and production, exists for students in the AEST and Agriculture and Natural Resources pathway.

- All respondents agreed that students in all three pathways should be exposed to the process by which agricultural products are grown, managed, harvested, processed, and marketed. As students study this process, they should be also exposed to the different careers that are involved in all segments of the industry.
- The role of federal and state agencies including the USDA, OSHA, FDA, EPA, and so forth should be discussed. Also, the role of agricultural organizations such as the Poultry Association, Nurseryman's Association, and Farm Bureau needs to be investigated.

Results of the survey of employers and agricultural agency representatives show that there are six major themes or topics that apply to a majority of occupations in the agriculture and natural resources area. These themes and their respective pathways are listed below.

Theme	AEST	Ag and Nat. Resources	Horticulture/Landscape
Principles of Leadership, Personal Development, and Career Success	X	X	X
Principles of Plant Science and Production	X	X	X
Principles of Animal Science and Production	X	X	
Principles of Soil, Water, and Air Quality, Conservation, and Use	X	X	X
Principles of Agricultural Power, Structures, and Technological Systems	X	X	X
Principles of Management, Economics, and Marketing	X	X	X

Executive Summary

Program Description

Science of Agricultural Plants is an advanced level course for the Agricultural and Environmental Science and Technology Program. The course focuses on the development of skills and knowledge related to the production of plants for food, fiber, ornamental, and other purposes. Instruction is provided in the basic principles of plant science as well as cultural practices and the use of technology to efficiently and effectively meet consumer needs. Plant growing structures, plant classification, growth, propagation, culture, pests, harvesting, and marketing are included. The course carries 1 Carnegie unit of credit that may count as an elective credit for high school graduation. Students may also earn an additional ½ Carnegie unit by completing a successful supervised agricultural experience program.

Industry Certification

No national industry recognized certifications are known to exist at this time in the field of Agriscience. Competencies and suggested performance indicators in the *Science of Agricultural Plants* course have been correlated, however to the National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards, which have been reviewed and endorsed at the national level by the National Council on Agricultural Education.

Articulation

There is no articulation for this course at this time.

Assessment

Students will be assessed using the AEST MS-CPAS2 test. All students will be tested on *Concepts of Agriscience* and the second course that they may take in their chosen path of study. The second course may be one of the following:

- Science of Agricultural Animals
- Science of Agricultural Environment
- Science of Agricultural Mechanization
- Science of Agricultural Plants

The MS-CPAS2 blueprint can be found at <http://redesign.rcu.msstate.edu/curriculum/>. If there are questions regarding assessment of this program, please contact the instructional design specialist at the Research and Curriculum Unit at 662.325.2510.

Student Prerequisites

Prior to enrolling in *Science of Agricultural Plants*, a student must have completed *Concepts of Agriscience*. *Science of Agricultural Plants* may be offered to students in grades 10–12. It is recommended that students enrolling in the course possess at least a C average in other science courses and a TABE reading score at the eighth grade level or higher.

Proposed Applied Academic Credit

The academic credit is still pending for this curriculum.

Licensure Requirements

A 992 endorsement is currently required to teach any course in the Agricultural and Environmental Science and Technology Program. In order to receive a 992 endorsement, applicants must do the following:

1. Hold a valid Mississippi Educator License with endorsement #301 – Vocational Agriculture Education Programs or #302 – Agriculture.
2. Possess a baccalaureate degree in an agricultural subject area.
3. Complete the 3 semester credit hour course devoted to the teaching of Agricultural and Environmental Science and Technology courses. The course, AIS 6113 - Methods of Teaching Agriscience, is currently offered by Mississippi State University.
4. Applicant must enroll immediately in the Vocational Instructor Preparation (VIP) or the Redesign Education Program (REP).
5. Applicant must complete the individualized Professional Development Plan (PDP) requirements of the VIP or REP prior to the expiration date of the 3-year vocational license.
6. Applicant must successfully complete an MDE-approved computer literacy certification exam.
7. Applicant must successfully complete a certification for an online learning workshop, module, or course that is approved by the MDE.

Note: If the applicant meets all requirements listed above, that applicant will be issued a (992) endorsement—a 5-year license. If the applicant does not meet **all** requirements, the applicant will be issued a 3-year endorsement (license), and all requirements stated above must be satisfied prior to the ending date of that license.

Professional Learning

The professional learning itinerary for the middle school or individual pathways can be found at <http://redesign.rcu.msstate.edu>. If you have specific questions about the content of each training session provided, please contact the Research and Curriculum Unit at 662.325.2510, and ask for the Professional Learning Specialist.

Course Outlines

Course Description: Science of Agricultural Plants is a course that develops competencies related to the production of plants for food, fiber, ornamental, and other purposes. It includes instruction in the basic principles of plant science as well as cultural practices and the use of technology to efficiently and effectively meet consumer needs. Plant growing structures, plant classification, growth, propagation, culture, pests, harvesting, and marketing are included.

Science of Agricultural Plants (One Carnegie Unit) - Course Code: 991003

Unit	Title	Hours
1	Introduction to Agricultural Plants*	10
2	Supervised Experience in Agriculture*	5
3	Plant Growth and Nutrition	15
4	Plant Classification and Physiology	15
5	Plant Reproduction and Propagation	20
6	Plant Growing Structures	10
7	Cultural and Harvesting Practices	15
8	Pest Management	10
9	Marketing in Plant Production	5
	Total Hours	105

* Note: These units are not tested by MS-CPAS2.

Using This Document

Unit Number and Title

Suggested Time on Task

An estimated number of clock hours of instruction that should be required to teach the competencies and objectives of the unit. A minimum of 140 hours of instruction is required for each Carnegie unit credit. The curriculum framework should account for approximately 75–80% of the time in the course.

Competencies and Suggested Objectives

A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies. The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.

Suggested Teaching Strategies

This section of each unit indicates research-based strategies that can be used to enable students to master each competency. Emphasis has been placed on strategies that reflect active learning methodologies. Teachers should feel free to modify or enhance these suggestions based on needs of their students and resources available in order to provide optimum learning experiences for their students.

Suggested Assessment Strategies

This section indicates research-based strategies that can be used to measure student mastery. Examples of suggested strategies could include rubrics, class participation, reflection, and journaling. Again, teachers should feel free to modify or enhance these suggested assessment strategies based on local needs and resources.

Integrated Academic Topics, 21st Century Skills and Information and Communication Technology Literacy Standards, ACT College Readiness Standards, and Technology Standards for Students

This section identifies related academic topics as required in the Subject Area Testing Program (SATP) in Algebra I, Biology I, English II, and U.S. History from 1877, which are integrated into the content of the unit. Research-based teaching strategies also incorporate ACT College Readiness standards. This section also identifies the 21st Century Skills and Information and Communication Technology Literacy skills. In addition, national technology standards for students associated with the competencies and suggested objectives for the unit are also identified.

References

A list of suggested references is provided for each unit. The list includes some of the primary instructional resources that may be used to teach the competencies and suggested objectives. Again, these resources are suggested, and the list may be modified or enhanced based on needs and abilities of students and on available resources.

Science of Agricultural Plants

Unit 1: Introduction to Agricultural Plants

10 Hours

Competency 1: Examine how plants are used to meet human and environmental needs. PS.01, BIO1, BIO1 3, BO 4, BO5

Suggested Enduring Understandings

1. Plants are renewable resources that meet essential human needs by providing a wide variety of products that provide food, clothing, and shelter.
2. Plants contribute to the environment and quality of life by converting sunlight into useable forms of energy, by converting greenhouse gases such as carbon dioxide into oxygen and by protecting and improving the soil and water resources.
3. Proper sanitation and handling measures for plant products reduce the chances of foodborne illnesses being transmitted to consumers.

Suggested Essential Questions

1. How do plants contribute to meeting essential human needs?
2. How do plants contribute to the environment and quality of life on earth?
3. How does sanitation affect the safety of plant products?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Examine the importance of plants in meeting essential human needs for food, clothing, shelter, and energy. (DOK 2)	a. Have students read Chapter 1 from the text (Biondo & Lee, 2003). Have them brainstorm ways in which plants affect their daily lives and contribute to their well-being. Compare the use of plants in the United States to their uses in other countries. Have students keep a log of plant products that they come in contact with during the week and prepare a chart showing which parts of each species are used in the products. Students should use the <i>Plant Use in Daily Life Assignment (1.1)</i> . CS 3, CS4, T6, R5	a. Evaluate the plant contact log for accuracy and completeness.
b. Describe how plants contribute to the environment and quality of life. (DOK 1)	b. Lead a class discussion on how plants contribute to the enhancement of the environment in general through processes such as photosynthesis and transpiration and through protection of the soil and water supply. CS3, CS4	b. Evaluate student understanding through a paper and pencil test.

Competency 2: Examine plant production enterprises. PS.02, BO 4

Suggested Enduring Understandings

1. The production of field, foliage, and fiber

Suggested Essential Questions

1. What general skills and knowledge are

plants requires knowledge of planting and cultural practices, production, sanitation, costs and returns, and marketing. 2. Ornamental and landscaping crops are grown as bedding plants, pot plants, foliage or flowering plants, container plants, and shrubs or trees. 3. Trees provide a number of forest products that are used in manufacturing, construction, paper making, chemical, and food products industries.	needed to engage in plant production enterprises? 2. What are the different types of plants grown for ornamental purposes? 3. What products are produced from trees and forests?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify different field and forage crops used for food and fiber production, and explore their production practices. (DOK 1)	a. Assign each student complete a <i>Plant Production Fact Sheet (1.2)</i> on a specific field, forage, or fiber plant, and have them conduct research on that area. The fact sheet should include incorporating a picture of the crop, planting practices, cultural techniques, estimated costs and returns, and marketing practices. Grade and correct the fact sheet, and post to the class Blackboard site, or make copies and provide to all students for study. ^{CS} 1, CS2, CS4, T1, T2, T3, T4, T6, R1, R2, R5, W2, W4, W5	a. Evaluate student fact sheets for accuracy and completeness.
b. Relate the importance of sanitation to plant production, animal and human health, and Hazard Analysis and Critical Control Point (HACCP) programs. (DOK 2)	b. Introduce the competency by stating that it is estimated that foodborne diseases cause approximately 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths in the United States each year. Known pathogens account for an estimated 14 million illnesses, 60,000 hospitalizations, and 1,800 deaths. Have students review the HACCP Manual for Chicago Schools . Assign students a section of the manual to read and summarize in a one-page fact sheet that applies to plant production and pest control in agriculture. Have students present their fact sheets and discuss the most important points. List major points on the LCD projector, and have students transcribe into their electronic notebooks or journals. ^{CS1, CS2, CS4, CS5, T1, T2, T3, T4, T6,}	b. Use the <i>HACCP Fact Sheet Rubric (1.7)</i> to evaluate student performance on this indicator.

R1, R2, R3, R4, R5, W1, W2, W4		
c. Identify and describe different types of ornamental and landscaping crops. (DOK 1)	c. Lead a classroom discussion on the different types of ornamental and landscaping crops (bedding plants, foliage plants, flowering plants, container plants, shrubs, trees, etc.). List important points concerning each type on the whiteboard or LCD projector, and have students enter these points into their electronic journals or notebooks. CS3, T2, T3, T6, R4, R5, W4, W5	c. Use a written test to evaluate student understanding on this indicator.
d. Explore the different types of forest products. (DOK 1)	d. Invite a representative of the forest industry to speak to the class on the variety of products that come from the forest (hardwood and softwood lumber, pulp, chips, veneer, chemicals, etc.). Follow up with a class discussion to make sure all major points are listed. Have students take notes and record major points in their electronic journals or notebooks. Follow up with a class discussion to make sure all major points are listed. CS1, CS4, T6, W4, W5	d. Evaluate student notebooks or journals for accuracy and completeness.

Competency 3: Demonstrate career and leadership skills required for employment in the plant industry.

Suggested Enduring Understandings

1. Most careers in the plant industry require knowledge of plant anatomy and physiology, planting and other cultural practices, as well as marketing, and management of plant enterprises.
2. In addition to technical skills in plant production, leadership, human relations, and general workplace skills are essential for success and advancement in a career.

Suggested Essential Questions

1. What different skill areas are needed for plant production careers?
2. What leadership, human relations, and general workplace skills are needed?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify and explore careers in the plant production industry including major skill areas required by employees. (DOK 2)	a. Provide a list of career areas in the plant industry. Have each student select an area of personal interest and prepare a PowerPoint presentation on the area. The presentation should include information on major skill areas, educational requirements, salary, specific skills, and occupational outlook. CS2, CS4, T2, T3, T4, T6, R1, R2,	a. Evaluate student PowerPoint for accuracy and completeness.

R4, R5, W4, W5

b. Demonstrate leadership, human relations, and workplace skills. (DOK 2)	b. Provide students with the listing of <i>21st Century Life and Career Skills (1.3)</i> found in this unit. Lead students in a discussion of how these skills apply to their current career as students and will apply to their career success after school. Provide students with a copy of the rubric that will be used to evaluate each student's demonstration of life and career skills. Have students self-evaluate their current scores on this rubric and explain that they will be periodically (at least once a grading period) graded on their ability to demonstrate these skills. CS1, CS2, CS3, CS4, CS5, T6	b. Use the <i>Rubric for Evaluating 21st Century Life and Career Skills (1.4)</i> to evaluate student attainment. This is an ongoing assessment throughout the year.

Competency 4: Demonstrate general safety precautions for the laboratory and greenhouse. BO 1, ES 1

Suggested Enduring Understandings

1. All workers must fully understand and comply with procedures for maintaining a safe and orderly workplace such as chemical safety, use of personal protective equipment, and general safety rules and policies.
2. Each person is responsible for promoting safety through his or her actions.
3. Each person must know the location of all safety devices, storage areas, exits, power controls, and environmental controls.
4. Each person must know and understand safety precautions for the handling, storage, use, and disposal of hazardous materials, including the location and contents of material safety data sheets.

Suggested Essential Questions

1. What am I expected to do in order to maintain a safe and orderly workplace?
2. What personal responsibilities and actions am I accountable for in the workplace?
3. What safety devices are present in the workplace and where are they located?
4. How are hazardous materials handled, stored, used, and disposed of?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe procedures for working in and maintaining a safe and orderly workplace. (DOK 1)	a. Provide students with a list of safety and housekeeping procedures that must be followed when working in the AEST laboratory and greenhouse (chemical safety, general laboratory safety, using glassware, personal protective equipment, laboratory rules and policies, etc.). Discuss these procedures with the students asking them to identify specific actions that either meet or do not meet the procedure. Have students sign an agreement	a. Assess student understanding through the use of a safety test. Students must answer 100% of all questions correctly.

stating that they have received and discussed procedures. ^{CS1, CS2, CS3, CS4, T5}		
b. Identify actions associated with safe personal behavior and conduct. (DOK 1)	b. Have students demonstrate and role-play acceptable and unacceptable behavior and conduct. Allow other students to view the role play and critique. ^{CS1, CS2, CS3, CS4, CS5, T1, T2, T3}	b. Use the <i>Rubric for Evaluating Role-Play on Behavior (1.5)</i> to evaluate student mastery.
c. Describe work site and laboratory organization procedures. (DOK 1)	c. Take students on a tour of the AEST lab and greenhouse, showing them the location of safety devices, emergency exits, storage facilities, tools and equipment, environmental controls, and so forth. During the tour, discuss procedures and policies related to the lab equipment and supplies. Demonstrate the use of safety devices and equipment. Identify potential hazards and safety procedures. ^{CS2, CS3, T6}	c. Assess student knowledge through the use of informal questioning following the tour. Follow up with a paper and pencil test.
d. Demonstrate procedures for safe use of chemicals and other hazardous materials in the laboratory and greenhouse, including the use of materials safety data sheets (MSDSs). (DOK 3)	d. Identify hazardous materials used in the AEST laboratory and greenhouse, and demonstrate their safe and proper storage, use, and disposal. Show students the location of the material safety data sheets (MSDSs) for hazardous materials. Provide students with a copy of a MSDS, and have the students read and complete the assignment <i>Interpret a Material Safety Data Sheet Worksheet (1.6)</i> to demonstrate their understanding. ^{CS2, CS4, CS5, T4, T6, R1, R2, R4, R5, S1}	d. Evaluate the student assignment for accuracy and completeness.

Standards

AFNR Industry Standards

- PS.01. Apply knowledge of plant classification, plant anatomy, and plant physiology to the production and management of plants.
- PS.02. Prepare and implement a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.

Biology I

- BIOI 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- BIOI 3 Investigate and evaluate the interaction between living organisms and their environment.

Botany

- BO 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- BO 4 Draw conclusions about the factors that affect the adaptation and survival of plants.
- BO 5 Relate an understanding of plant genetics to its uses in modern living.

Environmental Science

- ES 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS3 Social & Cross-Cultural Skills
- CS4 Productivity & Accountability
- CS5 Leadership & Responsibility

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T5 Digital Citizenship
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- S1 Interpretation of Data
- W4 Organizing Ideas
- W5 Using Language

Suggested References

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National FFA Organization. (n.d.). *American degree handbook*. Retrieved on June 14, 2010, from http://www.ffa.org/documents/degree_handbook.pdf

U. S. Department of Labor, Bureau of Labor Statistics. (n.d.). *Occupational outlook handbook (OOH)* (2010–11 ed.). Retrieved on June 9, 2010, from <http://www.bls.gov/OCO/>

Greenhouse and nursery safety: Industry in action. VEP. ISBN 1569181640

For additional references, activities, and web resources, please refer to: Information and Computer Technology B.R.I.D.G.E. Web site: <http://www.rcu.blackboard.com> (Available only to registered users).

Science of Agricultural Plants

Unit 2: Experiential Learning (SAE)

5 Hours

Competency 1: Plan and implement an experiential learning program. ABS.02, ABS.04

Suggested Enduring Understandings

1. Planning is a continuous process in business.
2. Plans must be reviewed and updated on a regular basis.

Suggested Essential Questions

1. What are my goals and plans for an SAE in the coming year?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Update and revise long-range and short-term goals of the experiential learning program. (DOK 3)	a. Based on the summary and analysis of the students' previous experiential learning activities, have students reflect and revise or amend their experiential learning long-range and short-term goals for the coming year. The goals should be added to the students' electronic portfolios. CS1, CS2, CS4, T1, T3, T4, T6, W1, W2, W4, W5	a. Use an experiential learning planning rubric and record keeping rubric to evaluate the students' goals. (See the <i>Rubric for Experiential Learning Planning and Record Keeping (2.1).</i>)
b. Update, revise, and implement the experiential learning plan/training agreement for the coming year. (DOK 3)	b. Based on the revised goals, have students update, amend, and revise their experiential learning plan/training agreement to reflect growth in skill and proficiency levels. The updated plan should be added to the students' electronic portfolios. CS1, CS2, CS4, T1, T3, T4, T6, W1, W2, W4, W5	b. Use an experiential learning planning rubric and record keeping rubric to evaluate the students' goals. (See the <i>Rubric for Experiential Learning Planning and Record Keeping (2.1).</i>)

Competency 2: Maintain records and documentation of experiential learning activities, projects, and enterprises. ABS.02, ABS.03, ABS.04, ABS.06

Suggested Enduring Understandings

1. Records must be maintained and updated on a regular and timely basis to accurately reflect progress.
2. Records should be summarized to give a "snapshot" of operations on a regular basis that can be used to make decisions.

Suggested Essential Questions

1. How do I update and maintain the records of my experiential learning program?
2. How do I summarize and analyze my experiential learning records?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Update and maintain records of experiential learning related income, expenses, activities, skills, and supplementary improvement projects. (DOK 3)	a. Review requirements for record keeping for the different types of experiential learning. Have students maintain and update their records electronically throughout the year. CS2, CS4, T3, T4, T6, M1, M2, W4	a. Use the <i>Rubric for Experiential Learning Planning and Record Keeping (2.1)</i> to evaluate the students' goals.
b. Prepare an annual summary report. (DOK 3)	b. Review procedures for summarizing records. Have students prepare an annual summary of their experiential learning activities at the end of the school year to include income and expense summary and a net worth statement. CS2, CS4, T3, T4, T6, M1, M2, W4	b. Use the <i>Rubric for Experiential Learning Planning and Record Keeping (2.1)</i> to evaluate the students' summaries.

Standards

AFNR Industry Standards

- ABS.02. Utilize appropriate management planning principles in AFNR business enterprises.
- ABS.03. Utilize record keeping to accomplish AFNR business objectives while complying with laws and regulations.
- ABS.04. Apply generally accepted accounting principles and skills to manage cash budgets, credit budgets, and credit for an AFNR business.
- ABS.05. Assess accomplishment of goals and objectives by an AFNR business.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS4 Productivity & Accountability

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- M1 Basic Operations and Applications
- M2 Probability, Statistics, and Data Analysis
- W1 Expressing Judgments
- W2 Focusing on the Topic
- W4 Organizing Ideas
- W5 Using Language

Suggested References

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Science of Agricultural Plants

Unit 3: Plant Growth and Nutrition

15 Hours

Competency 1: Examine the principles of plant growth. PS.01, BIOI 1, BIOI 2, BIOI 4, BIOII 2, BO 1, BO 2

Suggested Enduring Understandings

1. People who work with plants are better able to do their jobs if they understand the basics of plant growth.
2. There are two types of cell division: meiosis (associated with sexual reproduction) and mitosis (associated with cell division).
3. Life processes of plants are regulated by hormones produced in the cells.

Suggested Essential Questions

1. How do plant cells reproduce?
2. Why do growers use plant growth retardants and stimulants?
3. What environmental factors cause plants to respond in certain ways?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Discuss the principles of cell division, including both mitosis and meiosis. (DOK 3)	a. Access prior knowledge on the subject matter using the <i>Pre-Knowledge Assessment Example</i> (3.1). Use the Nova Online web site How Cells Divide, Mitosis and Meiosis to compare similarities and differences between mitosis and meiosis. Have students complete the <i>Onion Root Mitosis Activity</i> (3.2). As an extra activity, have students perform the <i>Challenge Activity - Onion Root Tip Experiment</i> (3.3). CS1, CS2, CS4, T1, T2, T4, M5, R2, R3, R4, W2, W4	a. Use the <i>Onion Root Mitosis Activity</i> (3.2) to evaluate student mastery.
b. Describe the use of growth retardants and stimulants. (DOK 1)	b. Have students search Web sites and prepare a newspaper article on plant growth retardants and stimulants to present to the class. (The instructor should suggest keywords to help students improve search strategies). CS1, CS2, CS4, T1, T2, T3, T4, T6, R1, R2, R3, R4, R5, W2, W4, W5	b. Use the <i>AgNews Rubric</i> (3.5) to evaluate the newspaper article.
c. List and explain the different types of tropisms. (DOK 1)	c. Have students use the <i>Tropism Summary and Demonstration Rubric</i> (Biondo & Lee, 2003, p. 51).	c. Evaluate students based on the <i>Tropism Summary and Demonstration Rubric</i> (3.6).

Competency 2: Discuss basic principles of plant nutrition and soil pH. PS.02, BIOI 1, BIOI 2, BIOI 4, BIOII 2, BO 1, BO 2

Suggested Enduring Understandings

1. Essential nutritional elements are needed for plant growth.
2. If a plant does not receive the proper

Suggested Essential Questions

1. What is the difference between macronutrients and micronutrients?
2. What are some of the common

nutrition, it will not grow or produce satisfactorily. 3. Soil pH plays a large role in the availability of plant nutrients. 4. When soil pH is above or below the plants preferred range, nutrients become unavailable, and plants do not grow or produce satisfactory. symptoms of nutrient deficiencies in plants? 3. What happens when too much fertilizer is applied? 4. Why is soil sampling technique important? 5. What range of soil pH are nutrients most available? 6. How do growers adjust pH of soil?		
Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Differentiate between macronutrients and micronutrients. (DOK 3)	a. Project the periodic chart (http://www.chemicool.com/) on the board, and ask students if they remember what certain elements stood for. Show students a bag of fertilizer, and discuss label information. Write elemental symbols on board, and let students make up an analogy to help them remember from the text (Biondo & Lee, 2003, p. 94). Allow students to choose a plant nutrient to conduct Internet search on and develop a PowerPoint presentation that covers nutrient functions in the plant, excess and deficiencies symptoms, and pH influence. CS1, CS2, CS4, CS5, T1, T2, T3, T4, T6, R1, R2,R3, R4, R5, W4, W5	a. Use the <i>Plant Nutrition PowerPoint Presentation Rubric (3.7)</i> to evaluate student mastery.
b. Describe the effect of excesses and deficiencies. (DOK 3)	b. Discuss effects of soluble salt buildup, remedies; show an example of soluble salt buildup at the bottom of a potted plant. Working in groups, design and conduct a nutrient experiment in which results will show deficiency and excesses symptoms. Have students record procedure, data, and conclusion. CS1, CS2, CS4, CS5, T1, T2, T3, T4, T6, M5, R2,R3, R4, R5, S2, W1, W4, W5	b. Use the <i>Nutrient Deficiencies and Excesses Experiment Rubric (3.8)</i> to evaluate student mastery.
c. Demonstrate the proper procedure for taking a soil sample. (DOK 2)	c. Have students review <i>Soil Testing for the Farmer</i> (http://msucares.com/pubs/infosheets/is0346.pdf) from the Mississippi Cooperative Extension Service and lead a discussion on the “do’s and don’ts” of soil sampling. Using soil probe and bucket, demonstrate soil sampling techniques on school campus. CS1, CS2, CS5, T4, T6, R4, W1, W2	c. Use the <i>Daily Participation Checklist (3.9)</i> to evaluate student mastery.
d. Predict the effect various pH levels will have on plant	d. Refer to Figure 9-6 in the text (Biondo & Lee, 2003, p. 159), and discuss pH effect on nutrient availability. Using the soil sample taken from	d. Use the <i>Plant Nutrition PowerPoint</i>

nutrition and growth. (DOK 4)	campus, demonstrate procedures for pH analysis using proper lab safety procedures. Discuss the effect, if any, pH would have on nutrient availability. Have students add pH effects to their plant nutrient PowerPoint presentation. CS1, CS2, CS4, CS5, T1, T2 T3, T4, T6, R3, R4, R5, W1, W2, W4, W5	<i>Presentation Rubric (3.7)</i> to evaluate student mastery.

Competency 3: Analyze soil fertility and calculate fertilizer application rates for a specific crop. PS.02, PS.03

Suggested Enduring Understandings

1. Plants need nutrients to grow effectively.
2. Plants will not grow and/or produce food at optimum levels unless proper nutrients are provided.

Suggested Essential Questions

1. Why is it important to have soil analyzed before applying fertilizer?
2. How many pounds of 13-13-13 fertilizer must be used to apply 1 lb of nitrogen per 1,000 ft² on a lawn that measures 5,000 ft²?
3. What types of equipment is used to apply fertilizer?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Analyze a soil sample for nutrient deficiencies by using the scientific method. (DOK 4)	a. Place students in three groups. Have at least one student in each group provide soil samples of sand, silt, and clay and discuss properties of each soil type. Have each group analyze a soil sample for pH and nutrient deficiencies and complete the <i>Soil Test Summary Report (3.10)</i> . CS1, CS2, CS4, CS5, T1, T2, T3, T4, T6, R2, R3, R4, R5, W1, W2, W4, W5	a. Evaluate <i>Soil Report Summary (3.10)</i> for accuracy and completeness.
b. Calculate fertilizer application rates to meet nutritional requirements for a specific crop. (DOK 2)	b. Discuss and demonstrate the procedure for calculating fertilizer application rates based on soil test recommendations and fertilizer analysis. Provide students with the <i>Fertilizer Calculation Worksheet (3.11)</i> and have them complete it in class. CS2, T2, T4, T6, R4, W2, M5	b. Evaluate <i>Fertilizer Calculation Worksheet (3.11)</i> for accuracy and completeness.
c. Select fertilizer application methods for different plant enterprises. (DOK 1)	c. Using the University of California – Davis PowerPoint presentation Fertilizer Applications , discuss the different methods and timings in applying fertilizers to different crops. CS2, T2, T4, T6, R4, W2, M5	c. Multiple choice questions on written test Questions for the test can be pulled from <i>Mississippi MCT Biology Sample Questions (3.4)</i> or <i>Questions for Unit Test (3.12)</i> .

Standards

AFNR Industry Standards

- PS.01. Apply knowledge of plant classification, plant anatomy, and plant physiology to the production and management of plants.
- PS.02. Prepare and implement a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.
- PS.03 Propagate, culture, and harvest plants.

Applied Academic Credit Standards

Biology I

- BIOI 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- BIOI 2 Describe the biochemical basis of life, and explain how energy flows within and between the living systems.
- BIOI 4 Analyze and explain the structures and function of the levels of biological organization.

Biology II

- BIOII 2 Describe and contrast the structures, functions, and chemical processes of the cell.

Botany

- BO 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- BO 2 Distinguish among the characteristics of botanical organization, structure, and function.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS4 Productivity & Accountability
- CS 5 Leadership and Responsibility

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R3 Sequential, Comparative, and Cause–Effect Relationships
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- M5 Graphical Representations
- W1 Expressing Judgments
- W2 Focusing on the Topic

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W4 Organizing Ideas

W5 Using Language

Suggested References

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For additional references, activities, and web resources, please refer to: Information and Computer Technology B.R.I.D.G.E. Web site: <http://www.rcu.blackboard.com> (Available only to registered users).

Science of Agricultural Plants

Unit 4: Plant Classification and Physiology

15 Hours

Competency 1: Examine plant classification methods.

PS.01, PS.02, PS.03, BIOI 2, BIOI 3, BIOI 6, BIOII 2, BIOII 5, BO 2, BO 5

Suggested Enduring Understandings

1. The scientific classification system was developed to allow scientists to have a universally recognized name for a plant and to classify plants according to their characteristics.
2. Types of plants are grouped together according to their characteristics.
3. Through biotechnology, plant breeders develop new varieties that offer genetic characteristics of disease and insect resistance, drought tolerance, higher yields, and different color flowers to farmers and consumers.
4. Annuals, biennials, and perennials are three common life cycles of plants.
5. There are some types of plants that thrive better when produced in a controlled environment. This type of growing environment is beneficial to growers producing these plants in a mass production system.
6. Some of these types of plants that do better in a controlled environment are bedding and seasonal potted plants. Bedding plants are typically installed with other plants for visual appeal in a landscaping design.

Suggested Essential Questions

1. Why do we classify plants?
2. What plant characteristics are commonly used to identifying plants?
3. Why is variety selection important?
4. What are the differences in the three common life cycles of plants?
5. What are the reasons plants should be produced in a controlled environment?
6. What are some common types of bedding and seasonal potted plants?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Interpret the scientific classification of plants. (DOK 1)	a. Show students a picture of a common plant that is grown across the world (i.e., corn). Ask students to name the plant (using a common name). Point out that this plant may have an entirely different common name in China or England. To allow people across the world to identify and describe using a universal name, the scientific classification system has been developed and accepted. Review the nomenclature of the scientific classification system beginning with kingdom and going through	a. Use the <i>Classification Poster Rubric (4.1)</i> to evaluate student mastery.

species. Tour campus and/or greenhouse on a weekly basis, and introduce students to the classification of a new plant each week. The students will be responsible for verbally identifying the scientific name of each plant during that week. Give each student an index card, and ask him or her to write down the name of his or her favorite plant and write down or draw sketches of 2–5 characteristics of the plant. To help students choose, teacher could provide resources such as textbooks, seed catalogs, seed company websites, and/or the USDA plant database Web site. Using information from the USDA NRCS plant database Web site (http://plants.usda.gov/), have students create a poster that includes scientific classification of their favorite plant. Make the poster assignment a competition with rewards for winners that include being able to pick something from the “happy table” or give “reward coupons.” CS1, CS2, CS4, CS5, T1, T2, T3, T4, T6, M5, R2, R4, W2		
b. Discuss variety and variety selection of various plants. (DOK 2)	c. Divide students into pairs, and assign each student an agronomic or horticultural crop. Have students search the Mississippi State University Extension Service Web site for variety recommendations and compile a list of different factors that must be considered in selecting a variety (yield, color, insect, disease, and drought resistance, response to day length, etc.). Bring the students back into a large group, and use PowerPoint or the White Board to compile a list of common characteristics used in selecting a specific variety. Have students include the listing in their electronic notebooks. CS1, CS2, CS4, CS5, T1, T2, T3, T4, T6, R2, R4, W2	b. Use the <i>Daily Participation Rubric (4.2)</i> to evaluate student participation in the discussion.
d. Classify plants according to life cycle. (DOK 1)	e. Review the three different life cycles of plants. Provide students <i>Annual, Biennial, or Perennial (4.3)</i> assignment, and have students conduct a search on the Internet to determine the life cycle of each plant. CS1, CS2, CS4, CS5, T1, T2, T3, T4, T6, R2, R4, W2	c. Evaluate <i>Annual, Biennial, or Perennial (4.3)</i> assignment for accuracy and completeness.
f. Identify three common bedding and seasonal potted plants. (DOK 1)	g. Use the <i>Bedding Plant Keyword Exercise (4.8)</i> to identify keywords, and discuss their meaning and application in bedding plant production. CS1, CS2, CS4, T2, T3, T4, R1, R2, R4, W2, W4, W5 Seasonal Examples: Easter lilies, poinsettias, and chrysanthemums Bedding Examples: begonias, impatiens, geraniums, petunias, pansies, and marigolds	d. Use the <i>Daily Participation Rubric (4.2)</i> to evaluate student participation in this exercise. Use a <i>Show What You Know</i>

	Give each student two pieces of different colored paper (Example: yellow and red) similar to index card size. Using a marker, ask students to write down each of the categories in large print (yellow for bedding and red for seasonal). Provide students with live examples or pictures of commonly grown bedding and seasonal potted. As you show each example, ask students to hold up the card colored coded to represent the category name. Discuss each example as you go through them and why each is classified in that particular group. Go through examples again to see how many right answers occur the second time around. CS1,CS2, CS4, T1, T2, T4, R5, W1, W2, W4, W5	competition to evaluate student performance on this indicator. Students could provide an award for winning group. Show pictures of bedding plants, and have the students indentify each plant.
h. Grow a greenhouse crop. (DOK 4)	i. Discuss how the Plant Hardiness Zone Map for Mississippi and Other States is used to select, and schedule bedding plant production. Have students select and schedule plants to be produced in time for planting. Students should choose plant(s) suited for the season and zone to be grown sexually or asexually. Assign students in pairs to be responsible for planting and caring for a flat of bedding plants. Have students maintain records of the plants during the growing period using the <i>Bedding Plant Production Data Sheet (4.9)</i>. CS1, CS2, CS4, CS5, T1, T2, T3, T4, T6, M5, R3, R4, R5, S2, W1, W2, W4	e. Evaluate the students' records for accuracy and completeness.

Competency 2: Investigate plant anatomy. PS.01, BO 2, BO 3, BO 5

Suggested Enduring Understandings

1. Plants are the only organism that produces its own food.
2. Plants have four main structures: roots, stems, leaves, and flowers.
3. Each structure performs functions that are critical for the survival of the plant species.
4. Roots absorb water and minerals and anchor the plant.
5. Stems hold the leaves and flowers and transport water and nutrients from the roots to the leaves.
6. The function of flowers is to reproduce the species.

Suggested Essential Questions

1. What important function do plant leaves serve?
2. Where does transpiration take place in a leaf?
3. What are the two types of tissue responsible for transporting water, food, and nutrients in plants?
4. What are the collective terms for the male and female parts of a flower?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify the types and structures of leaves. (DOK 1)	a. Say to students: The largest leaves grow on the Amazon water lily. In a single year, the plant will produce leaves of more than 2 m (6.6 ft) across. Ask what happens in a leaf. Have students read in (Biondo & Lee, 2003, p. 50) the section on leaves. Make reference to figures 3-17, 3-18, and 3-19. Complete handout taken from the activity manual (Biondo, 2002, p.19). If time allows, let students color in leaf parts on handout. CS1, CS2, CS4, T1, T3, T4, M4, R2, R4, W2, W4	a. Evaluate the handout taken from the activity manual (Biondo, 2002, p.19) for accuracy and completeness.
b. Draw and label the parts of a leaf, and describe their functions. (DOK 2)	b. To help students become excited about leaves, take a group <i>Leaf Walk</i>. During the walk, ask students questions such as the following: - Do the leaves have alternate or opposite leaf arrangement? - What type of margin does the leaf have? - Is the leaf simple or compound? - What are the characteristics of the plant? - Is the plant healthy? - What does the plant need to grow better? Have students bring in leaves <i>on a stem</i> to class (at least five different types). Using figures 15-13, 15-14, and 15-16 (Burton & Cooper, 2007, pp. 295–297), have students draw a sketch of their leaves identifying margins, shape, arrangement, and parts of their leaf specimen. Have students read out loud from text (Biondo & Lee, 2003) about leaves. CS1, CS2, CS4, T1, T3, T4, M4, R2, R4, W2, W4:	b. Evaluate student drawings for clarity and accuracy.
c. Draw and label the parts of a stem, and describe their functions. (DOK 2)	c. Give students four blank sheets of copy paper. Have students fold the paper in half to make a booklet. Give students the <i>Stems, Roots, and Flowers Booklet Rubric (4.4)</i>, and discuss grading criteria. Have students create a title page (for example: <i>Plant Structures, Plant Parts</i>), name included. Students could use their leaf samples to create an illustration on the title page. Have students draw, label, and briefly describe each type of stem in their booklets. CS1, CS2, CS4, T1, T3, T4, M4, R2, R4, W2, W4	c. Use the <i>Stems, Roots, and Flowers Booklet Rubric (4.4)</i> to evaluate student mastery.
d. Draw and label the types and parts of a root, and describe	d. Read out loud from text about roots (Burton & Cooper, 2007, p. 288). Have live examples adventitious roots, fibrous, and taproot to observe. Examine plant roots (i.e., carrot) in Root View Growth Chamber. Have students draw, label, and briefly describe each type of	d. Use the <i>Stems, Roots, and Flowers Booklet Rubric (4.4)</i> to evaluate

their functions. (DOK 2)	root system. ^{CS1, T2, T3, T4, R2, R4, R5, W1, W2} Have students draw, label, and describe each type of root including root structure (Burton & Cooper, 2007, Fig. 15-6, p. 291) in their booklets. ^{CS1, CS2, CS4, T1, T3, T4, M4, R2, R4, W2, W4}	student mastery.
e. Identify the types and structure of a flower. (DOK 2)	e. Provide students with the <i>Flower Structure Handout</i> taken from the activity manual (Biondo, 2002, p. 20). Prepare a cross section of a flower to observe under a microscope. Working in groups of two, have students label the flower diagram on the handout while observing under the microscope. Example: Hibiscus flowers While students are waiting to view flower structure under the microscope, they could be working on booklets. ^{CS1, CS2, CS4, CS5, T1, T2, T4, T6, M5, R1, R2, R3, R4, W2, W4, W5}	e. Evaluate the Flower Structure Handout for accuracy and completeness.
f. Draw and label the parts of a complete flower, and describe their functions. (DOK 2)	f. Read out loud from the text (Burton & Cooper, 2007, p. 298) about flowers. Have students draw, label, and briefly describe the cross section of an apple (Burton & Cooper, 2007, Fig. 15-19, p. 299) and the major parts of a flower (Burton & Cooper, 2007, Fig. 15-18, p. 299) in their booklets. ^{CS1, CS2, CS4, T1, T3, T4, M4, R2, R4, W2, W4}	f. Use the <i>Stems, Roots, and Flowers Booklet Rubric (4.4)</i> to evaluate student mastery.

Competency 3: Assess physiological principles of plants. ^{PS.01, BIOI 2, BIOII 2, BO 2, CHI 5}

Suggested Enduring Understandings

1. Photosynthesis is the most important process on the planet because it replenishes oxygen and manufactures the basic food supply for animals.
2. Plants are the only living organisms that can make their own food.
3. In many tropical areas of the world, there are huge forests. These are often known as the "lungs of the world" because they produce oxygen. These forests are really important because they reduce the amount of carbon dioxide in the air.

Suggested Essential Questions

1. How do plants obtain food energy?
2. What are the starting reactants for photosynthesis?
3. What are the end products of photosynthesis?
4. What factors affect the rate of photosynthesis?
5. What are the starting reactants for cellular respiration?
6. What are the end products of cellular respiration?

Suggested Performance	Suggested Teaching Strategies	Suggested Assessment

Indicators		Strategies
a. Describe photosynthesis, including the chemical reactions that occur. (DOK 2)	a. Photosynthesis literally means to build with light. Provide students with the <i>Photosynthesis, Respiration, and Transpiration Information Sheet (4.5)</i>. Discuss this information, making reference to photosynthesis and respiration formulas and beginning and end products. Draw the comparison table on an overhead projector or white board, and have students complete it and record in electronic notebooks. Challenge Activity: Use the Photosynthesis and Plant Pigment Kit to demonstrate the role of light, chlorophyll, carbon dioxide, and oxygen in photosynthesis. CS 1, CS4, T1, T2, T4, T6, S2	a. Use the <i>Photosynthesis, Respiration, and Transpiration Information Sheet (4.5)</i> and <i>Transpiration Activity (4.6)</i> for student mastery.
b. Describe the process of respiration and transpiration. (DOK 2)	b. Cover this competency simultaneously with photosynthesis and transpiration discussion. (See the <i>Photosynthesis, Respiration, and Transpiration Information Sheet (4.5)</i>.) CS1, CS4, T1, T2, T4, T6, S2 Introduce the concept of plant transpiration by asking students what they think happens when they exhale (breathe out) when they are outside on a very cold day. For students who have lived in or experienced cold climates, they should recall the interesting phenomenon of “seeing your breath.” A person’s exhaled breath is what releases water vapor and other gases from their lungs. Plants emit water vapor through their leaves mainly by a process called transpiration. Although “seeing your breath” is not an identical process to plant transpiration, it provides students with a conceptual model to help them understand what occurs when plants release (transpire) water vapor. The human body and plant leaves are both moist on the inside, and when gases from inside animals or plants are released to the outside, these gases carry water vapor with them. Reinforce transpiration concepts with the <i>Transpiration Activity (4.6)</i> or the <i>Transpiration in Plants</i> activity from the activity manual (Biondo, 2002, p. 21). Challenge Activity: <i>Coloring Flowers</i>. The Web site shown below has a good explanation of the transpiration process and experimental suggestion varying temperature effects. http://www.madsci.org/experiments/archive/887562625.Bi.html CS1, CS2, CS4, CS5, T2, T3, T4, T6, R1, R2, R3, R4, R5, W2, W4, W5	b. Use the <i>Photosynthesis, Respiration, and Transpiration Information Sheet (4.5)</i> and <i>Transpiration Activity (4.6)</i> for student mastery.
c. Explain how each plant part	c. Create a crossword puzzle that plant parts and their association to growth and development of the plant. (<i>EclipseCrossword</i> is a Web site for creating free crossword puzzles.) CS1, CS2, CS4, T1, T2, T4,	c. Completion of crossword

and process	R4, R5, W1, W2, W4, W5	puzzle
is		
important		Use the
in the		<i>Plant</i>
growth and		<i>Classification</i>
developme		<i>and</i>
nt of a		<i>Physiology</i>
plant. (DOK		<i>Unit Test</i>
2)		(4.7) to
		evaluate
		student
		mastery of
		the unit.

Standards

AFNR Industry Standards

- PS.01. Apply knowledge of plant classification, plant anatomy, and plant physiology to the production and management of plants.

Applied Academic Credit Standards

Biology I

- BIOI 2 Describe the biochemical basis of life and explain how energy flows within and between the living systems.
- BIOI 6 Demonstrate an understanding of principles that explain the diversity of life and biological evolution.

Biology II

- BIOII 2 Describe and contrast the structures, functions, and chemical processes of the cell.
- BIOII 5 Develop an understanding of organism classification.

Botany

- BO 2 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- BO 3 Demonstrate an understanding of plant reproduction.
- BO 5 Relate an understanding of plant genetics to its uses in modern living.

Chemistry I

- CHI 5 Compare factors associated with acid/base and oxidation/reduction reactions.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS4 Productivity & Accountability
- CS5 Leadership & Responsibility

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- M4 Expressions, Equations, and Inequalities
- M5 Graphical Representations
- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R3 Sequential, Comparative, and Cause–Effect Relationships
- R4 Meaning of Words
- R5 Generalizations and Conclusions

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S2	Scientific Investigation
W1	Expressing Judgments
W2	Focusing on the Topic
W4	Organizing Ideas
W5	Using Language

Suggested References

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For additional references, activities, and web resources, please refer to: Mississippi Agriculture Education B.R.I.D.G.E. Web site: <http://www.rcu.blackboard.com> (Available only to registered users).

Science of Agricultural Plants

Unit 5: Plant Reproduction and Propagation

20 Hours

Competency 1: Examine the principles of genetics. PS.01, BIOI 4, BIOI 5, BIOI 6, BIOII 2, BIOII 3, BIOII 4, BO 2, BO 5, BO 4, G 1, G 2, G 3

Suggested Enduring Understandings

1. Variations in plants are caused by the pairing of dominant and recessive genes from the two parent plants, i.e. Gregor Mendel.
2. The cell is the basic unit of a living plant and is composed of several different organelles that perform functions necessary for cell growth and division.
3. The nucleus of each plant cell contains genetic information that controls the characteristics of a plant. This information is contained in long molecular chains of deoxyribonucleic acid (DNA). Each DNA chain is composed of pairs of genes that control specific characteristics of the plant.

Suggested Essential Questions

1. How do the basic laws of genetics cause variations in plants?
2. What is the molecular chain that stores genetic information in all living cells?
3. Where is genetic information stored in the cell?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Explain the principles of Mendel's law. (DOK 1)	a. Have students try to roll their tongues, and describe how this is a genetic trait that is inherited from one of their parents. Instructors should limit the activity to two traits. Have students read the information sheet <i>Mendel's Law and Punnett Squares (5.1)</i> and discuss the terms and principles associated with Mendel's law. Have students draw the Punnett square in their notebooks and complete results. CS2, CS4, T4, M5, R1, R2, R3, R4, R5, W2, W4	a. Have students peer evaluate and correct the three Punnett square problems found in the information sheet.
b. Investigate the structure of a plant cell. (DOK 2)	b. Make signs with names of cell organelles (12) for each student to hang around his or her neck. Have students research the purpose of each organelle and draw a picture of the organelle on the sign. Have students role-play their organelle. CS1, CS2, CS4, CS5, T1, T2, T3, T4, M5, R1, R2, R3, R4, R5, W2, W4, W5	b. Use the <i>Daily Participation Rubric (5.2)</i> to evaluate student understanding.
c. Identify the makeup of chromosomes in a	c. Have students read out loud from the text (Biondo & Lee, 2003, p. 62) about offspring	c. Use the <i>Daily Participation Rubric (5.2)</i> to

plant cell. (DOK 1)	and genetics. Have students locate handout from <i>Unit 3</i> in their activity manual (Biondo, 2002) and review mitosis and meiosis. CS1, CS4, T3, T4, M5, R1, R2, R3, R4, W2, W4	evaluate student understanding.
d. Describe the structure of DNA. (DOK 2)	d. Review from the text (Biondo & Lee, 2003, p. 62) about offspring and genetics. Have students arrange a model of DNA showing the structure and pairing and placement of genes on the DNA as shown in the <i>DNA Structure Activity (5.3)</i> in this unit. Several variations can be used for a model. The following <u><i>Double Helix Model</i></u> Web site uses Styrofoam balls. Instructors can use beads and chenille sticks with students to demonstrate the creation of a DNA model. Students can refer to the activity manual (Biondo, 2002, p. 62) as a guide. CS1, CS2, CS4, T1, T2, T4, M5, R2, R4, W2, W4	d. Evaluate student accuracy and completeness in constructing the DNA model.

Competency 2: Distinguish between sexual and asexual reproduction. PS.01, PS.03, BIOI 1, BIOI 4, BO 1, BO 3

Suggested Enduring Understandings

1. Plants reproduce sexually by producing seed that contains a plant embryo and plant food surrounded by a seed wall.
2. The rate of germination is dependent on a number of factors including type of seed, quality of seed, seed treatment, temperature and light conditions, and moisture.
3. Asexual reproduction involves the reproduction of plants through the use of plant parts (roots, cuttings, explants, etc.). Asexual reproduction produces a plant that is genetically identical to the parent plant.
4. Traditional methods of plant propagation include cuttings, grafting, layering, separation, and division.
5. A newer, highly technical method of plant propagation is tissue culture.

Suggested Essential Questions

1. What advantage does sexual reproduction provide to a plant?
2. What conditions are needed for good seed germination?
3. What is seed viability, and how is it determined?
4. What are the advantages of asexual plant reproduction?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe sexual reproduction in plants. (DOK 1)	a. Use the following metaphor to recall by association: sexual reproduction and seed; the two S's. Have students read out loud from (Biondo & Lee, 2003, pp. 59–61) about sexual plant reproduction. Discuss Fig. 4-3, and make a connection between parts of the flower that develop into the fruit we eat (i.e., ovary develop into fruit and ovules develop into seed). Demonstrate by cutting open a fruit (i.e., watermelon) or discussing fruit parts in Fig. 4-7. R3, R4, W1, W2	a. Use a written test to evaluate student understanding. Questions can be used from <i>Unit Test Questions (5.6)</i> to create the test.
b. Describe the conditions needed for good seed germination. (DOK 1)	b. Lead a discussion about the relationship between good seed germination conditions and what students already know about spring plantings. Have students read out loud from (Biondo & Lee, 2003, pp. 65–68). Use a metaphor to recall information by association that stratification connects with stratus and cold; scarification connects with scaring of seed coat by animal stomach acid. CS1, T2, T4, R1, R2, R3, R4, G5, W2, W4, W5	b. Use a written test to evaluate student understanding. Questions can be used from <i>Unit Test Questions (5.6)</i> to create the test.
c. Plan and conduct a seed germination test. (DOK 3)	d. Show an example of a certified seed label, and describe/discuss the elements that it contains (purity, viability, inert matter, noxious weeds, etc.). Set up an experiment using equal numbers of acorns, corn, and beans. Place some of each seed in moist peat moss in a refrigerator and others in moist peat moss in the greenhouse, culture incubator, and classroom. Make observations, and record data over time using the <i>Germination Test Experiment (5.4)</i> . Determine germination as a percentage. Seed test could involve lighting treatment including greenhouse light, artificial light, and no light. Keep records of seeding date and number of seed that germinate each day. Mist daily and water peat moss when necessary. CS1, CS2, CS4, CS5,	d. Evaluate the <i>Germination Test Experiment (5.4)</i> for accuracy and completeness.

T1, T2, T3, T4, T6, M1, M2, M5, R1, R2, R3, R4, R5, S1, S2, W1, W2, W4, W5		
d. Identify and describe asexual reproduction methods. (DOK 3)	d. Have students read out loud from the text (Biondo & Lee, 2003, pp 68–72). Have plant material and tools on hand to demonstrate asexual reproduction by cuttings. CS1, CS2, CS4, CS5, T1, T2, T3, T4, T6, M1, M2, M5, R1, R2, R3, R4, R5, S1, S2, W1, W2, W4, W5 Obtain rooting hormone, and discuss with students the ingredients. Have students conduct an experiment that compares use of rooting hormone to no rooting hormone (control) while preparing vegetative cuttings. CS1, CS2, CS4, CS5, T1, T2, T3, T4, T6, M5, R1, R2, R3, R4, R5, S2, W1, W2, W4, W5	e. Evaluate the <i>Rooting Hormone Experiment Data Collection Sheet (5.5)</i> for accuracy and completeness.
f. Explore asexual plant reproduction techniques using grafting, cuttings, layering, separation and division, and tissue culture methods. (DOK 2)	f. Invite a local horticulturist to demonstrate grafting. Repot plants in greenhouse to demonstrate separation and division methods of asexual plant reproduction. Use the laminar flow hood to practice the aseptic techniques required for tissue culture. Challenge Activity: Use Venus Fly Trap tissue culture kits from Carolina Biological to practice tissue culture lab techniques. CS1, CS2, CS4, CS5, T1, T2, T3, T4 R3, R4, R5, W2, W4	f. Use the <i>Daily Participation Rubric (5.2)</i> to evaluate student understanding.

Standards

AFNR Industry Standards

- PS.01. Apply knowledge of plant classification, plant anatomy, and plant physiology to the production and management of plants.
- PS.03. Propagate, culture, and harvest plants.

Applied Academic Credit Standards

Biology I

- BIOI 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- BIOI 4 Analyze and explain the structures and function of the levels of biological organization.
- BIOI 5 Demonstrate an understanding of the molecular basis of heredity.
- BIOI 6 Demonstrate an understanding of principles that explain the diversity of life and biological evolution.

Biology II

- BIOII 2 Describe and contrast the structures, functions, and chemical processes of the cell.
- BIOII 3 Investigate and discuss the molecular basis of heredity.
- BIOII 4 Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.

Botany

- BO 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- BO 2 Distinguish among the characteristics of botanical organization, structure, and function.
- BO 3 Demonstrate an understanding of plant reproduction.
- BO 5 Relate an understanding of plant genetics to its uses in modern living.
- BO 4 Draw conclusions about the factors that affect the adaptation and survival of plants.

Genetics

- G 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- G 2 Analyze the structure and function of the cell and cellular organelles.
- G 3 Apply the principles of heredity to demonstrate genetic understandings.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS4 Productivity & Accountability
- CS5 Leadership & Responsibility

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

M1	Basic Operations and Applications
M2	Probability, Statistics, and Data Analysis
M5	Graphical Representations
R1	Main Ideas and Author's Approach
R2	Supporting Details
R3	Sequential, Comparative, and Cause–Effect Relationships
R4	Meaning of Words
R5	Generalizations and Conclusions
S1	Interpretation of Data
S2	Scientific Investigation
W1	Expressing Judgments
W2	Focusing on the Topic
W4	Organizing Ideas
W5	Using Language

Suggested References

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Science of Agricultural Plants

Unit 6: Plant Growing Structures

10 Hours

Competency 1: Describe the use of various plant growing structures and their environmental control systems. PS.02, PS.03, BIOI 2, BIOI 3, BIOII 2, BO 2

Suggested Enduring Understandings

1. Greenhouses and other structures are used by horticulturists to extend the growing season and to grow plants that would not normally be grown in the prevailing climate. There are several different types of commercial greenhouses in use today, and selection of a greenhouse type is based on crops to be grown and construction and maintenance costs.
2. Shade cloths are used to protect plants from strong sunlight and wind exposure.
3. While glass was used in the past, most greenhouses today are covered with polycarbonate, polyethylene, or fiberglass materials because of the economical cost of the material and the ease of installation.
4. For optimum plant growth, the greenhouse environment must be controlled to provide the proper temperature, light, humidity, and water level for the plants.
5. Light is essential for plant growth and must be monitored and controlled for intensity, color, and duration. Blue wavelengths affect photosynthesis, and red wavelengths affect flowering and reproduction.

Suggested Essential Questions

1. What is the purpose of a greenhouse?
2. What are the advantages and disadvantages of the different types of greenhouses?
3. Why is shade necessary for some plants?
4. How do you select a covering for a greenhouse?
5. What controls and equipment are used to control the environment within a greenhouse?
6. What factors must be considered in providing light for a greenhouse.
7. What factors must be considered in controlling temperature within a greenhouse?
8. How is plant watering managed in greenhouses?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify and compare the greenhouse types: Quonset, ridge and furrow, and even span. (DOK 2)	a. Organize a tour activity using AEST greenhouse. (See the <i>Greenhouse Tour Activity (6.1)</i> in this unit). Identify the different components, controls, and systems that will be covered in this unit. Assign some students to develop a PowerPoint presentation on the different types of greenhouses, their characteristics, and advantages/disadvantages. Assign other students a topic related to the different types of structures and environmental	a. Use the <i>Structure and Control Systems Presentation and Rubric (6.2)</i> to evaluate student mastery.

controls used in these structures, and have them develop and present a PowerPoint presentation. See the *Structure and Control Systems Presentation and Rubric (6.2)* for more instructions for PowerPoint development and presentation criteria. Topics can be assigned to individual students or groups, depending on class size. Have students assigned the topics related to different types of greenhouses make their presentations to the class.

Following each presentation, hold a class discussion to make sure that all key points related to the topic have been covered. Have students summarize the key points from the presentation and place in their electronic journals or notebooks. CS1, CS2, CS4, CS5, T1, T2, T3, T4, T6, M5, R1, R2, R4, R5, W2, W4, W5

b. Describe the different types of coverings used on greenhouses. (DOK 2)	b. For this indicator, have student(s) who developed PowerPoint presentations on different types of coverings used on greenhouses including fiberglass, polycarbonates, polyethylene, and shade cloths make their presentations to the class. Following the presentation, hold a class discussion to make sure that all key points have been covered. Have all students summarize the key points in the presentation and record in their electronic journals or notebooks. CS1, CS2, CS4, CS5, T1, T2, T3, T4, T6, M5, R1, R2, R4, R5, W2, W4, W5	b. Use the <i>Structure and Control Systems Presentation and Rubric (6.2)</i> to evaluate student performance.
c. Differentiate between environmental controls including humidistat, thermostat, cooling, watering, and heating. (DOK 3)	c. For this indicator, have students who developed PowerPoint presentations on different systems for heating, cooling, and controlling humidity and watering make their presentations to the class. Following the presentation, hold a class discussion to make sure that all key points have been covered. Have all students summarize the key points in the presentation and record in their electronic journals or notebooks. CS1, CS2, CS4, CS5, T1, T2, T3, T4, T6, M5, R1, R2, R4, R5, W2, W4, W5	c. Use the <i>Structure and Control Systems Presentation and Rubric (6.2)</i> to evaluate student performance.
d. Describe the importance of light in plant growth. (DOK 1)	d. Give each student a copy of NASA Predicts Non-Green Plants on Other Planets , and refer to Appendix 6C. Have them review the article and highlight what they consider the top three important points of the article. Throw a ball around to call on students to list their three important points. Keep a tally of how many	d. Use the <i>Daily Participation Rubric (6.3)</i> to evaluate student participation and understanding.

students listed the same points. Review article contents with the class to make sure that all key points are covered. Have students read out loud about the effects of light colors, duration, and intensity needed for plant growth (Biondo & Lee, 2003, pp.100–103). CS1, CS2, CS4, CS5, T1, T2, T3, T4, R1, R2, R3, R4, R5, W2, W4, W5		
e. Explain how temperature affects the growth of a plant. (DOK 1)	e. Have students read out loud about the effect of temperature on plant growth. Hold a class discussion on the key points in the material, and have students transcribe them into their electronic notebooks or journals (Biondo & Lee, 2003, pp. 103–105). CS1 , CS2 , CS4 , CS5 , T1 , T2 , T3 , T4 , R1 , R2 , R3 , R4 , R5 , W2 , W4 , W5	e. Use a written test to evaluate student understanding.
f. Discuss water management in growing plants. (DOK 3)	f. Have students read out loud about the water needs of plants (Biondo & Lee, 2003, pp. 106–108). Discuss water management of plants to be maintained including greenhouse, nursery, campus landscape, and interior school plants. In groups of two, have students maintain water regime for plants and record data using the <i>Plant Water Management Data Sheet (6.4)</i> . Challenge Activity: This assignment can be rotated among classmates with students training each other about water regime requirements. CS1 , CS2 , CS4 , CS5 , T2 , T3 , T4 , R3 , R5 , W1 , W4 , W5	f. Evaluate the <i>Plant Water Management Data Sheet (6.4)</i> to determine student understanding.

Standards

AFNR Industry Standards

- PS.02. Prepare and implement a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.
- PS.03. Propagate, culture, and harvest plants.
- PST.02. Design, operate, and maintain mechanical equipment, structures, biological systems, land treatment, power, and technology.

Applied Academic Credit Standards

Biology I

- BIOI 2 Describe the biochemical basis of life and explain how energy flows within and between the living systems.
- BIOI 3 Investigate and evaluate the interaction between living organisms and their environment.

Biology II

- BIOII 2 Describe and contrast the structures, functions, and chemical processes of the cell.

Botany

- BO 2 Distinguish among the characteristics of botanical organization, structure, and function.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS4 Productivity & Accountability
- CS5 Leadership & Responsibility

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- M5 Graphical Representations
- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R3 Sequential, Comparative, and Cause–Effect Relationships
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- S2 Scientific Investigation
- W1 Expressing Judgments
- W2 Focusing on the Topic
- W4 Organizing Ideas
- W5 Using Language

Suggested References

- Biondo, R. J., & Lee, J. S. (2003). *Introduction to plant and soil science technology* (2nd ed.). Lebanon, IN: Interstate Publishing.
- Biondo, R. J., & Lee, J. S. (2002). *Introduction to plant and soil science technology activity manual* (2nd ed.). Lebanon, IN: Interstate Publishing.
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Science of Agricultural Plants

Unit 7: Cultural and Harvesting Practices

15 Hours

Competency 1: Examine types of growing media. PS.02, PS.03, E3, BIOI 1, BIOII 1, BO1, ES1, PS1

Suggested Enduring Understandings

1. Soil is a complex substance composed of minerals, water, organic matter, and other materials.
2. Soil texture affects both the productivity and usefulness of land.
3. The Land Capability Classification System is designed to assist in determining the highest productive use of a piece of land.
4. An ideal growing medium for plants is one that provides the plants with adequate supplies of water, air, and minerals.
5. Organic soil amendments such as peat or compost provide water holding capacity and improve the texture of heavy soils.
6. Inorganic soil amendments such as vermiculite or perlite improve soil aeration and drainage.
7. Soilless media is often used in greenhouse and nursery operations because it is usually sterile; uniform and consistent in nutrients, texture, and pH; and easier to handle.
8. Hydroponic plant production is expensive to install but provides greater yields than conventional methods.

Suggested Essential Questions

1. How do the characteristics of soil affect its conservation and use?
2. How is the texture of a soil determined?
3. How is the Land Capability Classification System used to determine highest productive use?
4. What are the characteristics of an ideal growing medium?
5. How do organic soil amendments add to the productivity of a soil or soilless mixture?
6. How do inorganic soil amendments add to the productivity of a soil or soilless mixture?
7. What are the characteristics of a soilless medium?
8. Why is hydroponics being used to produce plants?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Discuss the characteristics and functions of soil components, including minerals, water, organic matter, and other constituents. (DOK 1)	a. Use the Earth Apple activity from the Earth Apple: Land Stewardship Project web site to introduce soil concepts. Ask students if soil is a renewable or nonrenewable resource. Show students an example of a soil profile; tell students that it may take 1,000 years for an inch of topsoil to form. Ask students why they think it takes so long. Have students read out loud from Chapter 7 of the text (Biondo & Lee, 2003) and lead a discussion on the characteristics and functions of the different soil components. CS1, CS2, T2, R4, R5, W1, W2, W4, W5	a. Use the <i>Group Participation Rubric (7.1)</i> to evaluate student mastery.
b. Determine soil	b. Review the section on soil particle size and on the	b. Evaluate the <i>Soil</i>

texture. (DOK 2)	use of a soil triangle in Chapter 7 of the text (Biondo & Lee, 2003). Set up samples of sand, silt, clay, and organic matter in petri dishes for students to view under the microscope. Have soil samples available for students to evaluate their textures using both microscope and ribbon method. Using the soil triangle, students record soil classification on the <i>Soil Data Summary Sheet (7.2)</i> . CS1, CS2, CS4, CS5, T2, T4, T6, M5, R1, R2, R3, R4, R5, W1, W2, W4, W5	<i>Data Summary Sheet (7.2)</i> for accuracy and completeness.
c. Apply principles of land capability to determine highest productive use and homesite evaluation capability. (DOK 3)	c. How easy is it to cultivate and grow crops on a mountain? What type of land do you think has highest crop production? Review the land capability classes guidelines in the text (Burton & Cooper, 2007). Discuss and demonstrate the use of land evaluation forms in <i>Instructions on Land Judging in Mississippi</i> to evaluate a chosen land area using the <i>Mississippi Land Judging Scorecard (7.3)</i> . CS1, CS2, CS4, CS5, T4, R1, R2, R3, R4, W2	c. Evaluate the <i>Mississippi Land Judging Scorecard (7.3)</i> for accuracy and completeness.
d. Identify the characteristics of an ideal growing medium. (DOK 1)	d. What happens if a plant gets too dry? What happens if a plant gets too wet? Live examples would help students visualize answers. Review the section on soil structure from the text (Biondo & Lee, 2003), and discuss the characteristics of an ideal plant growth medium. CS1, CS2, CS4, CS5, T2, T4, T6, R1, R2, R4, R5, W1, W2, W4, W5	d. Use a written test to evaluate student performance.
e. Discuss the characteristics of organic soil amendments including bark, compost, leaf mold, and peat moss. (DOK 2)	e. Use the Soil Organism Kit to conduct a laboratory activity to extract nematodes and other microscopic organisms from the soil. Use the microscope camera to project microorganisms in organic material. Discuss results and emphasize importance of organic matter in the soil. Show students examples of bark and peat moss. Discuss characteristics of drainage and water holding capacity. Develop a compost pile. Have students plant a tree or shrub on campus incorporating the soil with one of the organic soil amendments listed in objective. CS1, CS2, CS4, CS5, T1, T2, T4, R3, R4, W1, W2, W4	e. Use the <i>Group Participation Rubric (7.1)</i> to evaluate student performance.
	Display examples of perlite, vermiculite, and commercial potting media, and identify the characteristics they add to a plant growth medium (perlite, vermiculite, sand, etc.). Have empty bags of commercial potting media for students to read contents. Discuss soilless growing media components and characteristics. CS1, T2, R4, R5, W1, W2	Use a written test to evaluate student performance on this indicator.
	Conduct an experiment to test characteristics of various types of growing media. Include inorganic	

	soil amendments discussed in indicator e above and other soil and soilless types of media. Seedlings grown in the Plant Reproduction Unit can be used for this experiment. CS1, CS2, CS4, CS5, T1, T2, T3, T4, M5, R3, R4, R5, S2, W1, W2, W4, W5	Use the <i>Media Experiment Data Sheet and Rubric (7.5)</i> to evaluate student understanding and performance on this indicator.
f. Discuss the advantages and disadvantages of hydroponics plant production. (DOK 3)	f. Show students the Hydroponic Lettuce video . Have students design a booklet that includes drawings of different hydroponics systems and include a table listing advantages and disadvantages. CS1, CS2, CS4, CS5, T1, T2, T4, M5, R1, R2, R3, R4, W2	f. Use the <i>Hydroponics Booklet Rubric (7.4)</i> to evaluate student performance on this indicator.

Competency 2: Explore tillage, irrigation practices, harvesting methods, and harvest timing. PS.01, PS.02, PS.03, E4, ES2, NRS 04

Suggested Enduring Understandings

1. Many producers are switching to limited or no-till production practices in order to conserve fuel and limit soil compaction and erosion.
2. When a soil or growing medium is allowed to become too dry or to become too wet, plant growth is reduced, and plants become more prone to disease and insect damage.
3. Many producers are now installing irrigation systems to insure that adequate moisture is available to plants at all times. Irrigation systems can range from a sprinkler can in a greenhouse to a center pivot system in a 160-acre field.
4. Generally speaking, water for irrigation should be pure enough to drink and should not contain excessive amounts of harmful salt.
5. Harvesting is the process of moving plants or plant products from the field into storage or a market or processing plant.
6. Harvesting procedures vary depending on the plant being grown, timing and season, storage procedures, perishability, harvest methods, and pre and post-harvest losses.

Suggested Essential Questions

1. What are the advantages of limited tillage or no-till farming methods?
2. How does soil or growing medium moisture affect the growth of plants?
3. What are the different types of irrigation systems, and what production systems are they applicable to?
4. What effect does water quality have on irrigation and plant growth?
5. What factors affect when a crop or plant is harvested?

Suggested	Suggested Teaching Strategies	Suggested

Performance Indicators		Assessment Strategies
a. Compare traditional tillage and planting equipment and procedures to limited or no-till planting. (DOK 2)	a. Allow students to use the tiller on school campus. Show students pictures of traditional tillage, planting equipment, and limited and no-till planting. In groups of two or three, have students review research publications that compare traditional tillage to limited tillage and no-till planting. Students will identify three important components of the article to write on board or easel paper to discuss with the class. CS2, CS4, T1, T2, T3, T4, R1, R1, R4, R5, W2, W4	a. Use the <i>Group Participation Rubric (7.1)</i> to evaluate student mastery.
b. Discuss the role of moisture management in plant production. (DOK 3)	b. Have students read out loud from the section on <i>Moisture Management</i> from the text (Biondo & Lee, 2003). Tour the greenhouse and school campus to evaluate water needs of plants depending on soil type, light, and plant characteristics. Assign students certain plants to care for, take pictures, and develop a plant maintenance log for students to records. Use the soil moisture meter and light meter to add quantitative data. CS1, CS2, CS4, CS5, T2, T4, M5, R2, R3, R4, R5, W1, W2, W3, W4	b. Use the <i>Plant Maintenance Log Rubric (7.6)</i> to evaluate student mastery.
c. Define irrigation, and describe hand drip and sprinkler/mist irrigation systems. (DOK 2)	c. Have students read the section on <i>Irrigation Application Methods</i> from the text (Biondo & Lee, 2003). Show students the PowerPoint presentation <i>Irrigation Equipment Options</i> on different types of irrigation systems. Set up an irrigation system in greenhouse or on campus, or have students observe irrigation systems in local garden centers and/or farm fields, or take a field trip to wholesale nurseries or farms. Give students 5 minutes to construct a paragraph summarizing the key points about irrigation after brainstorming and writing keywords on the board. CS2, CS4, CS5, T4, R5, W1, W2, W4, W5	c. Use the <i>Paragraph Construction Rubric (7.7)</i> to evaluate student mastery.
d. Determine water quality for irrigation. (DOK 1)	d. Have students read out loud about quality irrigation water from the section on <i>Quality Irrigation Water</i> in the text (Biondo & Lee, 2003). Show students pots with soluble salt build up on drainage holes. Students should participate in a lab exercise to determine soluble salts in water. CS2, T3, T4, R1, R2, W1, W2, W4	d. Use a written test to evaluate student performance. Use the chart in the text (Boodley, 1998, p. 293).
e. Explore different harvesting methods. (DOK 2)	e. Begin by asking students why harvesting of plants is important. Set the stage for a <i>Dirty Jobs</i> activity where students will develop a PowerPoint presentation involving the harvest of plants or plant products and then role-play their job in harvesting.	e. Use the <i>Dirty Jobs Presentation Rubric (7.9)</i> to evaluate the students'

Divide the class into groups of two to three presentations. students, and assign each group a specific plant or plant product that is grown locally. This may include field crops, timber, nursery and greenhouse crops, or forage crops. Have students develop a PowerPoint presentation that reflects the types of products harvested from the plants, harvest timing, harvest methods and equipment, storage procedures for harvested products, preharvest and post-harvest losses, and perishability of the products. [CS1](#), [CS2](#), [CS3](#), [CS4](#), [CS5](#), [T1](#), [T2](#), [T3](#), [T4](#), [T6](#), [R2](#), [R3](#), [R4](#), [R5](#), [W2](#), [W2](#), [W4](#), [W5](#)

Competency 3: Examine sustainable agriculture practices in plant production. [PS.02](#), [PS.03](#), [PST.05](#), [E3](#), [E4](#), [ES 1](#), [ES 2](#), [ES 3](#), [NRS.01](#), [NRS.03](#), [NRS.04](#), [NRS.05](#), [PS.04](#), [SP 1](#), [SP 2](#)

Suggested Enduring Understandings

1. Sustainable agriculture involves the conservation and management of natural resources so that these resources can continue to be used to produce over future generations.
2. A point source of pollution can be identified to one specific place. A nonpoint source of pollution comes from many different places.
3. Soil and water conservation methods are designed to protect soil and water supplies while still allowing them to be used to produce food and other products.
4. Precision farming is a relatively new technique that employs the use of microcomputers, geographic information software, global positioning systems, remote sensing, and machinery controllers to reduce costs and increase yields in crops.

Suggested Essential Questions

1. How do sustainable agriculture practices enhance and protect the environment?
2. What is the difference in point and nonpoint pollution sources?
3. What are the common soil and water conservation methods, and how do they contribute to the environment?
4. What is precision farming, and why is it being used more frequently?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe how the concept of sustainable agriculture protects and enhances the environment. (DOK 2)	a. Prior to teaching this competency, have students read the section on <i>Sustainable Resource Use</i> from the text (Biondo & Lee, 2003). Use the <i>Concept Map</i> activity from the activity manual (Biondo, 2002) to lead a class discussion on ideas related to sustainability. After the discussion, have students draw concept maps for a given enterprise. CS2 , CS4 , T4 , M5 , R1 , R2 , R3 , R4 , R5 , W2 , W4	a. Evaluate students' concept maps for completeness and accuracy.
b. Distinguish	b. Have students write down definition of point and	b. Use the <i>Group</i>

between point and nonpoint pollution sources. (DOK 2)	nonpoint pollution. Using a Pictionary Activity, the instructor should develop a handout with pictures of various types of point and nonpoint pollution sources, like Pictionary cards, place student in groups, and use pictograph game rules. CS1, CS2, CS4, CS5, T1, T2, T4, R2, R3, R4, R5, W2, W3, W4, W5	<i>Participation Rubric (7.1)</i> to evaluate student mastery.
c. Describe soil and water conservation methods used in agriculture. (DOK 1)	c. After discussing methods of soil and water conservation, have students develop a poster or computer graphic following the rules set up by the National Association of Conservation Districts (http://www.nacdnet.org/education/contests/poster/). Invite a representative of the local Natural Resource Conservation Service office to help score posters and speak on conservation issues and solutions. CS1, CS2, CS4, CS5, T1, T2, T3, T4, R1, R2, R3, R4, R5, W2, W4	c. Use the <i>Soil and Water Conservation Graphic Rubric (7.10)</i> to evaluate the graphics created by the students.
d. Describe precision farming. (DOK 1)	d. Prior to teaching this competency, have students read the section on <i>Precision Farming</i> from the text (Biondo & Lee, 2003). Have a guest speaker from a local community college or extension service to discuss precision farming and provide an overview of the major components of a precision farming system (microcomputers, GIS, GPS, and controllers). Have students take notes and follow up the presentation with questions and comments. List important points on the LCD projector, and have students enter these points into their electronic notebooks or journals. CS1, CS3, CS4, T3, T6, R1, R2, R4, W2, W4, W5	d. Use the <i>Guest Speaker Evaluation Form (7.8)</i> to evaluate student mastery.

Standards

AFNR Industry Standards

- NRS.01. Explain interrelationships between natural resources and humans necessary to conduct management activities in natural environments.
- NRS.02. Apply scientific principles to natural resource management activities.
- NRS.03. Apply knowledge of natural resources industries to production and processing industries.
- NRS.04. Demonstrate techniques used to protect natural resources.
- NRS.05. Use effective methods and venues to communicate natural resource processes to the public.
- PS.01. Apply knowledge of plant classification, plant anatomy, and plant physiology to the production and management of plants.
- PS.02. Prepare and implement a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.
- PS.03. Propagate, culture, and harvest plants.
- PST.05 Apply technology principles in the use of agricultural technical systems.

Applied Academic Credit Standards

Earth Science

- E3 Discuss factors which are used to explain the geological history of earth.
- E4 Demonstrate an understanding of earth systems relating to weather and climate.

Environmental Science

- ES 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ES 2 Develop an understanding of the relationship of ecological factors that affect an ecosystem.
- ES 3 Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.

Spatial Information Science

- SP 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- SP 2 Develop an understanding of geographic information systems.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS3 Social & Cross-Cultural Skills
- CS4 Productivity & Accountability
- CS5 Leadership & Responsibility

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

M1	Basic Operations and Applications
M5	Graphical Representations
R1	Main Ideas and Author's Approach
R2	Supporting Details
R3	Sequential, Comparative, and Cause–Effect Relationships
R4	Meaning of Words
R5	Generalizations and Conclusions
W1	Expressing Judgments
W2	Focusing on the Topic
W4	Organizing Ideas
W5	Using Language

Suggested References

- Biondo, R. J., & Lee, J. S. (2003). *Introduction to plant and soil science technology* (2nd ed.). Lebanon, IN: Interstate Publishing.
- Biondo, R. J., & Lee, J. S. (2002). *Introduction to plant and soil science technology activity manual* (2nd ed.). Lebanon, IN: Interstate Publishing.
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Science of Agricultural Plants

Unit 8: Pest Management

10 Hours

Competency 1: Assess the effects of pests on plant production. PS.03 , FPP.02, NRS.04, BIOI 3, BIOI 6, BO 4

Suggested Enduring Understandings

1. The three common categories of plant pests are weeds, insects, and diseases.

Suggested Essential Questions

1. What are the most common insect, weed, and disease plant pests?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify types of plant pests (insects, wildlife, diseases, and weeds), and describe how each type of pest affects production. (DOK 1)	a. Have students read out loud about from the section on Management of Plant Pests in the text (Biondo & Lee, 2003). Have students collect weed samples from school campus and/or greenhouse and bring them back to the classroom. Use the Web site Weeds of Lawns, Yards and Flowerbeds in Mississippi to project images of different weeds and identify the weeds collected. Identify types of weeds collected. Have students identify insect and disease problems in the greenhouse; collect and observe under a microscope. While observing, instructor could include comments about host plants and susceptibility, resistance to pesticides, and biological control methods. Instructor should tailor further instruction according to crops grown in the area. The types of plant pests instruction should cover the following: Insects - o Siphoning - o Chewing - o Sucking - o Piercing Diseases - o Fungus - o Viruses - o Bacteria Weeds - o Annuals - o Perennials - o Biennials Wildlife - o Raccoon	b. Evaluate the <i>Pest Identification Chart (8.1)</i> for accuracy and completeness. The plant pest brochure should be graded by a presentation rubric.

- o Deer
- o Rabbit
- o Armadillo

Have students collect at least 10 pests and enter the appropriate information on the *Pest Identification Chart (8.1)*. The students will create a brochure describing the types of plant pests with their characteristics. CS1, CS2, CS4, CS5; T2, T4, R3, R4, R5, W1, W2, W4

Competency 2: Examine concepts of plant pest control. NRS.01, NRS.04, PS.03, BIOI 3, BIOI 6, BO 4

Suggested Enduring Understandings

1. Pest control may be achieved by means of biological, chemical, cultural, and mechanical methods.
2. Many insects are actually beneficial to plants since they prey on other insects that damage plants.
3. Crop rotation plays an important role in pest control by disrupting insect, weed, and disease cycles.

Suggested Essential Questions

1. How are biological and cultural pest control methods related?
2. What are examples of biological, chemical, and mechanical plant pest controls?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Discuss the relationship between biological, chemical, cultural, and mechanical control methods. (DOK 2)	a. Use the <i>Insect Populations Critical Thinking Activity</i> in the text (Biondo & Lee, 2003) to help students understand how pest populations multiply. Have students review text material covered in the sections related to integrated pest management, insect and nematode management, plant disease management, and weed management from the text (Biondo & Lee, 2003). Have students develop a table biological, chemical, cultural, and mechanical control methods and compare similarities. Instruction can be reinforced using greenhouse activities. CS2, CS4, T4, M5, R1, R2, R3, R4, R5, W4	a. Evaluate the biological, chemical, cultural, and mechanical control comparison table for accuracy and completeness.
b. Identify beneficial insects, and discuss how they benefit plants. (DOK 2)	b. Have students investigate one of the beneficial insects listed below and prepare a <i>Beneficial Insects Ag News Report (8.2)</i> that includes a picture of the insect, plants that are associated with the insect, and pests that they aid in controlling. Students should share their findings with the class. CS1, CS2, CS4, CS5, T1, T2, T3, T4, T6, R1, R2, R3, R5, W1, W2, W4, W5	b. Use the <i>Beneficial Insects Ag News Report (8.2)</i> that to evaluate student mastery.

Beneficial Insects

- o Ladybugs - o Parasitic wasps - o Praying mantis - o Bees		
c. Interpret safety precautions and formulations on pesticide labels. (DOK 2)	c. Use the Environmental Protection Agency Read the Label First Web site to allow students to read about the information that is required to be printed on a pesticide label. Assign a specific chemical pesticide to each student, and have him or her search for label information on the web and complete the <i>Pesticide Label Interpretation Assignment (8.3)</i> to interpret that information. CS1, CS2, CS4, CS5, T3, T6, R2, R3, R4, R5, W1, W2, W4, W5	c. Evaluate the assignment for completion and accuracy.
d. Design an integrated pest management plan for a designated crop. (DOK 3)	d. Divide the class into groups of two to three students, and assign each student a specific crop to design an integrated pest management plan. Using the Internet and other resources, the plan should include the name of the crop, typical pests encountered, and a description of cultural, mechanical, biological, and chemical methods what will be integrated for control of all pests. CS1, CS2, CS4, CS5, T1, T2, T3, T4, T6, R2, R3, R4, R5, W1, W2, W4, W5 The instruction should cover crops including the following: - o Corn - o Cotton - o Wheat - o Soybeans	d. Use the <i>Integrated Pest Management Plan Rubric (8.4)</i> to evaluate the IPM.

Standards

AFNR Industry Standards

- FPP.02. Apply safety principles, recommended equipment, and facility management techniques to the food products and processing industry.
- NRS.01. Explain interrelationships between natural resources and humans necessary to conduct management activities in natural environments.
- NRS.04. Demonstrate techniques used to protect natural resources.
- PS.03. Propagate, culture, and harvest plants.

Applied Academic Credit Standards

Biology I

- BIOI 3 Investigate and evaluate the interaction between living organisms and their environment.
- BIOI 6 Demonstrate an understanding of principles that explains the diversity of life and biological evolution.

Botany

- BO 4 Draw conclusions about the factors that affect the adaptation and survival of plants.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS4 Productivity & Accountability
- CS5 Leadership & Responsibility

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- M5 Graphical Representations
- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R3 Sequential, Comparative, and Cause–Effect Relationships
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- W2 Focusing on the Topic
- W4 Organizing Ideas
- W5 Using Language

Suggested References

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Science of Agricultural Plants

Unit 9: Marketing in Plant Production

5 Hours

Competency 1: Examine marketing practices used in crop and plant production. ^{ABS.06}

Suggested Enduring Understandings

1. Economic factors such as supply and demand and economies of scale affect the selection of crops and plants to be produced.
2. Usually several different markets are available, and marketing and transportation costs must be considered in selecting a market.

Suggested Essential Questions

1. How do economic factors affect plant production?
2. What markets are usually available for plant and crop products? How is a market selected?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify economic factors to consider in crops and plants to be produced. (DOK 1)	a. Prior to teaching this competency, have the students read the chapter on Marketing in the text (Burton & Cooper, 2007). Use the Marketing presentation (Oksa, n.d.) to lead a discussion of some basic concepts of crop marketing including utility, law of demand, law of supply, equilibrium price, price discovery, and economies of size. Have students summarize major points and definitions and record in their electronic notebooks or journals. ^{CS1, CS2, CS4, T3, T6, W4, W5}	a. Use a written test to evaluate student understanding.
b. Explore market availability. (DOK 1)	b. Lead a discussion on the pros and cons of different marketing options for plants and crop products such as sales to the public, wholesalers, retailers, cooperatives, regional and terminal markets, and direct sales to processors. Have students build a table in their electronic notebooks that summarizes the major points for each market option. ^{CS1, CS2, CS4, T3, T6, W4, W5}	b. Use a written test to evaluate student understanding.

Competency 2: Explore the economics of plant production. ^{ABS.06}

Suggested Enduring Understandings

1. The cash, futures, retail, and wholesale markets are all affected by the same forces. When one of these markets rises, the others usually follow.
2. The futures market can be used by producers to hedge against a loss in the cash market or as an investment by speculators.
3. In today's global economy, a factor that affects

Suggested Essential Questions

1. How are the different markets (cash, futures, retail, and wholesale) related to each other?
2. How is the futures market used by producers and speculators?
3. What are some issues arising from global

the market in one country will impact on the marketing?
markets in other countries.

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Differentiate between cash, futures, and wholesale and retail markets. (DOK 1)	a. Define the four different types of markets, and discuss the differences between the four different types of markets. Have students show how the four markets are related to and affect each other over time. CS1, CS2, CS4	a. Use a written test to evaluate student understanding.
b. Discuss the use of the futures market as a tool for hedging against risk and as a tool for speculation. (DOK 1)	b. Use the presentation Using Futures (Georgia Agricultural Education Curriculum Office, 2002) to acquaint students with the basic operation of the futures markets to “hedge” against a loss. Explain that producers use the futures market to “lock in” a price on their grain. Speculators are people who do not have grain to sell in the cash market but speculate that the futures price will either rise or fall before the contract closes. Have students track and graph prices on the cash and futures market over time to see the relationship between the two. CS1, CS2, CS4, T3, T6, M5	b. Evaluate student assignment to track prices over time on the cash and futures markets for accuracy and correctness.
c. Explore global marketing issues for crop and plant products. (DOK 1)	c. Have students track and graph commodity prices over a period of 1 month at several international markets for crops such as soybeans, rice, and wheat (London, Chicago, Hong Kong, Sao Palo, etc.). Have students note reasons for changes in prices and also note the relationship between the markets. CS1, CS2, CS4, T3, T6, M5, S1	c. Check graph and notes for accuracy and correctness.

Standards

AFNR Industry Standards

ABS.06. Use industry-accepted marketing practices to accomplish AFNR business objectives.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS4 Productivity & Accountability

National Education Technology Standards for Students (NETS)

- T3 Research and Information Fluency
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- M5 Graphical Representations
- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- S1 Interpretation of Data
- W2 Focusing on the Topic
- W4 Organizing Ideas
- W5 Using Language

Suggested References

- Biondo, R. J., & Lee, J. S. (2003). *Introduction to plant and soil science technology* (2nd ed.). Lebanon, IN: Interstate Publishing.
- Biondo, R. J., & Lee, J. S. (2002). *Introduction to plant and soil science technology activity manual* (2nd ed.). Lebanon, IN: Interstate Publishing.
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Student Competency Profile

Student Name: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Introduction to Agricultural Plants

- _____ 1. Examine how plants are used to meet human and environmental needs.
- _____ 2. Examine plant production enterprises.
- _____ 3. Demonstrate career and leadership skills required for employment in the plant industry.
- _____ 4. Demonstrate general safety precautions for the laboratory and greenhouse.

Unit 2: Experiential Learning (SAE)

- _____ 1. Plan and implement an experiential learning program.
- _____ 2. Maintain records and documentation of experiential learning activities, projects, and enterprises.

Unit 3: Plant Growth and Nutrition

- _____ 1. Examine the principles of plant growth.
- _____ 2. Discuss basic principles of plant nutrition and soil pH.
- _____ 3. Analyze soil fertility, and calculate fertilizer application rates for a specific crop.

Unit 4: Plant Classification and Physiology

- _____ 1. Examine plant classification methods.
- _____ 2. Investigate plant anatomy.
- _____ 3. Assess physiological principles of plants.

Unit 5: Plant Reproduction and Propagation

- _____ 1. Examine the principles of genetics.
- _____ 2. Distinguish between sexual and asexual reproduction.

Unit 6: Plant Growing Structures

- _____ 1. Describe the use of various plant growing structures and their environmental control systems.

Unit 7: Cultural and Harvesting Practices

- _____ 1. Examine types of growing media.
- _____ 2. Explore tillage, irrigation practices, harvesting methods, and harvest timing.
- _____ 3. Examine sustainable agriculture practices in plant production.

Unit 8: Pest Management

- _____ 1. Assess the effects of pests on plant production.
- _____ 2. Examine concepts of plant pest control.

Unit 9: Marketing in Plant Production

- _____ 1. Examine marketing practices used in crop and plant production.
- _____ 2. Explore the economics of plant production.

Appendix A: Suggested Rubrics, Checklists, and Activities

Name: _____
Date: _____
Period: _____

Plant Use in Daily Life Assignment (1.1)

Use the table below to list all the different plant products that you come in contact with over the next 24 hr. Identify part of each plant associated with each product. (Example: Paper is used as a fiber and comes from the trunks and limbs of trees. Corn flakes are used for food and come from the corn grain.)

Product	Use	Plant Part

Name:
Date:
Period:

Plant Production Fact Sheet (1.2)

Your teacher will assign you a plant that is produced for food, fiber, or ornamental purposes. Use the Internet and other sources to compile a fact sheet similar to the one shown below.

Insert a picture of the plant here.

What is the common name of the plant?

What is the scientific name of the plant?

What parts of this plant are useful, and what are they used for?

What is the growing season for this plant? Where does it grow?

How is this crop planted or reproduced?

What are the major cultural practices associated with this crop?

How is this crop harvested or sold? Where are the closest markets for this crop?

What are the estimated costs and returns for growing this crop?

Name: _____

Date: _____

Period: _____

21st Century Life and Career Skills (1.3)

Today's life and work environments require far more than thinking skills and content knowledge. The ability to navigate the complex life and work environments in the globally competitive information age requires students to pay rigorous attention to developing adequate life and career skills.

CS1 Global Awareness

1. Using 21st century skills to understand and address global issues
2. Learning from and working collaboratively with individuals representing diverse cultures, religions, and lifestyles in a spirit of mutual respect and open dialogue in personal, work, and community contexts
3. Understanding other nations and cultures, including the use of non-English languages

CS2 Financial, Economic, Business, and Entrepreneurial Literacy

1. Knowing how to make appropriate personal economic choices
2. Understanding the role of the economy in society
3. Using entrepreneurial skills to enhance workplace productivity and career options

CS3 Civic Literacy

1. Participating effectively in civic life through knowing how to stay informed and understanding governmental processes
2. Exercising the rights and obligations of citizenship at local, state, national, and global levels
3. Understanding the local and global implications of civic decisions

CS4 Health Literacy

1. Obtaining, interpreting and understanding basic health information and services and using such information and services in ways that enhance health
2. Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance, and stress reduction
3. Using available information to make appropriate health-related decisions
4. Establishing and monitoring personal and family health goals
5. Understanding national and international public health and safety issues

CS5 Environmental Literacy

1. Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water, and ecosystems
2. Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.)
3. Investigate and analyze environmental issues, and make accurate conclusions about effective solutions
4. Take individual and collective action towards addressing environmental challenges (e.g., participating in global actions, designing solutions that inspire action on environmental issues)

CSS2-Learning and Innovation Skills

CS6 Creativity and Innovation

1. Think Creatively

2. Work Creatively with Others
3. Implement Innovations

CS7 Critical Thinking and Problem Solving

1. Reason Effectively
2. Use Systems Thinking
3. Make Judgments and Decisions
4. Solve Problems

CS8 Communication and Collaboration

1. Communicate Clearly
2. Collaborate with Others

CSS3-Information, Media and Technology Skills

CS9 Information Literacy

1. Access and Evaluate Information
2. Use and Manage Information

CS10 Media Literacy

1. Analyze Media
2. Create Media Products

CS11 ICT Literacy

1. Apply Technology Effectively

CSS4-Life and Career Skills

CS12 Flexibility and Adaptability

1. Adapt to change
2. Be Flexible

CS13 Initiative and Self-Direction

1. Manage Goals and Time
2. Work Independently
3. Be Self-directed Learners

CS14 Social and Cross-Cultural Skills

1. Interact Effectively with others
2. Work Effectively in Diverse Teams

CS15 Productivity and Accountability

1. Manage Projects
2. Produce Results

CS16 Leadership and Responsibility

1. Guide and Lead Others
2. Be Responsible to Others

Name: _____

Date: _____

Period: _____

Rubric for Evaluating Life and Career Skills (1.4)

The following scale can be used to assess application of each of the Life and Career Skills of students.

Superior	(18–20 points) The student consistently demonstrates all aspects of this skill in classroom and laboratory activities.
Exceptional	(15–17 points) The student consistently demonstrates most of the aspects of this skills in classroom and laboratory activities but lapses at times on one to two of the indicators.
Adequate	(12–14 points) The student demonstrates knowledge of the skill during classroom and laboratory activities but lapses on three or more indicators from time to time.
Improving	(9–11 points) The student is vaguely aware of the skill but shows only marginal evidence of being able to apply it in the classroom or laboratory.
Minimal	(0–8 points) The student consistently fails to demonstrate knowledge or application of the skill.

Skill	Comments	Score
Flexibility and Adaptability		
Initiative & Self-Direction		
Social & Cross-Cultural Skills		
Productivity & Accountability		
Leadership & Responsibility		
TOTAL SCORE		

Name: _____

Date: _____

Period: _____

Rubric for Evaluating Role-Play on Behavior (1.5)

	Excellent 4 Points	Good 3 Points	Average 2 Points	Needs Improvement 1 Point	Score
Accuracy	All information was accurate.	Almost all information was accurate.	Most information was accurate.	Very little information was accurate.	
Role	Excellent character development; student contributed in a significant manner	Good character development; student contributed in a cooperative manner	Fair character development; student may have contributed	Little or no character development; student did not contribute much at all	
Knowledge Gained	Consistently showed specific knowledge of proper and improper behavior	Showed general knowledge of proper and improper behavior	Showed limited knowledge of proper and improper behavior	Did not show any knowledge of proper and improper behavior	
Props	Used several props and showed considerable creativity	Used one or two appropriate props that made the presentation better	Used one or two props that made the presentation better	Used no props to make the presentation better	
Required Elements	Included more information than required	Included all required information	Included most required information	Included less information than required	
TOTAL					

Comments:

Name: _____

Date: _____

Period: _____

Interpret a Materials Safety Data Sheet Worksheet (1.6)

Your instructor will assign you a common material found in agricultural enterprises that can pose a hazard to your health or the environment. Using the Internet, search for information to answer the following questions.

1. What is the common name of this material?
2. How hazardous is this material to your health?
3. If you accidentally drank or ate some of this material, what should you do?
4. If you accidentally spilled some of this material, what should you do?
5. How should you store this material?
6. If you no longer need this material, how should you dispose of it?

Name: _____
 Date: _____
 Period: _____

HACCP Fact Sheet Evaluation Rubric (1.7)

	Exemplary	Accomplished	Developing	Beginning	Score
Content	Content is accurate and detailed and applies to agricultural production practices. (60 points)	Content is accurate but general in nature with some application to agricultural practices. (45 points)	Content is accurate but general in nature with limited application to agricultural practices. (30 points)	Content does not focus on assigned topic, is inaccurate, or is totally unrelated to agricultural practices. (10 points)	
Grammar	Correct and effective use of grammar and mechanics (20 points)	Occasional minor errors in use of grammar and mechanics (15 points)	Problems in use of grammar and mechanics (10 points)	Repeated errors in use of grammar and mechanics (5 points)	
Organization	Ideas flow smoothly and logically with clarity and coherence. (20 points)	Logical order and appropriate sequencing of ideas with adequate transition (15 points)	Some evidence of an organizational plan or strategy (10 points)	Lacks organization (5 points)	
Total					

Comments

Name: _____

Date: _____

Period: _____

Rubric for Experiential Learning Planning and Record Keeping (2.1)

Scoring Criteria				
	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Long-range and short-term goals reflect the educational and career goals of the student.				
The SAE plan/training agreement reflects growth in student skill and proficiency.				
Records accurately reflect all SAE accomplishments of the student over the year.				
Records are maintained on a timely basis.				
Journals or calendars are maintained on a timely basis and serve as the source for record keeping.				
Hours and earnings are recorded based on activities.				
A summary of all activities is provided at the end of each grading period.				
Financial records are maintained accurately.				
Financial records are summarized at the end of the year.				

Name: _____

Date: _____

Period: _____

Pre-Knowledge Assessment Example (3.1)

What I Already Know		
Questions you could ask to stimulate thinking	MITOSIS	MEIOSIS
Where does mitosis/meiosis take place in plants?	Roots, stems, leaves, flower parts	Only in reproductive cells
	Asexual reproduction	Sexual reproduction
What results in greater genetic variation?	Duplication of genetic makeup	Genetic variation
How are the chromosomes divided in the new cells?	Same number of chromosomes	Cells with half the number of chromosomes

Note to Instructor: Below is an explanation for the questions in the table above.

What do chromosomes do?

Mitosis produces two daughter cells that are identical to the parent cell. If the parent cell is **haploid (N)**, then the daughter cells will be haploid. If the parent cell is diploid (**2N**), the daughter cells will also be diploid.

$N \rightarrow N$

$2N \rightarrow 2N$

This type of cell division allows multicellular organisms to grow and repair damaged tissue.

Meiosis produces daughter cells that have one half the number of **chromosomes** as the parent cell.

$2N \rightarrow N$

Taken from

<http://faculty.clintoncc.suny.edu/faculty/michael.gregory/files/Bio%20101/Bio%20101%20Lectures/Mitosis/mitosis.htm#Haploid,%20Diploid>

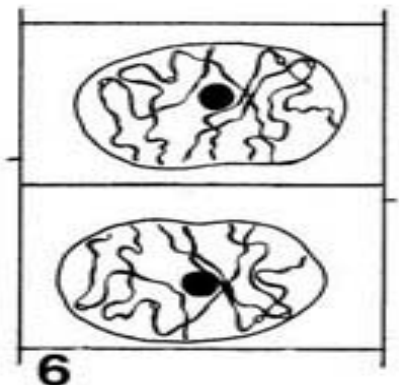
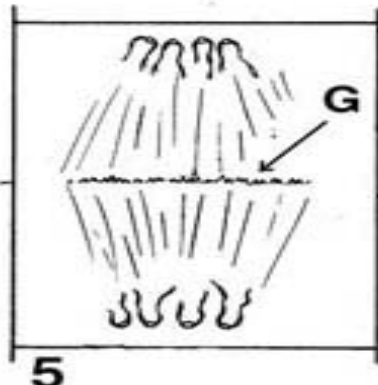
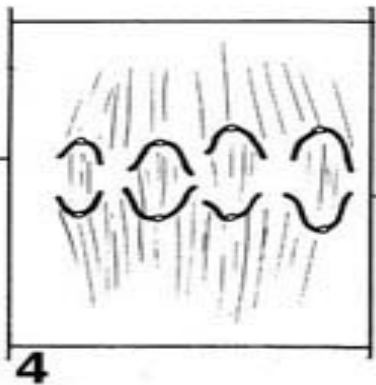
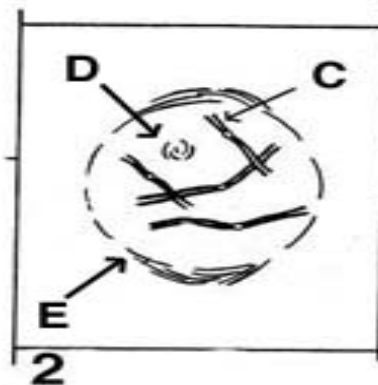
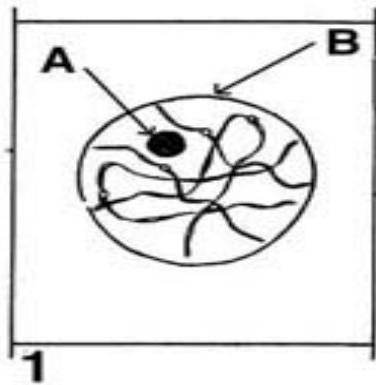
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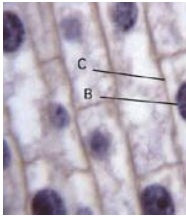
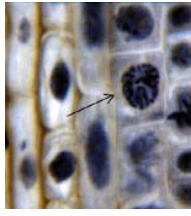
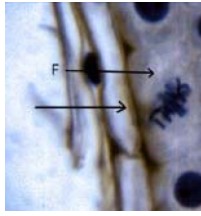
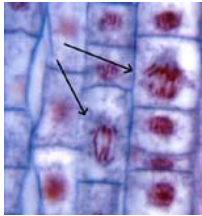
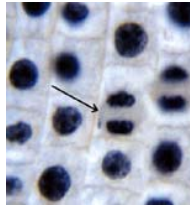
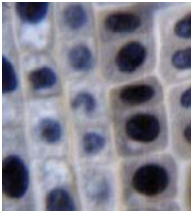
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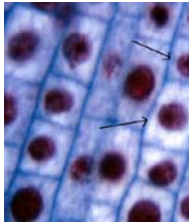
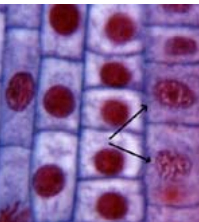
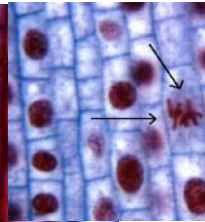
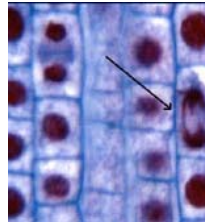
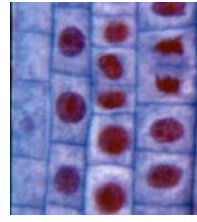
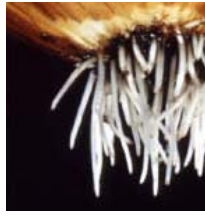
Period: _____

Onion Root Mitosis Activity (3.2)

DIRECTIONS: Check out the onion root slides, and read descriptions of each stage of mitosis on the following pages; then label the diagram.



					
This onion cell is in the interphase stage of the cell cycle. Early in interphase the cell reaches its full size and then starts preparing for its next division. Preparation includes chromosome replication, replication of cellular organelles, and the synthesis of microtubules. Distinct chromosomes are not visible at this time, but the nuclear region appears prominent after staining (B). Nucleoli also are present during interphase, and a single nucleolus is shown in the photo above (A). The cell wall (C) clearly identifies the cell as being from a plant.	The arrow in the photo points to a cell in the prophase stage of mitosis. The chromosomes are becoming visible, the nucleolus has disappeared, and the nuclear envelope has broken down. These events, along with the assembling of a spindle apparatus, not visible in this photo, mark the prophase stage of mitosis. Label diagram 2, (c) chromosome, (d) nucleolus, and (e) nuclear envelope.	The arrow in the photograph points to a cell in metaphase. The chromosomes are attached to the microtubules of the spindle, and they are lined up across the equator of the cell in a circle that is perpendicular to cell's long axis. At this time it is possible to see, using higher magnification, that each chromosome consists of two chromatids. Remember that the chromatids were formed during interphase when replication occurred. Label F and the arrow point to the region of the spindle. It is lighter in shade than the rest of the surrounding cytoplasm. Finish labeling diagram 3.	In the photograph, arrows point to two anaphase stage cells. In both cells sister chromatids, now individual chromosomes, have separated from one another. Their separation is caused by the removal of microtubular units at the polar ends of the fiber to which the chromosomes are attached. This process shortens the fiber and draws the chromosome ever closer to the pole. Label diagram 4.	The arrows point to two cells beginning the telophase stage of mitosis. During this stage the spindle is disassembled, and the nuclear envelope reforms around each set of chromosomes. The chromosomes also begin to uncoil during this phase, and soon they take on a more thread-like appearance. Telophase completes the process of mitosis. Label diagram 5.	Note that the daughter cells indicated by the arrows are approximately one half the size of the original cell. Note also that the nuclear envelope is present again and the individual chromosomes are no longer visible. Also there is some evidence of nucleoli within the nuclear region. This indicates rRNA synthesis is underway. The partition dividing the new cells is still incomplete, but in time cellulose will be laid down to form a complete wall. The new cells now enter the interphase stage and start their period of rapid growth and begin to prepare for their next division.

					
These cells have been stained using a different dye. Notice that many of the cells are in the interphase stage as they show a distinct nuclear region with nucleoli. <u>Label your drawing (1) of the interphase cell and then begin labeling drawing 2.</u>	The arrows point to two cells in prophase. The chromosomes are just becoming visible in this microscope photograph taken at a magnification of 1000X. The change in the chromosome from being thread-like and invisible is the result of the process of condensation where the chromosome coils and becomes very thick and compact. The growing but unfinished spindle apparatus being constructed at this time is not visible.	Metaphase ends as the chromatids of each chromosome begin their separation and start their migration to the opposite poles of the cell. The upper arrow points to the region of the spindle apparatus. The lower arrow points to the cell at metaphase. Label diagram 3 and then begin labeling drawing 4.	In this anaphase photograph, the separating sets of chromosomes are reaching the opposite poles of the cell. The genetic information in each set of chromosomes is identical as each set contains replicated "carbon copies" of the original set present in the cell at the start of interphase.	This cell, at the end of telophase, is beginning to assemble a cell plate that will eventually cut across the cell and partition the cytoplasm. The cell plate appears as a thin blue line midway between the groups of chromosomes in the photo. The assembly of the cell plate also produces two daughter cells (6). Label the cell plate (G).	

Name: _____

Date: _____

Period: _____

Challenge Activity – Onion Root Tip Experiment (3.3)

1. Learn about cell division by working through the interactive tutorial on mitosis (http://biologyinmotion.com/cell_division/index.html).
2. Learn about cell division in onion root tips.
[Online onion root tips - p. 1](#)
[Online onion root tips - p. 2](#) description
[Online onion root tips - p. 3](#) determining time spent in different phases of the cell cycle

Materials

- Onion
- Container of water
- Microscope slides
- Toluidine blue
- Compound microscope
- Paper towel

Procedure

1. Set the bottom part of an onion in water. Leave it there for about 4 to 5 days, until the roots begin to grow.
2. When the roots are about 2 cm long, with active growth, cut several millimeters of some of the roots off.
3. Place the roots on a microscope slide; cut them lengthwise.
4. Press another slide down on the roots to mash them, and then remove the top slide.
5. Add some nuclear stain such as toluidine blue.
6. To stop the cell division and to quicken the stain, warm the slide over a flame for a few seconds, without allowing the liquid to boil.
7. Add a few more drops of stain, and let the sample sit for a few minutes.
8. After a few minutes, blot the stain with a paper towel.
9. Add a few drops of water, and put a coverslip on it.
10. Observe with a microscope. Look for the various stages of cell division.

	Interphase	Prophase	Metaphase	Anaphase	Telophase	Total
# of cells						
% of cells						

Name: _____

Date: _____

Period: _____

Mississippi MCT Biology Sample Questions (3.4)

Biology State Test Questions Related to PS.3.1a

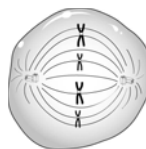
Highlights are the correct answers.

54. Meiosis is different from mitosis because meiosis produces:

- A. consistent genetic makeup of all gametes.
- B. larger daughter cells.
- C. two gametes for every original parent cell.
- D. cells with half the number of chromosomes.

57. What phase of mitosis is represented by the diagram shown above?

- A. Metaphase
- B. Prophase
- C. Telophase
- D. Interphase



63. Unlike mitosis, meiosis occurs only in:

- A. reproductive cells.
- B. muscle cells.
- C. connective tissue cells.
- D. nerve cells.

24. Sexual reproduction in plants depends on sex cells being produced by the process of:

- A. osmosis.
- B. fermentation.
- C. transpiration.
- D. meiosis.

37. Meiosis results in greater genetic variation than asexual reproduction because it:

- A. is a lengthy process full of errors.
- B. results in a greater number of offspring.
- C. is more common in higher order species.
- D. allows the recombination of genetic information.

Name: _____

Date: _____

Period: _____

Ag News Rubric (3.5)

Student Name	Content relevant to plant growth retardants and stimulants (40 points)	Content current, accurate, and reliable (40 points)	Grammar, punctuation, and spelling (20 points)	Total (100 points possible)

Name: _____

Date: _____

Period: _____

Tropism Summary and Demonstration Rubric (3.6)

[illegible]

Name: _____

Date: _____

Period: _____

Plant Nutrient PowerPoint Presentation (3.7)

Worth 100 points

	Points Worth	Points Obtained
Slide Creation		
• Title slide	5	
• Introduction slide (identify if macro/micro; elemental symbol)	5	
• Function in the Plant slide with pH reference	10	
• Deficiencies/Excess explanation with Illustration	10	
• Summary (no new information presented)	10	
• Reference Page	5	
Slide Format		
Bulleted list instead of paragraphs on slides	10	
Text Format/Capitalization Consistency (i.e., titles, bullets)	10	
Transition and Effect	5	
Presentation of Information		
• Voice Projection	10	
• Posture	5	
• Eye Contact with Audience	5	
• Familiar with Content	5	
• Answers to questions	5	
Subtotal		
Minus 2 points for each misspelled word		
Minus 5 points for presentation over 5 minutes NOT including questions		
Total		

- Each slide should have "Title Case."
- Bulleted list should have consistency in formatting with no more than six bullets/slide.
- Summary never contains "new information."
- Reference page should include where it came from (i.e., organization), not just the Web address.
- Presentation should be no longer than 5 minutes that does not include answers to questions.

Name: _____

Date: _____

Period: _____

Nutrient Deficiencies and Excesses Experiment (3.8)

Daily Observation Table

Treatment	Replication	Plant Height	Vigor Rating	Comments
Fertilizer Type	T-I			
	T-II			
Control Group	C-1			
	C-2			

Follow-Up Observations

Follow-up Observation and Summary

Treatment	Replication	Average Plant Height	Average Vigor Rating	Comments on color, deficiencies, excesses, etc.
Fertilizer Type	T-I			
	T-II			
Control Group	C-1			
	C-2			

Major Findings, Summary, and Recommendations: (Note to Instructor: Tables can be tailored to fit the experimental design. Students should record procedures and summarize results. Instructor can provide examples of findings, summary, and recommendations.)

Name: _____

Date: _____

Period: _____

Daily Participation Checklist (3.9)

CATEGORY	90–100 points/day	80–89 points/day	70–79 points/day	60–69 points/day	0–59 points/day
Attitude	Consistently positive attitude	Mostly positive attitude	Somewhat positive attitude	Neutral attitude	Somewhat to totally negative attitude
Pride	Work reflected the best the student could offer.	Work reflected a strong effort.	Work reflected some effort.	Work reflected very little effort.	No effort and no work
Focus on the Task	Student consistently focused on task or topic.	Student focused on task or topic most of the time.	Student focused on the task or topic some of the time.	Student paid little attention to the task or topic.	Student did not focus on the assigned task or topic.
Participation	Student consistently participated in an appropriate manner.	Student participated most of the time.	Student participated some of the time.	Student participated occasionally.	Student refused to participate.

Name: _____

Date: _____

Period: _____

Soil Test Report Summary (3.10)

Directions: Put your name on the top line, and fill in information under each column about the soil sample you brought in. Do the same for your group and each classmate.

Student Name	Soil Sample Site	Soil Type	Soil pH	Nutrient Content (if taken)			Recommendations
				N	P	K	

The purpose of this table is to compile **all** soil sample information. Students should write down their results and their group test results and other classmate test results.

Name: _____

Date: _____

Period: _____

Fertilizer Calculation Worksheet (3.11)

For each of the following situations, calculate the total amount of fertilizer that should be applied. You may use a calculator, but show all calculations in the space below each situation. (Round your answer to the nearest whole pound.)

1. A soil test reports that you should apply 60 lb of active nitrogen per acre to a corn field. If you are planning on using ammonium nitrate which is 34% N, how many pounds of this material would you apply on one acre?
2. Ammonium phosphate is a fertilizer material with an analysis of 18-46-0. If a soil test calls for application of 50 lb of active phosphate per acre, how many pounds of this material would you apply to a 120-acre pasture?
3. A soil test for a lawn calls for the application of $1 \frac{1}{2}$ lb of active nitrogen per 1,000 sq ft. If calcium nitrate contains 15% active N, how many pounds will be needed for a lawn that is 7,000 sq ft?
4. A soil test shows that a lawn is deficient in nitrogen and phosphate. If the test recommends that at least 1 lb of nitrogen and 2.5 lb of phosphate be applied to every 1,000 sq ft of lawn and if ammonium phosphate is rated as an 18-46-0 fertilizer, how many pounds of ammonium phosphate would you apply to a 10,000 sq ft lawn to make sure you applied enough nitrogen? At this rate, how many pounds of phosphate would you also be applying?

ANSWER SHEET FOR FERTILIZER CALCULATION WORKSHEET

1. 1 pound ammonium nitrate = 0.34 lb active nitrogen

$60 \text{ lb active nitrogen} \div 0.34 \text{ lb active nitrogen/1 lb ammonium nitrate} = 176 \text{ lb ammonium nitrate per acre}$

2. 1 lb ammonium phosphate = 0.46 lb active phosphate

$50 \text{ lb active phosphate} \div 0.46 \text{ lb active phosphate/1 lb ammonium phosphate} = 109 \text{ lb ammonium phosphate per acre}$

$109 \text{ lb per acre} \times 120 \text{ acres} = 13,080 \text{ lb}$

3. 1 lb calcium nitrate = 0.15 lb active nitrogen

$1 \frac{1}{2} \text{ lb active nitrogen} \div 0.15 \text{ lb active nitrogen/1 lb calcium nitrate} = 10 \text{ lb calcium nitrate per 1,000 sq ft}$

$10 \text{ lb/1,000 sq ft} \times 7,000 \text{ sq ft} = 70 \text{ lb of calcium nitrate}$

4. 1 lb ammonium phosphate = 0.18 lb active nitrogen and 0.46 lb active phosphate

$1 \text{ lb active nitrogen} \div 0.18 \text{ lb active nitrogen/1 lb ammonium phosphate} = 6 \text{ lb ammonium phosphate per 1,000 sq ft}$

$6 \text{ lb/1,000 sq ft} \times 10,000 \text{ sq ft} = 60 \text{ lb}$

$6 \text{ lb ammonium phosphate} \times 0.46 \text{ lb active phosphate per 1 lb ammonium phosphate} = 3 \text{ lb active phosphate}$

Name: _____

Date: _____

Period: _____

Questions for Unit Test (3.12)

Plant Growth and Nutrition Unit Test

Highlights are the correct answers.

Directions: Circle T if the statement is correct and F if the statement is false (5 pts ea).

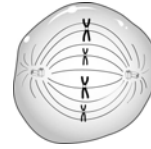
	True	False	Question
1	T	F	The tendrils of a muscadine vine are an example of phototropism.
2	T	F	Phototropism is caused by a plant hormone called auxin.
3	T	F	Plant growth stimulants are different from fertilizers.
4	T	F	Growth retardants help growers produce taller plants.
5	T	F	Blossom Buster (10-45-15) is high as potassium.
6	T	F	Nitrogen deficiency will cause a plant to have red spots on leaves.
7	T	F	There are 16 macronutrients.
8	T	F	Soil pH has no effect on plant nutrient availability.
9	T	F	Applications of lime will increase the pH of a soil.
10	T	F	The chemical formula for limestone is CaCO_3 .

Directions: Multiple Choice. Circle the best answer for each question (5 pts each). Questions 1, 2, 3, and 4 can be found on Biology State Sample Items.

- Meiosis is different from mitosis because meiosis produces:
 - genetic variation.
 - cells with half the number of chromosomes.
 - roots, stems, leaves, and flower parts.
 - both a and b.
- Unlike mitosis, meiosis occurs only in:
 - reproductive cells.
 - muscle cells.
 - connective tissue cells.
 - nerve cells.
- Sexual reproduction in plants depends on sex cells being produced by the process of:
 - osmosis.
 - fermentation.
 - transpiration.
 - meiosis.

4. What phase of mitosis is represented by the diagram show?

- a. Metaphase
- b. Prophase
- c. Telophase
- d. Interphase



5. Meiosis results in greater genetic variation than asexual reproduction because it:

- a. is a lengthy process full of errors.
- b. results in a greater number of offspring.
- c. is more common in higher order species.
- d. allows the recombination of genetic information.

6. The key nutrient that gives plants a rich green color is:

- a. nitrogen.
- b. phosphorous.
- c. potassium.
- d. calcium.

7. Nitrogen deficiency symptom causes a condition in the plant called:

- a. Tropism.
- b. etiolation.
- c. elongation.
- d. chlorosis.

8. How much nitrogen is in a 50-lb bag of 10-6-4 fertilizer? (Taken from AgScience textbook, 2002, p. 472)

- a. 5
- b. 6.5
- c. 8.5
- d. 13

9. How many pounds of 10-6-4 fertilizer must be used to apply 1 lb of nitrogen per 1,000 sq ft on a lawn that measures 5,000 sq ft?

- a. 25
- b. 50
- c. 75
- d. 100

10. CaCO_3 is the chemical formula for:

- a. gypsum.
- b. calcium sulfate.
- c. calcium carbonate.
- d. calcium chloride.

Name: _____

Date: _____

Period: _____

Classification Poster Rubric (4.1)

I Got This √	Poster Content	What It Is Worth	Points Obtained
	Common name of plant	10	
	One statistic about your plant	20	
	Classification (Family, genus, specie, and variety)	20	
	Description of native status (use more than one source if necessary)	10	
	Image of plant	20	
	Distribution in US and/or internationally (picture or text)	20	
	Quality Indicators		
	Quality of information • Poster provides accurate information and demonstrates complete understanding. (40) • Poster provides accurate information and demonstrates partial understanding. (20) • Poster contains inaccurate information and/or demonstrates limited understanding. (10)	40	
	Demonstration of understanding • Poster is very clear and easy to comprehend. (20) • Poster is cluttered but comprehensible. (15) • Poster is not easy to read or understand. (10)	20	
	Production quality • Poster is creative and original. (20) • Poster shows some creativity. (15) • Poster shows little creativity and originality. (10)	20	
	Overall Appeal		

Name: _____

Date: _____

Period: _____

Daily Participation Rubric (4.2)

CATEGORY	90–100 points/day	80–89 points/day	70–79 points/day	60–69 points/day	0–59 points/day
Attitude	Consistently positive attitude	Mostly positive attitude	Somewhat positive attitude	Neutral attitude	Somewhat to totally negative attitude
Pride	Work reflected the best the student could offer.	Work reflected a strong effort.	Work reflected some effort.	Work reflected very little effort.	No effort and no work
Focus on the Task	Student consistently focused on task or topic.	Student focused on task or topic most of the time.	Student focused on the task or topic some of the time.	Student paid little attention to the task or topic.	Student did not focus on the assigned task or topic.
Participation	Student consistently participated in an appropriate manner.	Student participated most of the time.	Student participated some of the time.	Student participated occasionally.	Student refused to participate.

Name: _____

Date: _____

Period: _____

Annual, Biennial, or Perennial (4.3)

Classify each of the following common plants are either an annual (A), a biennial (B), or a perennial (P).

_____ Parsley	_____ Corn	_____ Cotton
_____ Asparagus	_____ Roses	_____ Carrots
_____ Magnolia	_____ Daffodils	_____ Marigold
_____ Pansy	_____ Iris	_____ Soybean
_____ Lettuce	_____ Lima Bean	_____ Dandelion

Name: _____

Date: _____

Period: _____

Stems, Roots, and Flowers Booklet Rubric (4.4)

I Got This	Booklet Contents	What It Is Worth	Points Obtained
	Title page with illustration and name	10	
	Stem illustrations On page 2 of the booklet, draw and briefly describe the following: Bulb (Fig. 15-8) and description	10	
	Corm (Fig. 15-9) with description	10	
	Rhizomes (15-10) with description	10	
	Tuber (Fig. 15-11) with description	10	
	On page 3, draw and label part of stems (Fig. 15-7).	20	
	Total for Stem Section	60	
	Root illustrations On page 4 of the booklet, draw and briefly describe the following: Adventitious roots (Fig. 15-2) and description	10	
	Fibrous roots (Fig. 15-4) and description	10	
	Taproot (Fig. 15-5) and description	10	
	On page 5 of the booklet, draw and label root structure (Fig. 15-6).	20	
	Total for Root Section of Booklet	50	
	On page 5 of the booklet, draw and label a cross section of an apple.	10	
	On page 6 of the booklet, draw (8 pts) and label (22 pts) parts of a flower.	30	
	Total for Flower Section of Booklet	40	
	Drawings are colored.	20	
	Labeling is neat and readable.	10	
	Descriptions are neat and readable.	10	
	Total for Points for Neatness and Readability	40	
	TOTAL POINTS OBTAINED		

Figures referenced in this assignment can be found in the textbook, Unit 15 (Burton & Cooper, 2007).

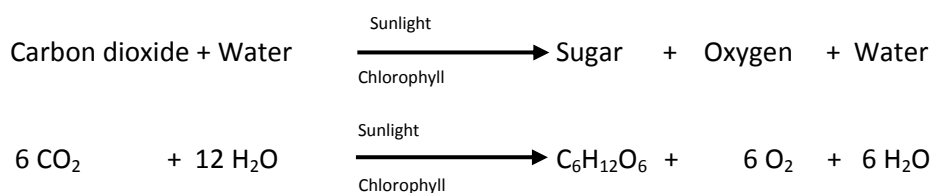
Name: _____

Date: _____

Period: _____

Photosynthesis, Respiration, and Transpiration Information Sheet (4.5)

An important life process is carried out in plants by the chloroplasts, small green bodies present in the cells of green leaves. This process is called photosynthesis. Photosynthesis is the process by which water (H_2O), carbon dioxide (CO_2), and light energy are changed into a sugar ($C_6H_{12}O_6$) and oxygen (O_2) as shown in the following chemical reaction:



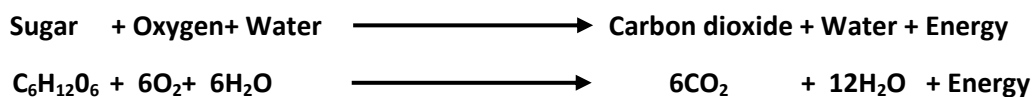
The water needed for photosynthesis is picked up by the roots. It travels upward through the stem to the leaves. The carbon dioxide gas needed for photosynthesis gets into the leaf cells through tiny openings (stomata) in the leaf.

Within the chloroplasts is a green substance called chlorophyll. The chlorophyll absorbs, or picks up, light energy. Then the light energy causes a change to take place. This change involves water and carbon dioxide. The result of this change is that a sugar and oxygen are produced. The plant uses the sugar for food. The oxygen is given off into the air through the openings in the leaf.

Not all of the food that a plant makes during photosynthesis is used right away. Some of the food is stored. This stored food is mostly used by the plant during the night for its life activities.

The process by which a plant uses the stored food is called respiration. Respiration is a kind of burning process and is the opposite of photosynthesis. Photosynthesis stores energy. Respiration releases energy. Photosynthesis and respiration are different in one other important way. Only cells with chlorophyll can carry on photosynthesis. However, all cells carry on respiration.

During respiration, oxygen is taken in through the openings in the leaf. The plant cells use the oxygen to help break down the stored food into energy. The plant uses the energy for life activities. This breakdown also produces water and carbon dioxide, which the plant gives off through the openings in the leaf. The following chemical reaction illustrates this process.



Much of the water a plant takes in is lost through transpiration. Transpiration is the loss of water through a plant's stomates. During the day, while a plant makes food, the stomates are open. These tiny openings in a leaf are controlled by special cells called guard cells, which are located on each side of the

opening. When the guard cells are full of water, the opening is open. When the guard cells are not full, the opening is closed or nearly closed. As water flows up to the leaves, most of it is lost through the stomates. The loss of water helps keep leaves cool during the day. This loss also helps pull water up through a plant. As water evaporates through the stomates, more water moves up and replaces the water that is lost.

RESPIRATION

Before cells can carry out respiration, they must first have food. How do plants get the food oxygen needed for respiration? How do cells change sugar to energy?

1. Sugar is made in the leaf.
2. It is carried by the veins in the leaf to the stem. Food-carrying tubes in the stem transport sugar to all parts of the stem and down to the roots.
3. The oxygen combines with sugar in the cell.
4. When oxygen and sugar combine, energy is released. The energy is used by the cell to carry out life processes.
5. Carbon dioxide and water are given off as waste products.

Comparison table for photosynthesis and respiration

The process of respiration is the opposite of the process of photosynthesis. Complete the table below to show differences in the two processes.

Photosynthesis	Respiration
Takes place only in cells with chlorophyll	
	Sugar is broken down.
Energy from the sun is stored.	
	Carbon dioxide is produced.
Water is taken in.	
	Oxygen is used.

Name: _____

Date: _____

Period:

Transpiration Activity (4.6)

Did you know that plants are an important part of the water cycle? In this activity, you are going to learn how plants are part of the water cycle by collecting water vapor from the leaves of plants.

Directions

1. Carefully slide a large, plastic bag over a branch or stem of a plant containing at least three or four healthy green leaves that are dry on the surface. Attach the bag around the stem with a clothespin. Best results will occur on a warm day if there is a good amount of sunlight available (not overcast). Observe the bag after 20– 30 minutes.
2. On the data table below, write down the date and type of tree or other plant, if known (e.g., maple, oak, dogwood). Draw a picture of one of your leaves. You can compare your results with another group in your class who may select another type of tree.
3. After 30–40 minutes, check your leaves to see if you collected any moisture. (You may check again later in the day.) Write down your observations. You may also take a digital photo of your plant to record the amount of moisture in the bag.
4. You may be able to collect enough water to measure the amount (volume) in milliliters using a graduated cylinder. To do this, collect the water in the plastic bag using an eyedropper, and transfer to the graduated cylinder. Record your results on the data table.

Transpiration Data Sheet

Name _____

[illegible]

Questions

1. Where do you think the water in the plastic bags came from?

2. If the bag had not been placed over the plant, where would the water that you observed have gone?

3. Is there a connection between the water that transpires from plant leaves and the water that falls to earth from clouds (rain and snow)?

4. How do your results compare with your classmates' (who may have collected water in other types of plants)? Be sure to think about the size of the leaves.

5. Why do you think trees are an important part of keeping rainforests rainy?

Name: _____

Date: _____

Period: _____

Plant Classification and Physiology Unit Test (4.7)

Directions: Circle T if the statement is correct and F if the statement is false (5 pts each).

Highlights are the correct answers.

	True	False	Question
1	T	F	A perennial completes its life cycle in 1 year.
2	T	F	Transpiration takes place in the stomata of the leaves.
3	T	F	A carrot has a fibrous root system.
4	T	F	The apical meristem is the least actively growing part of a plant.
5	T	F	Respiration occurs in all cells.
6	T	F	As xylem tubes die they forms tree rings.
7	T	F	Dripping sap usually comes from the phloem.
8	T	F	A potato is a specialized stem called a bulb.
9	T	F	Plant varieties develop in nature.
10	T	F	Pecan leaves are considered simple leaves.

Directions: Multiple Choice. Circle the *best answer* for each question. (5 pts each)

- Which of these scientific classification groups has the fewest members?
 - Class
 - Genus
 - Species
 - Family
- The scientific name for bay live oaks that grow along the coast is *Quercus virginiana* var. *maritima* (Mill). Which of the following is MOST closely related to bay live oaks?
 - Batis maritime*
 - Carpinus carolina* var. *virginiana*
 - Clematis virginiana* L.
 - Quercus falcata* var. *pagodaefolia* (Ell.)
- Two plants probably belong to the same species if they:
 - have leaves that look alike.
 - can produce fertile offspring.
 - have the same number of cotyledons.
 - develop the same type of chlorophyll.
- The red maple tree is known by the scientific name *Acer rubrum*. The sugar maple tree is known as *Acer saccharum*. What is the smallest classification division these trees have in common?
 - Phylum
 - Order
 - Genus
 - Species

5. Oxygen is added to an ecosystem by:
 - a. cellular respiration.
 - b. photosynthesis.
 - c. the nitrogen cycle.
 - d. dehydration.
6. During photosynthesis, energy from the sun is trapped in:
 - a. chemical bonds.
 - b. the nuclei of atoms.
 - c. enzymes.
 - d. Golgi bodies.
7. The process of photosynthesis produces sugar, water, and:
 - a. hydrogen gas.
 - b. nitrogen dioxide gas.
 - c. carbon dioxide gas.
 - d. oxygen gas.
8. Because most plants are able to undergo photosynthesis, they do NOT:
 - a. require carbon dioxide.
 - b. store energy for later use.
 - c. undergo cellular respiration.
 - d. depend on other organisms for energy.
9. What are the end products of photosynthesis?
 - a. Oxygen and sugar
 - b. Carbon dioxide and water
 - c. Glucose and carbohydrates
 - d. Xylem and Phloem
10. What are the reactants for photosynthesis?
 - a. Oxygen and sugar
 - b. Carbon dioxide and water
 - c. Glucose and carbohydrates
 - d. Xylem and Phloem
11. What are the end products of cellular respiration?
 - a. Oxygen and sugar
 - b. Carbon dioxide and water
 - c. Glucose and carbohydrates
 - d. Xylem and Phloem
12. What is the primary light-gathering pigment in plants?
 - a. Chlorophyll
 - b. Chloroplast
 - c. Carotenoids
 - d. Mitochondria
13. Where is the chlorophyll found?
 - a. Chromatids
 - b. Chloroplast
 - c. Carotenoids
 - d. Mitochondria

14. Where does transpiration occur in plant leaf cells?

- a. Stomata
- b. Vacuole
- c. Stroma
- d. Cell wall

15. The collective term for all female flower parts is called:

- a. stigma.
- b. style.
- c. stamen
- d. pistil.

Name: _____

Date: _____

Period: _____

Bedding Plant Keyword Exercise (4.8)

Directions: Read the following paragraph, underline keywords already learned in Plant Science, and be prepared to discuss their meaning.

Hundreds of different annuals, perennials, herbs, and vegetable transplants can be grown and sold as bedding plants. A single commercial greenhouse business may produce as many as 500 different kinds of bedding plants in the spring. Some of the most popular bedding plants include: impatiens, petunias, geraniums, pansies, begonias, and marigolds. Tomatoes, peppers, and cole crops are popular vegetable transplants.

Name: _____

Date: _____

Period:

Bedding Plant Production Data Sheet (4.9)

Name of plant:

Length of time from seeding to market size:

Projected market date:

Planting date:

Type of container used:

Type of media used:

Number of seeds planted:

Number of seeds that germinated:

Use the following table to record events and growth records for your plants such as planting date, number of seeds that germinated, and fertilization, watering, and pest control practices:

[illegible]

Enter the total cost of production below. (If you used school materials, have your teacher provide you with an estimated cost.)

Containers
Media
Fertilizer
Pest Control
Other Costs
TOTAL COSTS

How many plants did you produce?

What was the average cost per plant?

Name: _____
Date: _____
Period: _____

Mendel's Law and Punnet Squares (5.1)

Gregor Mendel and the Basics of Genetics

When most people think of genetics, they think of a modern, high-tech science, with people in lab coats doing strange things to cells. What they do not realize is that the science of genetics was invented by a 19th Century monk who enjoyed a spot of gardening.

Gregor Mendel was born in 1822 in what is now the Czech Republic, the son of poor peasant farmers. Although he did well at school, his parents could not afford to send him to university, so he went instead to the Augustinian monastery at Brunn¹. After studying there for some time, he moved to the University of Vienna in Austria to study science and mathematics. After failing his exams for a teaching degree, Mendel returned to the monastery where he became Abbot and spent the rest of his life.

Mendel's Garden

The monastery at Brunn was blessed with large and beautiful gardens, and Mendel was a keen gardener. It was during his work in the garden that he began to take a close interest in garden peas. He noticed that peas had certain characteristics that seemed to be passed from generation to generation. For example, plants with peas that were green had offspring with green peas, while those with yellow peas produced yellow offspring. Over seven years, Mendel carried out an enormous number of experiments with these plants, studying characteristics such as height, seed shape, seed colour and flower colour. Despite knowing nothing about DNA² or the biochemistry of inheritance, Mendel developed his two 'Laws of Heredity', which remain the basis of modern genetics.

Big Plants and Little Plants

Mendel's experiments relied on studying pairs of characteristics that seemed to be 'either-or' in the plants. For example, the garden had tall pea plants and short pea plants, but no in-between ones. So, Mendel decided to cross a tall plant with a short plant and measure the result. To his surprise, all the offspring were tall, rather than the intermediate size that might have been expected. Continuing the experiment, he crossed the new tall plants with each other. In the next generation, three-quarters of the plants were tall, but one-quarter were short. In summary:

These results were repeated with whatever pair of characteristics Mendel chose. Yellow seeds crossed with green seeds produced all yellow seeds. If the new yellow seeds were crossed with each other, three-quarters were yellow and one-quarter were green.

Tall x Short
|
Tall
/ \
Tall x Tall
|
3 Tall + 1 Short

From these simple experiments, Mendel theorized that these characteristics must be inherited as 'particles' of some sort - what we now know as 'genes'. Each plant had two genes for each characteristic. If the gene for tallness is shown with a capital T and the gene for 'shortness' by a lower-case t, then each plant could be either TT (pure-bred tall), tt (pure-bred short) or Tt. These Tt plants were tall because the T gene is 'dominant' to the t gene, which is referred to as 'recessive'³:

$$\begin{array}{c} Tt \times tt \\ | \\ Tt \end{array}$$

In Mendel's original experiment, each offspring plant must have inherited a T gene from the tall parent and a t gene from the short parent - no other combinations are possible. At this stage in his experiments, however, Mendel did not know for certain that each offspring inherited one gene from each parent. It was confirmed when Mendel crossed the new Tt plants, and this happened:

$$\begin{array}{c} Tt \times Tt \\ | \\ TT \quad Tt \quad tT \quad tt \end{array}$$

It can be seen that three-quarters of the plants will be tall, having either TT or Tt genes, while the remaining quarter have inherited the 'recessive' short gene from both parents and will therefore be short. This is precisely what happened in the real experiment, and the separation of the pairs of genes during reproduction became Mendel's First Law.

Having covered the concepts of dominance and recessivity, this seems like a good time for a quick...

Try This At Home

To see Mendel's first law in action, try rolling your tongue (i.e., curling your tongue into a tube). Then ask your parents, siblings, children, aunts, uncles, cousins and grandparents if they can do it. Tongue rolling is an action controlled by a single gene with two alleles. Those who can do it have at least one dominant 'R' gene, while those who can't have two recessive 'r' genes.

Big Yellow Plants and Little Green Plants

In Mendel's second set of experiments, he looked at two pairs of characteristics together. For example, he took tall plants that produced yellow seeds (both dominant characteristics) and crossed them with short plants producing green seeds (both recessive characteristics). Using 'Y' to represent the 'yellow' allele and 'y' to represent the 'green' allele, the results looked something like this:

$$\begin{array}{c} (TT YY) \times (tt yy) \\ | \\ (Tt Yy) \end{array}$$

So, a parent that is (Tt Yy) can produce four different gametes: Have students draw the following table in their notebook and fill in blanks for genetic combinations and discuss results.

	Y	y		Y	y
T			T	TY	Ty
t			t	tY	ty

Then, when two (Tt Yy) parents mate, there are 16 possible combinations in the offspring. Have students draw the following table in their notebook and fill in blanks for genetic combination and discuss results.

	TY	Ty	tY	ty
TY				
Ty				
tY				
ty				

	TY	Ty	tY	ty
TY	TT YY	TT Yy	Tt YY	Tt Yy
Ty	TT yY	TT yy	Tt yY	Tt yy
tY	tT YY	tT Yy	tt YY	tt Yy
ty	Tt Yy	tT yy	tt yY	tt yy

Tall, yellow seeds	9/16	TT YY TT Yy TT yY Tt YY Tt Yy Tt yY tT YY tT Yy tT yY
Tall, green seeds	3/16	TT yy Tt yy tT yy
Short, yellow seeds	3/16	tt YY tt Yy tt yY
Short, green seeds	1/16	tt yy

The table on the left could be also given with blank areas for students to fill out.

Mendel's work allowed us to understand the concept of inheritance, leading to breakthroughs in fields as diverse as agriculture and medicine.

Reference: BBC-h2g2 (23rd December 2002). Gregor Mendel and the basics of genetics. Retrieved on June 15, 2010, from <http://www.bbc.co.uk/dna/h2g2/A885521>

Name: _____

Date: _____

Period: _____

Daily Participation Rubric (5.2)

CATEGORY	100 points/day	90 points/day	80 points/day	70 points/day	50 points/day
Attitude	I always have a positive attitude about the task(s).	I often have a positive attitude about the task(s).	I usually have a positive attitude about the task(s).	I often have a negative attitude about the task(s).	I refused to do the assigned task(s).
Pride	The work I did reflected my best effort.	The work I did reflected a strong effort.	My work reflected some effort.	My work reflected very little effort.	I refused to work on any assigned task.
Focus on the Task	I stayed focused on the task and what needed to be done.	I focused on the task and what needed to be done most of the time.	I focused on the task and what needed to be done some of the time.	I did not focus on the task and what needed to be done. I let others do the work.	I did not focus on any assigned task.
Cleanup	I helped make sure cleanup tasks were done to completion.	I helped do some of the cleanup task.	Cleanup task were done, but I did not participate.	The work space was left in a mess.	I refused to participate in cleanup.

Students will get up to 100 points/day for a possible total of 500 points for the week. A weekly average will be taken and posted on PARENT CONNECT for your viewing.

If a student is absent, he or she will be held responsible for making up any daily assignments and/or tasks they missed.

I have read and understand the above terms in which grades will be issued based on my daily participation in AEST class.

Student Signature

Date

Parent Signature

Date

Name: _____

Date: _____

Period: _____

DNA Structure Activity (5.3)

Material: To construct a DNA model, you will need the following material:

- Styrofoam balls (about 100)
- Double end toothpicks (75)
- Wooden or metal laboratory stand
- Brushes for painting the balls
- Additional material such as paint or water color, glue, string



You may purchase all the required material separately from different local stores or you may prefer to order a kit; however, you should know that kits do not come with paint and glue.

Instructions: Decide what colors you want to use for small molecules forming each large DNA molecule. The model shown above is based on colors suggested in the kit instructions; however, you may select any other colors for the balls. Paint all the balls, and let them dry. Depending on the paint, it may take up to 24 hr for paints to dry.



Start from the base, and connect the molecules to each other using toothpicks.

For the first row, make a pair of C-G (Cytosine-Guanine). Add the phosphates to the backbone, and then assemble the second row that again can be C-G or A-T (Adenine-Thymine). Continue the ladder until you run out of balls.

You may use the same balls as atoms to make models of models of different chemicals.

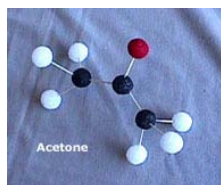
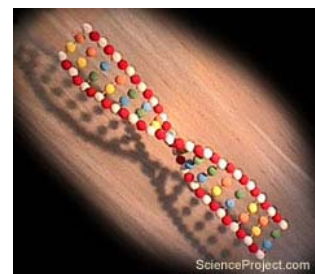
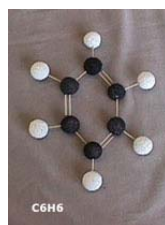


Image in the left shows a molecule of Acetone. White balls are hydrogen. Black balls are carbon; the red ball is oxygen (connected with two bonds). Image on the right is a molecule of benzene.



You can order a materials kit for DNA Model. In addition to the kit, you will need some water color or water-based paints to paint the balls.

Name: _____

Date: _____

Period: _____

Germination Test Experiment (5.4)

Seed Germination Data Sheet

Date turned in: _____

Names in group: _____

Type of seed: Acorn

Treatments	Date planted	# planted	Seed Coat Split Date	Temp when planted	Date germinated	# Germinated	% Germinated	Comments
Refrigerated								
Greenhouse								
Incubator								
Classroom								

Type of seed: Bean

Treatments	Date planted	# planted	Seed Coat Split Date	Temp when planted	Date germinated	# Germinated	% Germinated	Comments
Refrigerated								
Greenhouse								
Incubator								
Classroom								

Type of seed: Corn

Treatments	Date planted	# planted	Seed Coat Split Date	Temp when planted	Date germinated	# Germinated	% Germinated	Comments
Refrigerated								
Greenhouse								
Incubator								
Classroom								

SUMMARY OF RESULTS: (30 pts) Discussion should include everything you did (procedures).

- Students could be placed in groups.
- Media should be the same. Moist peat moss usually recommended
- Have one data sheet per group.
- Each piece of data in the chart could be worth 5 and summary worth 20 points.

Adapted from Dirr, M & Heuser, C. JR. (1987). *The reference manual of woody plant propagation. From seed to tissue culture*. Varsity Press, Inc. Athens, GA. ISBN 0-942375-00-9

Name: _____

Date: _____

Period: _____

Rooting Hormone Experiment Data Collection Sheet (5.5)

Rooting Hormone Experiment						
Plant Type:						
Media Type:						
Names in Group:						
Treatments	ROOT RATINGS - After 1 Month					
	0	1	2	3	4	5
RH-Plant1						
RH-P2						
RH-P3						
No rooting hormone						
No-RH-P1						
No-RH-P2						
No-RH-P3						

Root ratings are based on a scale with 0 = Dead and 5 = Most Roots.

SUMMARY OF RESULTS:

Name: _____

Date: _____

Period: _____

Unit Test Questions (5.6) Highlights are the correct answers.

Directions: Circle T if the statement is correct and F if the statement is false (5 pts ea).

	True	False	Question
1	T	F	rDNA uses DNA molecules from two unrelated organisms to create superior offspring.
2	T	F	DNA is located in chromatins.
3	T	F	Seeds require light for germination.
4	T	F	Leaves of a monocot have parallel venations.
5	T	F	Explants are small pieces of plants used in tissue culture.

Directions: Multiple Choice. Circle the best answer for each question. (5 pts each)

- What is the molecular chain that stores genetic information in all living cells?
 - Chromosomes
 - Nucleus
 - DNA**
 - Nuclear envelop
- What profession involves genetic engineering of plants?
 - Biotechnology**
 - Entomology
 - Pathology
 - Toxicology
- Seeds develop from what part of the flower?
 - Ovule**
 - Ovary
 - Sperm
 - Epicotyl
- The process whereby a seed must go through a period of cold temperatures before it germinates is called:
 - stratification.**
 - scarification.
 - propagation.
 - dissemination.
- What form of plant reproduction involves the combining of genetic material from two parents?
 - Sexual plant reproduction**
 - Asexual Plant Reproduction
 - Tissue Culture
 - Vegetative Cuttings

6. What part of the flower develops into the fruit?
 - a. Ovule
 - b. Ovary
 - c. Sperm
 - d. Epicotyl
7. Seed leaves are called:
 - a. embryo.
 - b. cotyledon.
 - c. epicotyl.
 - d. hypocotyl.
8. What type of asexual plant reproduction allows for thousands of identical plants produced from small pieces of plants?
 - a. Vegetative cuttings
 - b. Layering
 - c. Division
 - d. Tissue culture

Complete the Punnett's square shown below using the following information. (T=tall, t=short, Y=yellow, y=green)

	TT	tt
YY		
yy		

Name: _____

Date: _____

Period: _____

Greenhouse Tour Activity (6.1)

Instructions:

Take a tour of the greenhouse. Use the chart below to provide students with the number and name of each station on the tour. Have students complete the chart as they participate in the tour. Note: Greenhouse control panel should be shown by instructor only.

Station Number	Station Name	Comments, Characteristics, Uses, etc.
1	QUONSET STYLE GREENHOUSE	
2	GREENHOUSE COVERING (POLYETHYLENE)	
3	COOLING FANS	
4	VENTS	
5	DOOR SIZE	
6	GREENHOUSE FLOOR COVERING (GRAVEL)	
7	INSIDE FANS	
8	THERMOSTAT	
9	HOSE (TALK ABOUT PRESSURE)	
10	HOSE USAGE AND PLACEMENT	
11	COOLING PADS	
12	SUMP PUMP	
13	TWO LAYERS POLY	
14	BLOWER MOTOR	
15	SHADE CLOTH	
16	THERMOMETER	

Name:
Date:
Period:

Structure and Control Systems Presentation and Rubric (6.2)

Assign a student or pair of students to research each of the following topics and prepare a PowerPoint presentation to be made to the entire class: even span greenhouses, Quonset greenhouses, ridge and furrow greenhouses, greenhouse coverings (fiberglass, polyethylene, polycarbonate, and shade cloths), heating systems and controls, cooling systems and controls, humidity indicators, and ventilation systems and controls.) All students should make a presentation as it will count for a grade. Presentations will be evaluated using the rubric on the following page.

Have students present their PowerPoint presentations to the class as a whole. After the presentations, have students ask questions and hold a class discussion to make sure that all important points are covered. Have students summarize the major points of each presentation and enter into their electronic journals or notebooks. Questions on the major points covered will be included on the unit test.

PowerPoint Presentation Criteria and Rubric 100 points		
Topic: _____		
Name: _____		Date: _____
	Points Worth	Points Obtained
Slide Creation (Three–six slides including reference page; all slides should contain pictures)		
• Title slide	5	
• Introduction slide with description and picture	5	
• Characteristics	10	
• Advantages/disadvantages/uses	10	
• Summary (no new information presented)	10	
• Reference page	5	
Slide format		
Bulleted list NOT PARAGRAPHS	10	
Text format/capitalization consistency(i.e., titles, bullets)	10	
Transition and effect	5	
Presentation of Information		
• Voice projection	10	
• Posture	5	
• Eye contact with audience	5	
• Familiar with content	5	
• Answers to questions	5	
Subtotal		
Minus 2 points for each misspelled word and/or grammatical error		
Minus 5 points for presentation over 5 min NOT including questions		

Name: _____

Date: _____

Period: _____

Daily Participation Rubric (6.3)

CATEGORY	100 points/day	90 points/day	80 points/day	70 points/day	50 points/day
Attitude	I always have a positive attitude about the task(s).	I often have a positive attitude about the task(s).	I usually have a positive attitude about the task(s).	I often have a negative attitude about the task(s).	I refused to do the assigned task(s).
Pride	The work I did reflected my best effort.	The work I did reflected a strong effort.	My work reflected some effort.	My work reflected very little effort.	I refused to work on any assigned task.
Focus on the Task	I stayed focused on the task and what needed to be done.	I focused on the task and what needed to be done most of the time.	I focused on the task and what needed to be done some of the time.	I did not focus on the task and what needed to be done. I let others do the work.	I did not focus on any assigned task.
Cleanup	I helped make sure cleanup task were done to completion.	I helped do some of the cleanup task.	Cleanup tasks were done, but I did not participate.	The work space was left in a mess.	I refused to participate in cleanup.

Students will get up to 100 points/day for a possible total of 500 points for the week. A weekly average will be taken and posted on PARENT CONNECT for your viewing.

If a student is absent, he or she will be held responsible for making up any daily assignments and/or task missed.

I have read and understand the above terms in which grades will be issued based on my daily participation in AEST class.

Student Name	Date
Parent/Guardian Name	Date

Name: _____

Date: _____

Period: _____

Plant Water Management Data Sheet (6.4)

Did you fertilize?		If yes, with what?	At what rate?
Y	N		

Plant Name	Location	Pot Size	Soil Condition	Pruned?	Plant Health Observations	Other Comments

Name: _____

Date: _____

Period: _____

Group Participation Rubric (7.1)

	Beginning	Developing	Accomplished	Exemplary	Score
	1 point	2 points	3 points	4 points	
Group Discussions	Rarely contributed to discussions of the group	Contributed good effort to discussions of the group	Contributed great effort to discussions of the group	Contributed exceptional effort to discussions of the group	
On-task Behavior	Exhibited on-task behavior inconsistently	Exhibited on-task behavior some of the time	Exhibited on-task behavior most of the time	Exhibited on-task behavior consistently	
Helping Others	Did not assist other group members	Seldom assisted other group members	Occasionally assisted other group members	Assisted other group members	
Listening	Ignored ideas of group members	Seldom listened to ideas of group members	Occasionally listened to ideas of group members	Always listened to ideas of group members	

Name: _____

Date: _____

Period: _____

Soil Data Summary Sheet (7.2)

Sample No.	Microscopic Evaluation			Ribbon Test Description	Textural Class
	% Sand	% Silt	% Clay		
1					
2					
3					
4					
5					

Name: _____

Date: _____

Period: _____

Mississippi Land Judging Scorecard (7.3)

Part I (30 points)		Part II – Practices for Land Treatment (30 points)	
Score	A. SURFACE TEXTURE ☐ 1. Medium ☐ 2. Moderately fine ☐ 3. Fine ☐ 4. Moderately coarse ☐ 5. Coarse	Score	VEGETATION PRACTICES Use soil conserving and improving crops. ☐ 1. Every 4th or 5th year ☐ 2. Every 3rd or 4th year ☐ 3. Every 2nd year ☐ 4. Do not burn crop residue. ☐ 5. Crop residue management ☐ 6. Establish recommended grasses and/or legumes. ☐ 7. Proper pasture or range management ☐ 8. Protect from burning. ☐ 9. Control grazing. ☐ 10. Control noxious plants. ☐ 11. Plant recommended tree. ☐ 12. Harvest trees selectively. ☐ 13. Timber stand improvement ☐ 14. Prevent forest fires. ☐ 15. Build and/or maintain fire roads.
	B. PERMEABILITY ☐ 1. Moderate ☐ 2. Slow ☐ 3. Very slow ☐ 4. Rapid		
	C. DEPTH, SURFACE, + SUBSOIL ☐ 1. Deep ☐ 2. Moderately deep ☐ 3. Shallow ☐ 4. Very shallow		
	D. SLOPE ☐ 1. Nearly level ☐ 2. Gently sloping ☐ 3. Moderately sloping ☐ 4. Strongly sloping ☐ 5. Steep ☐ 6. Very steep		MECHANICAL PRACTICES ☐ 16. Filter strips ☐ 17. Terrace and farm on contour ☐ 18. Construct and maintain diversion terraces. ☐ 19. Install drainage system. ☐ 20. Control gullies. ☐ 21. Provide vegetative outlets. ☐ 22. Fence ☐ 23. Provide stock water.
	E. EROSION ☐ 1. None to slight ☐ 2. Moderate ☐ 3. Severe ☐ 4. Very severe		FERTILIZER & SOIL AMENDMENTS ☐ 24. Lime ☐ 25. Animal by-product/compost ☐ 26. Nitrogen ☐ 27. Phosphate ☐ 28. Potash ☐ 29. Nitrogen, phosphate, and potash ☐ 30. No fertilizers or soil amendments needed
	F. SURFACE RUNOFF ☐ 1. Good ☐ 2. Fair ☐ 3. Poor ☐ 4. Excessive		
	G. FACTORS THAT KEPT LAND FROM BEING CLASS I ☐ 1. Texture ☐ 2. Permeability ☐ 3. Depth ☐ 4. Slope ☐ 5. Erosion ☐ 6. Surface runoff		Score Part I _____ (Possible 30 points)
	H. LAND CAPABILITY CLASS (Circle your choice) 1 2 3 4 5 6 7 8		Score Part II _____ (Possible 30 points)
	I. HIGHEST LAND USE (Check one) ☐ 1. Row crops ☐ 2. Pasture ☐ 3. Woodland		Total Score _____ (Possible 30 points)

Name: _____

Date: _____

Period: _____

Hydroponics Booklet Rubric (7.4)

I Got This	Booklet Contents	What It Is Worth	Points Obtained
	Title page with illustration and name	5	
	Hydroponics system drawings		
	On pages 2 and 3 of the booklet, draw, label, and briefly describe a continuous flow system.	20	
	On pages 4 and 5 of the booklet, draw, label, and briefly describe an aeroponics system.	20	
	On pages 6 and 7 of the booklet draw, label, and briefly describe an aggregate culture system.	20	
	Listing of advantages and disadvantages	20	
	Total Points for Content		
	Drawings are colored.	5	
	Labeling is neat and readable.	5	
	Descriptions are neat and readable.	5	
	Total for Points for Neatness and Readability		
	TOTAL POINTS OBTAINED		

This booklet should take four standard (8 ½ x 11 inches) pages, folded in half.

Name: _____

Date: _____

Period: _____

Media Experiment Data Sheet and Rubric (7.5)

Media Experiment Assignment - Worth 100 points

Instructions: There will be three to four replications per media treatments. Plants will be labeled according to media treatment and rep. Quantitative data to be collected prior to experiment will be plant height; qualitative data will be plant vigor (1=poor, 5=best). After 1 month, rating will be repeated. Note: media treatment can be modified to instructor preference. Same data chart should be used at the beginning and end of the experiment. Pictures should be taken.

Students Names in Group: _____

Planting Date: _____ Data Collection Date: _____

Media Treatments	Plant Height				Plant Vigor				Comments
	R1	R2	R3	R4	R1	R2	R3	R4	
Organic Soil Amendment									
Inorganic Soil Amendment									
Control (No Amendment)									

Rubric for Media Experiment (7.5)

	Possible Points	Score
Procedure: Procedures for conducting the experiment should be written in detail, including the all materials used, treatment materials used, and procedures for tending to the plants. A hypothesis should be stated.	25	
Data Collection: Data should be collected accurately following a standard procedure.	25	
Results: Results should be summarized and reported in graphic and narrative form and should include a conclusion and recommendation.	50	

Name: _____

Date: _____

Period: _____

Plant Maintenance Log Rubric (7.6)

	Exemplary	Accomplished	Developing	Beginning	Score
Content	Content is accurate and detailed and applies to agricultural production practices. (60 points)	Content is accurate but general in nature with some application to agricultural practices. (45 points)	Content is accurate but general in nature with limited application to agricultural practices. (30 points)	Content does not focus on assigned topic, is inaccurate, or is totally unrelated to agricultural practices. (10 points)	
Grammar	Correct and effective use of grammar and mechanics (20 points)	Occasional minor errors in use of grammar and mechanics (15 points)	Problems in use of grammar and mechanics (10 points)	Repeated errors in use of grammar and mechanics (5 points)	
Organization	Ideas flow smoothly and logically with clarity and coherence. (20 points)	Logical order and appropriate sequencing of ideas with adequate transition (15 points)	Some evidence of an organizational plan or strategy (10 points)	Lacks organization (5 points)	
TOTAL					

Comments

Name: _____

Date: _____

Period: _____

Paragraph Construction Rubric (7.7)

CONTENTS of PARAGRAPH	PTS Worth	PTS Received
Paragraph Construction		
Used an introductory sentence that was interesting and appropriate	15	
Used at least five sentences to summarize major observations	50	
Used the list of terms as assigned	25	
Saved paragraph in assigned location using proper file name	10	
SUBTOTAL		
SENTENCE STRUCTURE – (-2 for each error listed below)		
• Redundant use of pronouns (ex. I, my)		
• Sentences too long (>21 words or 3 typed lines)		
• Capitalization, punctuation, grammar, spelling, etc.		
GRAND TOTAL		

Name: _____

Date: _____

Period: _____

Guest Speaker Evaluation Form (7.8)

1. List five main ideas expressed in the presentation.

1. _____

2. _____

3. _____

4. _____

5. _____

2. Write a brief summary relating the topics of the presentation to your life.

Name: _____

Date: _____

Period: _____

Dirty Jobs Presentation Rubric (7.9)

Presentation Content		
• Introduction slide with description and picture of crop	5	
• Products harvested	10	
• Timing of harvest (includes comments on maturity/perishability, nutrition, and marketing)	10	
• Harvesting equipment and procedures	10	
• Storage procedures	10	
• Discussion of preharvest loss and harvest loss	10	
• Summary (no new information presented)	10	
• Reference page	5	
SUBTOTAL FOR CONTENT (70 POINTS)		
Slide Format		
• Bulleted list, NOT PARAGRAPHS	5	
• Text format/capitalization consistency (i.e., titles, bullets)	5	
• Transition and effect	5	
SUBTOTAL FOR SLIDES (15 points total)		
Presentation of Information		
• Voice projection	3	
• Eye contact with audience	3	
• Familiar with content	3	
• Individual role-play of character in dirty job activity	3	
• Group participation	3	
SUBTOTAL FOR PRESENTATION (15 points total)		
TOTAL POINTS		

Name: _____

Date: _____

Period: _____

Soil and Water Conservation Graphic Rubric (7.10)

	Possible Points	Score
• Conservation message completeness and accuracy	50	
• Visual effectiveness	30	
• Originality	10	
• Universal Appeal	10	
TOTAL (100 POINTS)		

Name: _____

Date: _____

Period: _____

Pest Identification Chart (8.1)

PEST IDENTIFICATION CHART - 100 points Collect 10 samples, and fill in the chart. (2 pts each)				
Student Name:		Date:		
Pest Name	Type of Pest (i.e., weed, insect, disease)	Location Collected	Type of Damage	Biological Control Recommendation

Name: _____

Date: _____

Period: _____

Beneficial Insects Ag News Report Rubric (8.2)

Your instructor will assign you one of the beneficial insects listed below. Prepare a 1–2-min Ag News Report that includes the following information: (1) picture of the insect, (2) plants that are associated with the insect, and (3) pests that they aid in controlling.

Ladybugs
Praying mantis
Bees
Parasitic wasps

Name	Topic Presented	Introduction (name and source)	Relevant to Subject	Posture	Voice Projection	Eye Contact with Audience	Familiarity with Content	Visual Aid	Answers Questions	Total

Grading Instructions

Each News Report should be no less than 1 min and no more than 2. Teacher will hold up a sign at ½ min, 1 min, and 2 min. There will be a 5 point deduction for less than 1 and more than 2, unless permission and/or different instruction are given from teacher.

REMEMBER THERE WILL BE 10 POINTS DEDUCTED FOR EACH DAY LATE.

Name: _____

Date: _____

Period: _____

Pesticide Label Interpretation Assignment (8.3)

Your teacher will assign you a specific chemical pesticide. You are to search the Internet, locate a label for this chemical, and answer the following questions:

1. What is the active ingredient in this product and its percentage?
2. What personal protective equipment should be used when working with this pesticide?
3. What pests does this pesticide control?
4. How is this pesticide applied, and what plants are approved for its use?
5. What type(s) of formulation(s) are manufactured for this chemical?
6. If someone accidentally swallowed this material, what should you do?

Name: _____

Date: _____

Period: _____

Integrated Pest Management Plan Rubric (8.4)

Component:	Possible Points	Score
Background: The plan clearly identified the plants to be protected under the plan and the most commonly associated pests including weeds, diseases, and insects. Life cycle and damage caused by each pest was described.	25	
Cultural and Mechanical Controls: The plan identified and described how cultural and mechanical pest control methods would be implemented and maintained during the growing season.	25	
Biological Controls: The plan identified any biological controls that would be implemented and maintained during the growing season.	25	
Chemical Controls: The plan identified chemical controls that would be used including the economic threshold that would cause chemicals to be applied and specific chemicals and formulations that would be used.	25	
		Total

Appendix B: 21st Century Skills Standards

CSS1-21st Century Themes

CS1 Global Awareness

1. Using 21st century skills to understand and address global issues
2. Learning from and working collaboratively with individuals representing diverse cultures, religions, and lifestyles in a spirit of mutual respect and open dialogue in personal, work, and community contexts
3. Understanding other nations and cultures, including the use of non-English languages

CS2 Financial, Economic, Business and Entrepreneurial Literacy

1. Knowing how to make appropriate personal economic choices
2. Understanding the role of the economy in society
3. Using entrepreneurial skills to enhance workplace productivity and career options

CS3 Civic Literacy

1. Participating effectively in civic life through knowing how to stay informed and understanding governmental processes
2. Exercising the rights and obligations of citizenship at local, state, national, and global levels
3. Understanding the local and global implications of civic decisions

CS4 Health Literacy

1. Obtaining, interpreting and understanding basic health information and services and using such information and services in ways that enhance health
2. Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance, and stress reduction
3. Using available information to make appropriate health-related decisions
4. Establishing and monitoring personal and family health goals
5. Understanding national and international public health and safety issues

CS5 Environmental Literacy

1. Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water, and ecosystems
2. Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.)
3. Investigate and analyze environmental issues, and make accurate conclusions about effective solutions
4. Take individual and collective action towards addressing environmental challenges (e.g., participating in global actions, designing solutions that inspire action on environmental issues)

CSS2-Learning and Innovation Skills

CS6 Creativity and Innovation

1. Think Creatively
2. Work Creatively with Others
3. Implement Innovations

CS7 Critical Thinking and Problem Solving

1. Reason Effectively
2. Use Systems Thinking
3. Make Judgments and Decisions
4. Solve Problems

CS8 Communication and Collaboration

1. Communicate Clearly

2. Collaborate with Others

CSS3-Information, Media and Technology Skills

CS9 Information Literacy

1. Access and Evaluate Information
2. Use and Manage Information

CS10 Media Literacy

1. Analyze Media
2. Create Media Products

CS11 ICT Literacy

1. Apply Technology Effectively

CSS4-Life and Career Skills

CS12 Flexibility and Adaptability

1. Adapt to change
2. Be Flexible

CS13 Initiative and Self-Direction

1. Manage Goals and Time
2. Work Independently
3. Be Self-directed Learners

CS14 Social and Cross-Cultural Skills

1. Interact Effectively with others
2. Work Effectively in Diverse Teams

CS15 Productivity and Accountability

1. Manage Projects
2. Produce Results

CS16 Leadership and Responsibility

1. Guide and Lead Others
2. Be Responsible to Others

Appendix C: MS Academic Standards

MISSISSIPPI SCIENCE FRAMEWORK COMPETENCIES

Marine and Aquatic Science

- AQ 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- AQ 2 Develop an understanding of physical and chemical properties of water and aquatic environments.
- AQ 3 Apply an understanding of the diverse organisms found in aquatic environments.
- AQ 4 Draw conclusions about the relationships between human activity and aquatic organisms.
1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
 - a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
 - b. Formulate questions that can be answered through research and experimental design. (DOK 3)
 - c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
 - d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
 - e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
 - g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
 2. **Develop an understanding of physical and chemical properties of water and aquatic environments.**
 - a. Analyze the physical and chemical properties of water, and justify why it is essential to living organisms. (DOK 1)
 - b. Explain the causes and characteristics of tides. (DOK 1)
 - c. Research, create diagrams, and summarize principles related to waves and current characteristics and formation. (DOK 2)
 - d. Compare and contrast the physical and chemical parameters of dissolved O₂, pH, temperature, salinity, and results obtained through analysis of different water column depths/zones. (DOK 2)
 - e. Investigate the causes and effects of erosion and discuss conclusions. (DOK 2)
 - f. Describe and differentiate among the major geologic features of specific aquatic environments. (DOK 1)
 - Plate tectonics
 - Rise, slope, elevation, and depth
 - Formation of dunes, reefs, barrier/volcanic islands, and coastal/flood plains
 - Watershed formation as it relates to bodies of freshwater
 - g. Compare and contrast the unique abiotic and biotic characteristics of selected aquatic ecosystems. (DOK 2)
 - Barrier island, coral reef, tidal pool, and ocean
 - River, stream, lake, pond, and swamp
 - Bay, sound, estuary, and marsh
 3. **Apply an understanding of the diverse organisms found in aquatic environments.**
 - a. Analyze and explain the diversity and interactions among aquatic life. (DOK 3)

- Adaptations of representative organisms for their aquatic environments
- Relationship of organisms in food chains/webs within aquatic environments
- b. Research, calculate, and interpret population data. (DOK 2)
- c. Research and compare reproductive processes in aquatic organisms. (DOK 2)
- d. Differentiate among characteristics of planktonic, nektonic, and benthic organisms. (DOK 1)
- e. Explore the taxonomy of aquatic organisms, and use dichotomous keys to differentiate among the organisms. (DOK 2)
- f. Research and explain the symbiotic relationships in aquatic ecosystems. (DOK 3)
- 4. **Draw conclusions about the relationships between human activity and aquatic organisms.**
 - a. Describe the impact of natural and human activity on aquatic ecosystems, and evaluate the effectiveness of various solutions to environmental problems. (DOK 3)
 - Sources of pollution in aquatic environments and methods to reduce the effects of the pollution
 - Effectiveness of a variety of methods of environmental management and stewardship
 - Effects of urbanization on aquatic ecosystems and the effects of continued expansion
 - b. Research and cite evidence of the effects of natural phenomena such as hurricanes, floods, or drought on aquatic habitats and organisms. (DOK 3)
 - c. Discuss the advantages and disadvantages involved in applications of modern technology in aquatic science. (DOK 2)
 - Careers related to aquatic science
 - Modern technology within aquatic science (e.g., mariculture and aquaculture)
 - Contributions of aquatic technology to industry and government

Biology I

BIOI 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BIOI 2	Describe the biochemical basis of life, and explain how energy flows within and between the living systems.
BIOI 3	Investigate and evaluate the interaction between living organisms and their environment.
BIOI 4	Analyze and explain the structures and function of the levels of biological organization.
BIOI 5	Demonstrate an understanding of the molecular basis of heredity.
BIOI 6	Demonstrate an understanding of principles that explain the diversity of life and biological evolution.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
 - a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
 - d. Formulate questions that can be answered through research and experimental design. (DOK 3)
 - e. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 2)
 - f. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
 - g. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - h. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
 - i. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. Describe the biochemical basis of life, and explain how energy flows within and between the living systems.

- a. Explain and compare with the use of examples the types of bond formation (e.g., covalent, ionic, hydrogen, etc.) between or among atoms. (DOK 2)
 - Subatomic particles and arrangement in atoms
 - Importance of ions in biological processes
- b. Develop a logical argument defending water as an essential component of living systems (e.g., unique bonding and properties including polarity, high specific heat, surface tension, hydrogen bonding, adhesion, cohesion, and expansion upon freezing). (DOK 2)
- c. Classify solutions as acidic, basic, or neutral, and relate the significance of the pH scale to an organism's survival (e.g., consequences of having different concentrations of hydrogen and hydroxide ions). (DOK 2)
- d. Compare and contrast the structure, properties, and principle functions of carbohydrates, lipids, proteins, and nucleic acids in living organisms. (DOK 2)
 - Basic chemical composition of each group
 - Building components of each group (e.g., amino acids, monosaccharides, nucleotides, etc.)
 - Basic functions (e.g., energy, storage, cellular, heredity) of each group
- e. Examine the life processes to conclude the role enzymes play in regulating biochemical reactions. (DOK 2)
 - Enzyme structure
 - Enzyme function, including enzyme-substrate specificity and factors that affect enzyme function (pH and temperature)
- f. Describe the role of adenosine triphosphate (ATP) in making energy available to cells. (DOK 1)
 - ATP structure
 - ATP function
- g. Analyze and explain the biochemical process of photosynthesis and cellular respiration, and draw conclusions about the roles of the reactant and products in each. (DOK 3)
 - Photosynthesis and respiration (reactants and products)
 - Light-dependent reactions and light independent reactions in photosynthesis, including requirements and products of each
 - Aerobic and anaerobic processes in cellular respiration, including products each and energy differences

3. Investigate and evaluate the interaction between living organisms and their environment.

- a. Compare and contrast the characteristics of the world's major biomes (e.g., deserts, tundra, taiga, grassland, temperate forest, tropical rainforest). (DOK 2)
 - Plant and animal species
 - Climate (temperature and rainfall)
 - Adaptations of organisms
- b. Provide examples to justify the interdependence among environmental elements. (DOK 2)
 - Biotic and abiotic factors in an ecosystem (e.g., water, carbon, oxygen, mold, leaves)
 - Energy flow in ecosystems (e.g., energy pyramids and photosynthetic organisms to herbivores, carnivores, and decomposers)
 - Roles of beneficial bacteria
 - Interrelationships of organisms (e.g., cooperation, predation, parasitism, commensalism, symbiosis, and mutualism)
- c. Examine and evaluate the significance of natural events and human activities on major ecosystems (e.g., succession, population growth, technology, loss of genetic diversity, consumption of resources). (DOK 2)

4. Analyze and explain the structures and function of the levels of biological organization.

- a. Differentiate among plant and animal cells and eukaryotic and prokaryotic cells. (DOK 2)
 - Functions of all major cell organelles and structures (e.g., nucleus, mitochondrion, rough ER, smooth ER, ribosomes, Golgi bodies, vesicles, lysosomes, vacuoles, microtubules,

- microfilaments, chloroplast, cytoskeleton, centrioles, nucleolus, chromosomes, nuclear membrane, cell wall, cell membrane [active and passive transport], cytosol)
- Components of mobility (e.g., cilia, flagella, pseudopodia)
- b. Differentiate between types of cellular reproduction. (DOK 1)
 - Main events in the cell cycle and cell mitosis (including differences in plant and animal cell divisions)
 - Binary fission (e.g., budding, vegetative propagation, etc.)
 - Significance of meiosis in sexual reproduction
 - Significance of crossing over
- c. Describe and differentiate among the organizational levels of organisms (e.g., cells, tissues, organs, systems, types of tissues). (DOK 1)
- d. Explain and describe how plant structures (vascular and nonvascular) and cellular functions are related to the survival of plants (e.g., movement of materials, plant reproduction). (DOK 1)
- 5. **Demonstrate an understanding of the molecular basis of heredity.**
 - a. Analyze and explain the molecular basis of heredity and the inheritance of traits to successive generations by using the Central Dogma of Molecular Biology. (DOK 3)
 - Structures of DNA and RNA
 - Processes of replication, transcription, and translation
 - Messenger RNA codon charts
 - b. Utilize Mendel's laws to evaluate the results of monohybrid Punnett squares involving complete dominance, incomplete dominance, codominance, sex linked, and multiple alleles (including outcome percentage of both genotypes and phenotypes.) (DOK 2)
 - c. Examine inheritance patterns using current technology (e.g., pedigrees, karyotypes, gel electrophoresis). (DOK 2)
 - d. Discuss the characteristics and implications of both chromosomal and gene mutations. (DOK 2)
 - Significance of nondisjunction, deletion, substitutions, translocation, frame shift mutation in animals
 - Occurrence and significance of genetic disorders such as sickle cell anemia, Tay-Sachs disorder, cystic fibrosis, hemophilia, Down syndrome, color blindness
- 6. **Demonstrate an understanding of principles that explain the diversity of life and biological evolution.**
 - a. Draw conclusions about how organisms are classified into a hierarchy of groups and subgroups based on similarities that reflect their evolutionary relationships. (DOK 2)
 - Characteristics of the six kingdoms
 - Major levels in the hierarchy of taxa (e.g., kingdom, phylum/division, class, order, family, genus, and species)
 - Body plans (symmetry)
 - Methods of sexual reproduction (e.g., conjugation, fertilization, pollination)
 - Methods of asexual reproduction (e.g., budding, binary fission, regeneration, spore formation)
 - b. Critique data (e.g., comparative anatomy, Biogeography, molecular biology, fossil record, etc.) used by scientists (e.g., Redi, Needham, Spallanzani, Pasteur) to develop an understanding of evolutionary processes and patterns. (DOK 3)
 - c. Research and summarize the contributions of scientists (including Darwin, Malthus, Wallace, Lamarck, and Lyell) whose work led to the development of the theory of evolution. (DOK 2)
 - d. Analyze and explain the roles of natural selection, including the mechanisms of speciation (e.g., mutations, adaptations, geographic isolation) and applications of speciation (e.g., pesticide and antibiotic resistance). (DOK 3)
 - e. Differentiate among chemical evolution, organic evolution, and the evolutionary steps along the way to aerobic heterotrophs and photosynthetic autotrophs. (DOK 2)

Biology II

BIOII 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BIOII 2	Describe and contrast the structures, functions, and chemical processes of the cell.
BIOII 3	Investigate and discuss the molecular basis of heredity.
BIOII 4	Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.
BIOII 5	Develop an understanding of organism classification.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- Use current technologies such as CD-ROM, DVD, Internet, and on-line data search to explore current research related to a specific topic. (DOK 3)
- Clarify research questions and design laboratory investigations. (DOK 3)
- Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
- Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. Describe and contrast the structures, functions, and chemical processes of the cell.

- Relate the structure and function of a selectively permeable membrane to its role in diffusion and osmosis. (DOK 2)
- Summarize how cell regulation controls and coordinates cell growth and division. (DOK 2)
- Analyze and describe the function of enzymes in biochemical reactions. (DOK 2)
 - The impact of enzymatic reactions on biochemical processes
 - Factors that affect enzyme function (e.g., pH, concentration, temperature, etc.)
- Differentiate between photosynthesis and cellular respiration. (DOK 2)
 - Cellular sites and major pathways of anaerobic and aerobic respiration (with reactants, products, and ATP per monosaccharide)
 - Cellular respiration with respect to the sites at which they take place, the reactions involved, and the energy input and output in each stage (e.g., glycolysis, Krebs cycle, electron transport chain)
 - Pigments, absorption, reflection of light, and light-dependent and light-independent reactions of photosynthesis
 - Oxidation and reduction reactions

3. Investigate and discuss the molecular basis of heredity.

- Explain how the process of meiosis clarifies the mechanism underlying Mendel's conclusions about segregation and independent assortment on a molecular level. (DOK 1)
- Research and explain how major discoveries led to the determination of DNA structure. (DOK 2)
- Relate gene expression (e.g., replication, transcription, translation) to protein structure and function. (DOK 2)
 - Translation of a messenger RNA strand into a protein
 - Processing by organelles so that the protein is appropriately packaged, labeled, and eventually exported by the cell
 - Messenger RNA codon charts to determine the effects of different types of mutations on amino acid sequence and protein structure (e.g., sickle cell anemia resulting from base substitution mutation)
 - Gene expression regulated in organisms so that specific proteins are synthesized only when they are needed by the cell (e.g., allowing cell specialization)
- Assess the potential implications of DNA technology with respect to its impact on society. (DOK 3)

- Modern DNA technologies (e.g., polymerase chain reaction (PCR), gene splicing, gel electrophoresis, transformation, recombinant DNA) in agriculture, medicine, and forensics
- e. Develop a logical argument defending or refuting bioethical issues arising from applications of genetic technology (e.g., the human genome project, cloning, gene therapy, stem cell research). (DOK 3)

4. Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.

- a. Explain the history of life on earth, and infer how geological changes provide opportunities and constraints for biological evolution. (DOK 2)
 - Main periods of the geologic timetable of earth's history
 - Roles of catastrophic and gradualistic processes in shaping planet Earth
- b. Provide support for the argument based upon evidence from anatomy, embryology, biochemistry, and paleontology that organisms descended with modification from common ancestry. (DOK 2)
- c. Identify and provide supporting evidence for the evolutionary relationships among various organisms using phylogenetic trees and cladograms. (DOK 2)
- d. Formulate a scientific explanation based on fossil records of ancient life-forms, and describe how new species could originate as a result of geological isolation and reproductive isolation. (DOK 2)
- e. Compare and contrast the basic types of selection (e.g., disruptive, stabilizing, directional, etc.). (DOK 2)
- f. Cite examples to justify behaviors that have evolved through natural selection (e.g., migration, parental care, use of tools, etc.). (DOK 1)
- g. Research and explain the contributions of 19th century scientists (e.g., Malthus, Wallace, Lyell, and Darwin) on the formulation of ideas about evolution. (DOK 2)
- h. Develop a logical argument describing ways in which the influences of 20th century science have impacted the development of ideas about evolution (e.g., synthetic theory of evolution, molecular biology). (DOK 3)
- i. Analyze changes in an ecosystem resulting from natural causes (succession), changes in climate, human activity (pollution and recycling), or introduction of nonnative species. (DOK 2)

5. Develop an understanding of organism classification.

- a. Classify organisms according to traditional Linnaean classification characteristics (e.g., cell structure, biochemistry, anatomy, fossil record, methods of reproduction) and the cladistic approach. (DOK 2)
- b. Categorize organisms according to the characteristics that distinguish them as Bacteria, Archaea, or Eucarya. (DOK 1)
 - Bacteria, fungi, and protists
 - Characteristics of invertebrates (e.g., habitat, reproduction, body plan, locomotion) as related to phyla (e.g., Porifera, Cnidarians, Nematoda, Annelida, Platyhelminthes, and Arthropoda) and classes (e.g., Insecta, Crustacea, Arachnida, Mollusca, Echinodermata)
 - Characteristics of vertebrates (e.g., habitat, reproduction, body plan, locomotion) as related to classes (e.g., Agnatha, Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, Mammalia)
 - Nomenclature of various types of plants (e.g., Bryophyta, Tracheophyta, Gymnospermae, Angiospermae, Monocotyledonae, Dicotyledonae, vascular plants, nonvascular plants)

Botany

BO 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BO 2	Distinguish among the characteristics of botanical organization, structure, and function.
BO 3	Demonstrate an understanding of plant reproduction.
BO 4	Draw conclusions about the factors that affect the adaptation and survival of plants.
BO 5	Relate an understanding of plant genetics to its uses in modern living.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols

- Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
 - b. Formulate questions that can be answered through research and experimental design. (DOK 3)
 - c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
 - d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
 - e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
 - g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
2. **Distinguish among the characteristics of botanical organization, structure, and function.**
- a. Relate plant cell structures to their functions (e.g., major organelles, cell wall components, photosynthetic chemical reactions, plant pigments, plant tissues, roots, stems, leaves, flowers). (DOK 1)
 - b. Differentiate the characteristics found in various plant divisions. (DOK 2)
 - Differences and similarities of nonvascular plants
 - Characteristics of seed-bearing and non-seed bearing vascular plants relative to taxonomy
 - Major vegetative structures and their modifications in angiosperms and gymnosperms
 - c. Compare and contrast leaf modifications of gymnosperms and angiosperms (e.g., needles, overlapping scales, simple leaves, compound leaves, evergreen trees, and deciduous trees). (DOK 2)
 - d. Apply the modern classification scheme utilized in naming plants to identify plant specimens. (DOK 2)
 - Classification scheme used in botany
 - Classification of native Mississippi plants
 - e. Use inquiry to investigate and discuss the physical and chemical processes of plants. (DOK 3)
 - Relationships among photosynthesis, cellular respiration, and translocation
 - Importance of soil type and soil profiles to plant survival
 - Mechanism of water movement in plants
 - Effects of environmental conditions for plant survival
 - Tropic responses of a plant organ to a given stimulus
3. **Demonstrate an understanding of plant reproduction.**
- a. Compare and contrast reproductive structures (e.g., cones, flowers). (DOK 2)
 - b. Differentiate among the vegetative organs of monocots, herbaceous dicots, and woody dicots. (DOK 1)
 - c. Differentiate between the structures and processes of sexual and asexual reproduction in plants. (DOK 1)
 - Reproductive structures, their modifications, and the mechanisms involved in plant reproduction
 - Functions of flower parts, seeds, cones
 - Spore production in bryophytes and ferns
 - d. Explain and provide examples of the concept of alternation of generations and its examples. (DOK 2)
 - e. Categorize types of fruits and methods of seed distribution in plants. (DOK 1)
 - f. Research and compare various methods of plant propagation. (DOK 2)
4. **Draw conclusions about the factors that affect the adaptation and survival of plants.**
- a. List and assess several adaptations of plants to survive in a given biome. (DOK 2)
 - b. Design and conduct an experiment to determine the effects of environmental factors on photosynthesis. (DOK 3)
 - c. Explain how natural selection and the evolutionary consequences (e.g., adaptation or extinction) support scientific explanations for similarities of ancient life-forms in the fossil record and molecular similarities present in living organisms. (DOK 2)
 - d. Research factors that might influence or alter plant stability, and propose actions that may reduce the negative impacts of human activity. (DOK 2)
5. **Relate an understanding of plant genetics to its uses in modern living.**
- a. Research, prepare, and present a position relating to issues surrounding the current botanical trends involving biotechnology. (DOK 3)

- b. Apply an understanding of the principles of plant genetics to analyze monohybrid and dihybrid crosses, and predict the potential effects the crosses might have on agronomy and agriculture. (DOK 3)
- c. Discuss the effects of genetic engineering of plants on society. (DOK 2)
- d. Describe the chemical compounds extracted from plants, their economical importance, and the impact on humans. (DOK 3)
 - Plant extracts, their function, and origin
 - Impact of the timber industry on local and national economy

Chemistry I

- CHI 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- CHI 2 Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.
- CHI 3 Develop an understanding of the periodic table.
- CHI 4. Analyze the relationship between microscopic and macroscopic models of matter.
- CHI 5 Compare factors associated with acid/base and oxidation/reduction reactions.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
- b. Clarify research questions and design laboratory investigations. (DOK 3)
- c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
- e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBLs, etc.). (DOK 3)

2. Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.

- a. Describe and classify matter based on physical and chemical properties and interactions between molecules or atoms. (DOK 1)
 - Physical properties (e.g., melting points, densities, boiling points) of a variety of substances
 - Substances and mixtures
 - Three states of matter in terms of internal energy, molecular motion, and the phase transitions between them
- b. Research and explain crucial contributions and critical experiments of Dalton, Thomson, Rutherford, Bohr, de Broglie, and Schrödinger, and describe how each discovery contributed to the current model of atomic and nuclear structure. (DOK 2)
- c. Develop a model of atomic and nuclear structure based on theory and knowledge of fundamental particles. (DOK 2)
 - Properties and interactions of the three fundamental particles of the atom
 - Laws of conservation of mass, constant composition, definite proportions, and multiple proportions
- d. Write appropriate equations for nuclear decay reactions, describe how the nucleus changes during these reactions, and compare the resulting radiation with regard to penetrating ability. (DOK 1)
 - Three major types of radioactive decay (e.g., alpha, beta, gamma) and the properties of the emissions (e.g., composition, mass, charge, penetrating power)
 - The concept of half-life for a radioactive isotope (e.g., carbon-14 dating) based on the principle that the decay of any individual atom is a random process

- e. Compare the properties of compounds according to their type of bonding. (DOK 1)
 - Covalent, ionic, and metallic bonding
 - Polar and nonpolar covalent bonding
 - Valence electrons and bonding atoms
 - f. Compare different types of intermolecular forces, and explain the relationship between intermolecular forces, boiling points, and vapor pressure when comparing differences in properties of pure substances. (DOK 1)
 - g. Develop a three-dimensional model of molecular structure. (DOK 2)
 - Lewis dot structures for simple molecules and ionic compounds
 - Valence shell electron pair repulsion theory (VSEPR)
- 3. Develop an understanding of the periodic table.**
- a. Calculate the number of protons, neutrons, and electrons in individual isotopes using atomic numbers and mass numbers, write electron configurations of elements and ions following the Aufbau principle, and balance equations representing nuclear reactions. (DOK 1)
 - b. Analyze patterns and trends in the organization of elements in the periodic table, and compare their relationship to position in the periodic table. (DOK 2)
 - Atomic number, atomic mass, mass number, and number of protons, electrons, and neutrons in isotopes of elements
 - Average atomic mass calculations
 - Chemical characteristics of each region
 - Periodic properties (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius)
 - c. Classify chemical reactions by type. (DOK 2)
 - Single displacement, double displacement, synthesis (combination), decomposition, disproportionation, combustion, or precipitation
 - Products (given reactants) or reactants (given products) for each reaction type
 - Solubility rules for precipitation reactions and the activity series for single and double displacement reactions
 - d. Use stoichiometry to calculate the amount of reactants consumed and products formed. (DOK 3)
 - Difference between chemical reactions and chemical equations
 - Formulas and calculations of the molecular (molar) masses
 - Empirical formula given the percent composition of elements
 - Molecular formula given the empirical formula and molar mass
- 4. Analyze the relationship between microscopic and macroscopic models of matter.**
- a. Calculate the number of protons, neutrons, and electrons in individual isotopes using atomic numbers and mass numbers, write electron configurations of elements and ions following the Aufbau principle, and balance equations representing nuclear reactions. (DOK 1)
 - b. Analyze patterns and trends in the organization of elements in the periodic table, and compare their relationship to position in the periodic table. (DOK 2)
 - Atomic number, atomic mass, mass number, and number of protons, electrons, and neutrons in isotopes of elements
 - Average atomic mass calculations
 - Chemical characteristics of each region
 - Periodic properties (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius)
 - c. Classify chemical reactions by type. (DOK 2)
 - Single displacement, double displacement, synthesis (combination), decomposition, disproportionation, combustion, or precipitation
 - Products (given reactants) or reactants (given products) for each reaction type
 - Solubility rules for precipitation reactions and the activity series for single and double displacement reactions
 - d. Use stoichiometry to calculate the amount of reactants consumed and products formed. (DOK 3)

- Difference between chemical reactions and chemical equations
- Formulas and calculations of the molecular (molar) masses
- Empirical formula given the percent composition of elements
- Molecular formula given the empirical formula and molar mass

5. Compare factors associated with acid/base and oxidation/reduction reactions.

- a. Analyze and explain acid/base reactions. (DOK 2)
 - Properties of acids and bases, including how they affect indicators and the relative pH of the solution
 - Formation of acidic and basic solutions
 - Definition of pH in terms of the hydronium ion concentration and the hydroxide ion concentration
 - The pH or pOH from the hydrogen ion or hydroxide ion concentrations of solution
 - How a buffer works and examples of buffer solutions
- b. Classify species in aqueous solutions according to the Arrhenius and Bronsted-Lowry definitions respectively, and predict products for aqueous neutralization reactions. (DOK 2)
- c. Analyze a reduction/oxidation reaction (REDOX) to assign oxidation numbers (states) to reaction species, and identify the species oxidized and reduced, the oxidizing agent, and reducing agent. (DOK 2)

Organic Chemistry

- ORGC 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ORGC 2 Demonstrate an understanding of the properties, structure, and function of organic compounds.
- ORGC 3 Discuss the versatility of polymers and the diverse application of organic chemicals.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Formulate questions that can be answered through research and experimental design. (DOK 3)
- c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
- e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
- f. Recognize and analyze alternative explanations for experimental results, and make predictions based on observations and prior knowledge. (DOK 3)
- g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. Demonstrate an understanding of the properties, structure, and function of organic compounds.

- a. Apply International Union of Pure and Applied Chemistry (IUPAC) nomenclature, and differentiate the structure of aliphatic, aromatic, and cyclic hydrocarbon compounds. (DOK 1)
 - Structures of hydrocarbon compounds
 - Isomerism in hydrocarbon compounds
- b. Relate structure to physical and chemical properties of hydrocarbon. (DOK 1)
- c. Apply principles of geometry and hybridization to organic molecules. (DOK 2)
 - Lewis structures for organic molecules
 - Bond angles
 - Hybridization (as it applies to organic molecules)
- d. Write, complete, and classify common reactions for aliphatic, aromatic, and cyclic hydrocarbons. (DOK 1)
- e. Construct, solve, and explain equations representing combustion reactions, substitution reactions, dehydrogenation reactions, and addition reactions. (DOK 2)

- f. Classify functional groups (e.g., alcohols, ethers, aldehydes, ketones, carboxylic acids, esters, amines, amides, and nitriles) by their structure and properties. (DOK 2)
 - Structural formulas from functional group names and vice versa
 - Chemical and physical properties of compounds containing functional groups
 - Equations representing the transformation of one functional group into another
- 3. **Discuss the versatility of polymers and the diverse application of organic chemicals.**
 - a. Describe and classify the synthesis, properties, and uses of polymers. (DOK 2)
 - Common polymers
 - Synthesis of polymers from monomers by addition or condensation
 - Condensations of plastics according to their commercial types
 - Elasticity and other polymer properties
 - b. Develop a logical argument supporting the use of organic chemicals and their application in industry, drug manufacture, and biological chemistry. (DOK 1)
 - Common uses of polymers and organic compounds in medicine, drugs, and personal care products
 - Compounds that have the property to dye materials
 - Petrochemical production
 - Biologically active compounds in terms of functional group substrate interaction
 - c. Research and summarize the diversity, applications, and economics of industrial chemicals (solvents, coatings, surfactants, etc.). (DOK 3)

Earth and Space Science

- E1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- E2 Develop an understanding of the history and evolution of the universe and earth.
- E3 Discuss factors that are used to explain the geological history of earth.
- E4 Demonstrate an understanding of earth systems relating to weather and climate.
- E5 Apply an understanding of ecological factors to explain relationships between earth systems.

- 1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
 - a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers.
 - b. Formulate questions that can be answered through research and experimental design. (DOK 3)
 - c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
 - d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
 - e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
 - g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
- 2. **Develop an understanding of the history and evolution of the universe and earth.**
 - a. Summarize the origin and evolution of the universe. (DOK 2)
 - Big bang theory
 - Microwave background radiation
 - The Hubble constant
 - Evidence of the existence of dark matter and dark energy in the universe and the history of the universe

- b. Differentiate methods used to measure space distances, including astronomical unit, light-year, stellar parallax, Cepheid variables, and the red shift. (DOK 1)
 - c. Interpret how gravitational attraction played a role in the formation of the planetary bodies and how the fusion of hydrogen and other processes in “ordinary” stars and supernovae lead to the formation of all other elements. (DOK 2)
 - d. Summarize the early evolution of the earth, including the formation of Earth’s solid layers (e.g., core, mantle, and crust), the distribution of major elements, the origin of internal heat sources, and the initiation of plate tectonics. (DOK 2)
 - How the decay of radioactive isotopes is used to determine the age of rocks, earth, and the solar system
 - How Earth acquired its initial oceans and atmosphere
- 3. Discuss factors which are used to explain the geological history of earth.**
- a. Develop an understanding of how plate tectonics create certain geological features, materials, and hazards. (DOK 1)
 - Plate tectonic boundaries (e.g., divergent, convergent, and transform)
 - Modern and ancient geological features to each kind of plate tectonic boundary
 - Production of particular groups of igneous and metamorphic rocks and mineral resources
 - Sedimentary basins created and destroyed through time
 - b. Compare and contrast types of mineral deposits/groups (e.g., oxides, carbonates, halides, sulfides, sulfates, silicates, phosphates). (DOK 2)
 - c. Categorize minerals and rocks by determining their physical and/or chemical characteristics. (DOK 2)
 - d. Justify the causes of certain geological hazards (e.g., earthquakes, volcanoes, tsunamis) to their effects on specific plate tectonic locations. (DOK 2)
 - e. Interpret and explain how rock relationships and fossils are used to reconstruct the geologic history of the earth. (DOK 2)
 - f. Apply principles of relative age (e.g., superposition, original horizontality, crosscutting relations, and original lateral continuity) to support an opinion related to earth’s geological history. (DOK 3)
 - Types of unconformity (e.g., disconformity, angular unconformity, nonconformity)
 - Geological timetable
 - g. Apply the principle of uniformitarianism to relate sedimentary rock associations and their fossils to the environments in which the rocks were deposited. (DOK 2)
 - h. Compare and contrast the relative and absolute dating methods (e.g., the principle of fossil succession, radiometric dating, and paleomagnetism) for determining the age of the earth. (DOK 1)
- 4. Demonstrate an understanding of earth systems relating to weather and climate.**
- a. Explain the interaction of earth systems that affect weather and climate. (DOK 1)
 - Latitudinal variations in solar heating
 - The effects of Coriolis forces on ocean currents, cyclones, anticyclones, ocean currents, topography, and air masses (e.g., warm fronts, cold fronts, stationary fronts, and occluded fronts).
 - b. Interpret the patterns in temperature and precipitation that produce the climate regions on earth, and relate them to the hazards associated with extreme weather events and climate change (e.g., hurricanes, tornadoes, El Niño/La Niña, global warming). (DOK 2)
 - c. Justify how changes in global climate and variation in earth/sun relationships contribute to natural and anthropogenic (human-caused) modification of atmospheric composition. (DOK 2)
 - d. Summarize how past and present actions of ice, wind, and water contributed to the types and distributions of erosional and depositional features in landscapes. (DOK 1)
 - e. Research and explain how external forces affect earth’s topography. (DOK 2)
 - How surface water and groundwater act as the major agents of physical and chemical weathering
 - How soil results from weathering and biological processes
 - Processes and hazards associated with both sudden and gradual mass wasting
- 5. Apply an understanding of ecological factors to explain relationships between earth systems.**
- a. Draw conclusions about how life on earth shapes earth systems and responds to the interaction of earth systems (lithosphere, hydrosphere, atmosphere, and biosphere). (DOK 3)

- Nature and distribution of life on earth, including humans, to the chemistry and availability of water
- Distribution of biomes (e.g., terrestrial, freshwater, and marine) to climate regions through time
- Geochemical and ecological processes (e.g., rock, hydrologic, carbon, nitrogen) that interact through time to cycle matter and energy and how human activity alters the rates of these processes (e.g., fossil fuel formation and combustion, damming and channeling of rivers)
- b. Interpret the record of shared ancestry (fossils), evolution, and extinction as related to natural selection. (DOK 2)
- c. Identify the cause and effect relationships of the evolutionary innovations that most profoundly shaped earth systems. (DOK 1)
 - Photosynthesis and the atmosphere
 - Multicellular animals and marine environments
 - Land plants and terrestrial environments
- d. Cite evidence about how dramatic changes in earth's atmosphere influenced the evolution of life. (DOK 1)

Environmental Science

- ES 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ES 2 Develop an understanding of the relationship of ecological factors that affect an ecosystem.
- ES 3 Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Formulate questions that can be answered through research and experimental design. (DOK 3)
- c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
- f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
- g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK3)

2. Develop an understanding of the relationship of ecological factors that affect an ecosystem.

- a. Compare ways in which the three layers of the biosphere change over time and their influence on an ecosystem's ability to support life. (DOK 2)
- b. Explain the flow of matter and energy in ecosystems. (DOK 2)
 - Interactions between biotic and abiotic factors
 - Indigenous plants and animals and their roles in various ecosystems
 - Biogeochemical cycles within the environment
- c. Predict the impact of the introduction, removal, and reintroduction of an organism on an ecosystem. (DOK 3)
- d. Develop a logical argument explaining the relationships and changes within an ecosystem. (DOK 2)
 - How a species adapts to its niche
 - Process of primary and secondary succession and its effects on a population
 - How changes in the environment might affect organisms
- e. Explain the causes and effects of changes in population dynamics (e.g., natural selection, exponential growth, predator/prey relationships) to carrying capacity and limiting factors. (DOK 2)

- f. Research and explain how habitat destruction leads to the loss of biodiversity. (DOK 2)
 - g. Compare and contrast the major biomes of the world's ecosystems, including location, climate, adaptations and diversity. (DOK 1)
3. **Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.**
- a. Summarize the effects of human activities on resources in the local environments. (DOK 2)
 - Sources, uses, quality, and conservation of water
 - Renewable and nonrenewable resources
 - Effects of pollution (e.g., water, noise, air, etc.) on the ecosystem
 - b. Research and evaluate the impacts of human activity and technology on the lithosphere, hydrosphere, and atmosphere, and develop a logical argument to support how communities restore ecosystems. (DOK 3)
 - c. Research and evaluate the use of renewable and nonrenewable resources, and critique efforts to conserve natural resources and reduce global warming in the United States including (but not limited) to Mississippi. (DOK 3)

Genetics

- G 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- G 2 Analyze the structure and function of the cell and cellular organelles.
- G 3 Apply the principles of heredity to demonstrate genetic understandings.

1. **Use critical thinking and scientific problem solving in designing and performing biological research and experimentation. (L, P, E)**

- a. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
- b. Clarify research questions and design laboratory investigations. (DOK 3)
- c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for pie, bar, and line graphs) to draw conclusions and make inferences. (DOK 3)
- e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBLs, etc.). (DOK 3)

2. **Review the structure and function of the cell as it applies to genetics. (L)**

- a. Cite evidence to illustrate how the structure and function of cells are involved in the maintenance of life. (DOK 2)
- b. Describe how organic components are integral to biochemical processes. (DOK 2)
- c. Differentiate among the processes by which plants and animals reproduce. (DOK 1)
 - Cell cycle and mitosis
 - Meiosis, spermatogenesis, and oogenesis
- d. Explain the significance of the discovery of nucleic acids. (DOK 1)
- e. Analyze and explain the structure and function of DNA and RNA in replication, transcription, translation and DNA repair. (DOK 2)
- f. Cite examples to compare the consequences of the different types of mutations. (DOK 1)
- g. Draw conclusions about the importance and potential impacts of the process of gene transfer used in biotechnology. (DOK 3)

3. **Analyze the structure and function of DNA and RNA molecules. (L, P)**

- a. Cite evidence that supports the significance of Mendel's concept of "particulate inheritance" to explain the understanding of heredity. (DOK 1)

- b. Apply classical genetics principles to solve basic genetic problems. (DOK 2)
 - Genes and alleles, dominance, recessiveness, the laws of segregation, and independent assortment
 - Inheritance of autosomal and sex-linked traits
 - Inheritance of traits influenced by multiple alleles and traits with polygenetic inheritance
 - Chromosomal theory of inheritance
- c. Apply population genetic concepts to summarize variability of multicellular organisms. (DOK 2)
 - Genetic variability
 - Hardy-Weinberg formula
 - Migration and genetic drift
 - Natural selection in humans
- d. Distinguish and explain the applications of various tools and techniques used in DNA manipulation. (DOK 1)
 - Steps in genetic engineering experiments
 - Use of restriction enzymes
 - Role of vectors in genetic research
 - Use of transformation techniques
- e. Research and present a justifiable explanation the practical uses of biotechnology (e.g., chromosome mapping, karyotyping, and pedigrees). (DOK 2)
- f. Develop and present a scientifically-based logical argument for or against moral and ethical issues related to genetic engineering. (DOK 3)
- g. Research genomics (human and other organisms), and predict benefits and medical advances that may result from the use of genome projects. (DOK 2)

Geology

GE1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
GE2	Develop an understanding of plate tectonics and geochemical and ecological processes that affect earth.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Formulate questions that can be answered through research and experimental design. (DOK 3)
- c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
- f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
- g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. Develop an understanding of plate tectonics and geochemical and ecological processes that affect earth.

- a. Differentiate the components of the earth's atmosphere and lithosphere. (DOK 1)
- b. Research and summarize explanations of how earth acquired its initial atmosphere and oceans. (DOK 2)
- c. Compare the causes and effects of internal and external components that shape earth's topography. (DOK 2)
 - Physical weathering (e.g., atmospheric, glacial, etc.)
 - Chemical weathering agents (e.g., acid precipitation, carbon dioxide, oxygen, water, etc.)

- d. Develop an understanding of how plate tectonics create certain geologic features, materials, and hazards. (DOK 2)
 - Types of crustal movements and the resulting landforms (e.g., seafloor spreading, paleomagnetic measurements, and orogenesis)
 - Processes that create earthquakes and volcanoes
 - Asthenosphere
- e. Summarize the theories of plate development and continental drift, and describe the causes and effects involved in each. (DOK 2)
- f. Develop a logical argument to explain how geochemical and ecological processes (e.g., rock, hydrologic, carbon, nitrogen) interact through time to cycle matter and energy and how human activity alters the rates of these processes (e.g., fossil fuel formation and combustion, damming, and channeling of rivers). (DOK 2)
- g. Interpret how the earth's geological time scale relates to geological history, landforms, and life-forms. (DOK 2)
- h. Research and describe different techniques for determining relative and absolute age of the earth (e.g., index of fossil layers, superposition, radiometric dating, etc.) (DOK 1)
- i. Summarize the geological activity of the New Madrid fault line, and compare and contrast it to geological activity in other parts of the world. (DOK 2)
- j. Identify and differentiate the major geological features in Mississippi (e.g., Delta, Coastal Areas, etc.). (DOK 1)
- k. Evaluate an emergency preparedness plan for natural disasters associated with crustal movement. (DOK 3)

Physical Science

PS 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
PS 2	Describe and explain how forces affect motion.
PS 3	Demonstrate an understanding of general properties and characteristics of waves.
PS 4	Develop an understanding of the atom.
PS 5	Investigate and apply principles of physical and chemical changes in matter.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Use appropriate laboratory safety symbols and procedures to design and conduct a scientific investigation. (DOK 2)
 - Safety symbols and safety rules in all laboratory activities
 - Proper use and care of the compound light microscope
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Identify questions that can be answered through scientific investigations. (DOK 3)
- c. Identify and apply components of scientific methods in classroom investigations. (DOK 3)
 - Predicting, gathering data, drawing conclusions
 - Recording outcomes and organizing data from a variety of sources (e.g., scientific articles, magazines, student experiments, etc.)
 - Critically analyzing current investigations/problems using periodicals and scientific scenarios
- d. Interpret and generate graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures and data to draw conclusions about the validity of research. (DOK 3)
- f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- g. Communicate effectively to present and explain scientific results, using appropriate terminology and graphics. (DOK 3)

2. Describe and explain how forces affect motion.

- a. Demonstrate and explain the basic principles of Newton's three laws of motion including calculations of acceleration, force, and momentum. (DOK 2)

- Inertia and distance-time graphs to determine average speed
 - Net force (accounting for gravity, friction, and air resistance) and the resulting motion of objects
 - Effects of the gravitational force on objects on Earth and effects on planetary and lunar motion
 - Simple harmonic motion (oscillation)
 - b. Explain the connection between force, work, and energy. (DOK 2)
 - Force exerted over a distance (results in work done)
 - Force-distance graph (to determine work)
 - Network on an object that contributes to change in kinetic energy (work-to-energy theorem)
 - c. Describe (with supporting details and diagrams) how the kinetic energy of an object can be converted into potential energy (the energy of position) and how energy is transferred or transformed (conservation of energy). (DOK 2)
 - d. Draw and assess conclusions about charges and electric current. (DOK 2)
 - Static/current electricity and direct current/alternating current
 - Elements in an electric circuit that are in series or parallel
 - Conductors and insulators
 - Relationship between current flowing through a resistor and voltage flowing across a resistor
 - e. Cite evidence and explain the application of electric currents and magnetic fields as they relate to their use in everyday living (e.g., the application of fields in motors and generators and the concept of electric current using Ohm's Law). (DOK 2)
- 3. Demonstrate an understanding of general properties and characteristics of waves.**
- a. Differentiate among transverse, longitudinal, and surface waves as they propagate through a medium (e.g., string, air, water, steel beam). (DOK 1)
 - b. Compare properties of waves (e.g., superposition, interference, refraction, reflection, diffraction, Doppler effect), and explain the connection among the quantities (e.g., wavelength, frequency, period, amplitude, and velocity). (DOK 2)
 - c. Classify the electromagnetic spectrum's regions according to frequency and/or wavelength, and draw conclusions about their impact on life. (DOK 2)
 - The emission of light by electrons when moving from higher to lower levels
 - Energy (photons as quanta of light)
 - Additive and subtractive properties of colors
 - Relationship of visible light to the color spectrum
 - d. Explain how sound intensity is measured and its relationship to the decibel scale. (DOK 1)
- 4. Develop an understanding of the atom.**
- a. Cite evidence to summarize the atomic theory. (DOK 1)
 - Models for atoms
 - Hund's rule and Aufbau process to specify the electron configuration of elements
 - Building blocks of matter (e.g., proton, neutron, and electron) and elementary particles (e.g., positron, mesons, neutrinos, etc.)
 - Atomic orbitals (s, p, d, f) and their basic shapes
 - b. Explain the difference between chemical and physical changes, and demonstrate how these changes can be used to separate mixtures and compounds into their components. (DOK 2)
 - c. Research the history of the periodic table of the elements, and summarize the contributions that led to the atomic theory. (DOK 2)
 - Contributions of scientists (e.g., John Dalton, J.J. Thomson, Ernest Rutherford, Newton, Einstein, Neils, Bohr, Louis de Broglie, Erwin Schrödinger, etc.)
 - Technology (e.g., X-rays, cathode-ray tubes, spectroscopes)
 - Experiments (e.g., gold-foil, cathode-ray, etc.)
 - d. Utilize the periodic table to predict and explain patterns and draw conclusions about the structure, properties, and organization of matter. (DOK 2)
 - Atomic composition and valence electron configuration (e.g., atomic number, mass number of protons, neutrons, electrons, isotopes, and ions)
 - Periodic trends using the periodic table (e.g., valence, reactivity, atomic radius)

- Average atomic mass from isotopic abundance
- Solids, liquids, and gases
- Periodic properties of elements (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius) and how they relate to position in the periodic table

5. Investigate and apply principles of physical and chemical changes in matter.

- Write chemical formulas for compounds comprising monatomic and polyatomic ions. (DOK 1)
- Balance chemical equations. (DOK 2)
- Classify types of chemical reactions (e, g., composition, decomposition, single displacement, double displacement, combustion, acid/base reactions). (DOK 2)

Physics I

PHYI 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
PHYI 2	Develop an understanding of concepts related to forces and motion.
PHYI 3	Develop an understanding of concepts related to work and energy.
PHYI 4	Discuss the characteristics and properties of light and sound.
PHYI 5	Apply an understanding of magnetism, electric fields, and electricity.
PHYI 6	Analyze and explain concepts of nuclear physics.

1. Investigate and apply principles of physical and chemical changes in matter.

- Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
- Clarify research questions, and design laboratory investigations. (DOK 3)
- Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
- Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. Develop an understanding of concepts related to forces and motion.

- Use inquiry to investigate and develop an understanding of the kinematics and dynamics of physical bodies. (DOK 3)
 - Vector and scalar quantities
 - Vector problems (solved mathematically and graphically)
 - Vector techniques and free-body diagrams to determine the net force on a body when several forces are acting on it
 - Relations among mass, inertia, and weight
- Analyze, describe, and solve problems by creating and utilizing graphs of one-dimensional motion (e.g., position, distance, displacement, time, speed, velocity, acceleration, the special case of freefall). (DOK 3)
- Analyze real-world applications to draw conclusions about Newton's three laws of motion. (DOK 2)
- Apply the effects of the universal gravitation law to graph and interpret the force between two masses, acceleration due to gravity, and planetary motion. (DOK 2)
 - Situations where g is constant (falling bodies)
 - Concept of centripetal acceleration undergoing uniform circular motion
 - Kepler's third law
 - Oscillatory motion and the mechanics of waves

3. Develop an understanding of concepts related to work and energy.

- Explain and apply the conservation of energy and momentum. (DOK 2)

- Concept of work and applications
 - Concept of kinetic energy, using the elementary work-energy theorem
 - Concept of conservation of energy with simple examples
 - Concepts of energy, work, and power (qualitatively and quantitatively)
 - Principles of impulse in inelastic and elastic collisions
- b. Analyze real-world applications to draw conclusions about mechanical potential energy (the energy of configuration). (DOK 3)
- c. Apply the principles of impulse, and compare conservation of momentum and conservation of kinetic energy in perfectly inelastic and elastic collisions. (DOK 1)
- d. Investigate and summarize the principles of thermodynamics. (DOK 2)
- How heat energy is transferred from higher temperature to lower temperature until equilibrium is reached
 - Temperature and thermal energy as related to molecular motion and states of matter
 - Problems involving specific heat and heat capacity
 - First and second laws of thermodynamics as related to heat engines, refrigerators, and thermal efficiency
- e. Develop the kinetic theory of ideal gases and explain the concept of Carnot efficiency. (DOK 2)
- 4. Discuss the characteristics and properties of light and sound.**
- a. Describe and model the characteristics and properties of mechanical waves. (DOK 2)
- Simple harmonic motion
 - Relationships among wave characteristics such as velocity, period, frequency, amplitude, phase, and wavelength
 - Energy of a wave in terms of amplitude and frequency.
 - Standing waves and waves in specific media (e.g., stretched string, water surface, air, etc.)
- b. Differentiate and explain the Doppler effect as it relates to a moving source and to a moving observer. (DOK 1)
- c. Explain the laws of reflection and refraction, and apply Snell's law to describe the relationship between the angles of incidence and refraction. (DOK 2)
- d. Use ray tracing and the thin lens equation to solve real-world problems involving object distance from lenses. (DOK 2)
- e. Investigate and draw conclusions about the characteristics and properties of electromagnetic waves. (DOK 2)
- 5. Apply an understanding of magnetism, electric fields, and electricity.**
- a. Analyze and explain the relationship between electricity and magnetism. (DOK 2)
- Characteristics of static charge and how a static charge is generated
 - Electric field, electric potential, current, voltage, and resistance as related to Ohm's law
 - Magnetic poles, magnetic flux and field, Ampère's law and Faraday's law
 - Coulomb's law
- b. Use schematic diagrams to analyze the current flow in series and parallel electric circuits, given the component resistances and the imposed electric potential. (DOK 2)
- c. Analyze and explain the relationship between magnetic fields and electrical current by induction, generators, and electric motors. (DOK 2)
- 6. Analyze and explain concepts of nuclear physics.**
- a. Analyze and explain the principles of nuclear physics. (DOK 1)
- The mass number and atomic number of the nucleus of an isotope of a given chemical element
 - The conservation of mass and the conservation of charge
 - Nuclear decay
- b. Defend the wave-particle duality model of light, using observational evidence. (DOK 3)
- Quantum energy and emission spectra
 - Photoelectric and Compton effects

Spatial Information Science

- SP 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
SP 2 Develop an understanding of geographic information systems.

1. Demonstrate the basic concepts of global positioning systems (GPS). (E)

- a. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
- b. Clarify research questions, and design laboratory investigations. (DOK 3)
- c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, and theory development). (DOK 3)
- d. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences). (DOK 3)
- e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. Demonstrate the basic concepts of remote sensing. (E, P)

- a. Describe the characteristics of the electromagnetic spectrum.
- b. Using images and graphs, interpret the absorption/reflection spectrum.
- c. Distinguish between passive vs. active sensor systems.
- d. Analyze the effects of changes in spatial, temporal, and spectral resolution.
- e. Analyze the effects on images due to changes in scale.
- f. Identify the types of sensor platforms.

Zoology

- ZO 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
ZO 2 Develop an understanding of levels of organization and animal classification.
ZO 3 Differentiate among animal life cycles, behaviors, adaptations, and relationships.
ZO 4 Demonstrate an understanding of the principles of animal genetic diversity and evolution.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Formulate questions that can be answered through research and experimental design. (DOK 3)
- c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
- f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
- g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. Develop an understanding of levels of organization and animal classification.

- a. Explain how organisms are classified, and identify characteristics of major groups. (DOK 1)
 - Levels of organization of structures in animals (e.g., cells, tissues, organs, and systems)

- Characteristics used to classify organisms (e.g., cell structure, biochemistry, anatomy, fossil record, and methods of reproduction)
 - b. Identify and describe characteristics of the major phyla. (DOK 1)
 - Symmetry and body plan
 - Germ layers and embryonic development
 - Organ systems (e.g., digestive, circulatory, excretory, and reproductive)
 - Locomotion and coordination
 - c. Distinguish viruses from bacteria and protists, and give examples. (DOK 1)
 - d. Differentiate among the characteristics of bacteria, archaea, and eucarya. (DOK 1)
 - Phylogenic sequencing of the major phyla
 - Invertebrate characteristics (e.g., habitat, reproduction, body plan, locomotion) of the following phyla: Porifera, Cnidarians, Nematoda, Annelida, Platyhelminthes, Arthropoda, Insecta, Crustacea, Arachnida, Mollusca [Bivalvia and Gastropoda], and Echinodermata
 - Vertebrate characteristics (e.g., habitat, reproduction, body plan, locomotion) of the following classes: Agnatha, Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, and Mammalia
3. **Differentiate among animal life cycles, behaviors, adaptations, and relationships.**
- a. Describe life cycles, alternation of generations, and metamorphosis of various animals, and evaluate the advantages and disadvantages of asexual and sexual reproduction. (DOK 1)
 - b. Describe and explain concepts of animal behavior, and differentiate between learned and innate behavior. (DOK 1)
 - Division of labor within a group of animals
 - Communication within animals groups
 - Degree of parental care given in animal groups
 - c. Evaluate the unique protective adaptations of animals as they relate to survival. (DOK 2)
 - d. Compare and contrast ecological relationships, and make predictions about the survival of populations under given circumstances. (DOK 3)
 - Terrestrial and aquatic ecosystems
 - Herbivores, carnivores, omnivores, decomposers and other feeding relationships
 - Symbiotic relationships such as mutualism, commensalisms, and parasitism
 - e. Contrast food chains and food webs. (DOK 2)
4. **Demonstrate an understanding of the principles of animal genetic diversity and evolution.**
- a. Categorize and explain sources of genetic variation on the cellular level (e.g., mutations, crossing over, and nondisjunction) and the population level (e.g., nonrandom mating, migration, etc.). (DOK 2)
 - Relationship between natural selection and evolution
 - Mutations, crossing over, non-disjunction
 - Nonrandom mating, migration, etc.
 - Effects of genetic drift on evolution
 - b. Develop a logical argument defending or refuting issues related to genetic engineering of animals. (DOK 3)

Appendix D: ACT College Readiness Standards

English

E1 Topic Development in Terms of Purpose and Focus

- Identify the basic purpose or role of a specified phrase or sentence.
- Delete a clause or sentence because it is obviously irrelevant to the essay.
- Identify the central idea or main topic of a straightforward piece of writing.
- Determine relevancy when presented with a variety of sentence-level details.
- Identify the focus of a simple essay, applying that knowledge to add a sentence that sharpens that focus or to determine if an essay has met a specified goal.
- Delete material primarily because it disturbs the flow and development of the paragraph.
- Add a sentence to accomplish a fairly straightforward purpose such as illustrating a given statement.
- Apply an awareness of the focus and purpose of a fairly involved essay to determine the rhetorical effect and suitability of an existing phrase or sentence or to determine the need to delete plausible but irrelevant material.
- Add a sentence to accomplish a subtle rhetorical purpose such as to emphasize, to add supporting detail, or to express meaning through connotation.
- Determine whether a complex essay has accomplished a specific purpose.
- Add a phrase or sentence to accomplish a complex purpose, often expressed in terms of the main focus of the essay.

E2 Organization, Unity, and Coherence

- Use conjunctive adverbs or phrases to show time relationship in simple narrative essays (e.g., *then, this time, etc.*).
- Select the most logical place to add a sentence in a paragraph.
- Use conjunctive adverbs or phrases to express straightforward logical relationships (e.g., *first, afterward, in response*).
- Decide the most logical place to add a sentence in an essay.
- Add a sentence that introduces a simple paragraph.
- Determine the need for conjunctive adverbs or phrases to create subtle logical connections between sentences (e.g., *therefore, however, in addition*).
- Rearrange the sentences in a fairly uncomplicated paragraph for the sake of logic.
- Add a sentence to introduce or conclude the essay or to provide a transition between paragraphs when the essay is fairly straightforward.
- Make sophisticated distinctions concerning the logical use of conjunctive adverbs or phrases, particularly when signaling a shift between paragraphs.
- Rearrange sentences to improve the logic and coherence of a complex paragraph.
- Add a sentence to introduce or conclude a fairly complex paragraph.
- Consider the need for introductory sentences or transitions, basing decisions on a thorough understanding of both the logic and rhetorical effect of the paragraph and essay.

E3 Word Choice in Terms of Style, Tone, Clarity, and Economy

- Revise sentences to correct awkward and confusing arrangements of sentence elements.
- Revise vague nouns and pronouns that create obvious logic problems.
- Delete obviously synonymous and wordy material in a sentence.
- Revise expressions that deviate from the style of an essay.
- Delete redundant material when information is repeated in different parts of speech (e.g., *alarmingly startled*).
- Use the word or phrase most consistent with the style and tone of a fairly straightforward essay.
- Determine the clearest and most logical conjunction to link clauses.
- Revise a phrase that is redundant in terms of the meaning and logic of the entire sentence.
- Identify and correct ambiguous pronoun references.
- Use the word or phrase most appropriate in terms of the content of the sentence and tone of the essay.
- Correct redundant material that involves sophisticated vocabulary and sounds acceptable as conversational English (e.g., *an aesthetic viewpoint* versus *the outlook of an aesthetic viewpoint*).
- Correct vague and wordy or clumsy and confusing writing containing sophisticated language.
- Delete redundant material that involves subtle concepts or that is redundant in terms of the paragraph as a whole.

E4 Sentence Structure and Formation

- Use conjunctions or punctuation to join simple clauses.
- Revise shifts in verb tense between simple clauses in a sentence or between simple adjoining sentences.
- Determine the need for punctuation and conjunctions to avoid awkward sounding sentence fragments and fused sentences.
- Decide the appropriate verb tense and voice by considering the meaning of the entire sentence.
- Recognize and correct marked disturbances of sentence flow and structure (e.g., participial phrase fragments, missing or incorrect relative pronouns, dangling or misplaced modifiers).
- Revise to avoid faulty placement of phrases and faulty coordination and subordination of clauses in sentences with subtle structural problems.
- Maintain consistent verb tense and pronoun person on the basis of the preceding clause or sentence.
- Use sentence-combining techniques, effectively avoiding problematic comma splices, run-on sentences, and sentence fragments, especially in sentences containing compound subjects or verbs.
- Maintain a consistent and logical use of verb tense and pronoun person on the basis of information in the paragraph or essay as a whole.
- Work comfortably with long sentences and complex clausal relationships within sentences, avoiding weak conjunctions between independent clauses and maintaining parallel structure between clauses.

E5 Conventions of Usage

- Solve such basic grammatical problems as how to form the past and past participle of irregular but commonly used verbs and how to form comparative and superlative adjectives.
- Solve such grammatical problems as whether to use an adverb or adjective form, how to ensure straightforward subject–verb and pronoun–antecedent agreement, and which preposition to use in simple contexts.
- Recognize and use the appropriate word in frequently confused pairs such as *there* and *their*, *past* and *passed*, and *led* and *lead*.
- Use idiomatically appropriate prepositions, especially in combination with verbs (e.g., *long for*, *appeal to*).
- Ensure that a verb agrees with its subject when there is some text between the two.
- Ensure that a pronoun agrees with its antecedent when the two occur in separate clauses or sentences.
- Identify the correct past and past participle forms of irregular and infrequently used verbs, and form present–perfect verbs by using *have* rather than *of*.
- Correctly use reflexive pronouns, the possessive pronouns *its* and *your*, and the relative pronouns *who* and *whom*.

- Ensure that a verb agrees with its subject in unusual situations (e.g., when the subject–verb order is inverted or when the subject is an indefinite pronoun).
- Provide idiomatically and contextually appropriate prepositions following verbs in situations involving sophisticated language or ideas.
- Ensure that a verb agrees with its subject when a phrase or clause between the two suggests a different number for the verb.

E6 Conventions of Punctuation

- Delete commas that create basic sense problems (e.g., between verb and direct object).
- Provide appropriate punctuation in straightforward situations (e.g., items in a series).
- Delete commas that disturb the sentence flow (e.g., between modifier and modified element).
- Use commas to set off simple parenthetical phrases.
- Delete unnecessary commas when an incorrect reading of the sentence suggests a pause that should be punctuated (e.g., between verb and direct object clause).
- Use punctuation to set off complex parenthetical phrases.
- Recognize and delete unnecessary commas based on a careful reading of a complicated sentence (e.g., between the elements of a compound subject or compound verb joined by *and*).
- Use apostrophes to indicate simple possessive nouns.
- Recognize inappropriate uses of colons and semicolons.
- Use commas to set off a nonessential/nonrestrictive appositive or clause.
- Deal with multiple punctuation problems (e.g., compound sentences containing unnecessary commas and phrases that may or may not be parenthetical).
- Use an apostrophe to show possession, especially with irregular plural nouns.
- Use a semicolon to indicate a relationship between closely related independent clauses.
- Use a colon to introduce an example or an elaboration.

Math

M1 Basic Operations and Applications

- Perform one-operation computation with whole numbers and decimals.
- Solve problems in one or two steps using whole numbers.
- Perform common conversions (e.g., inches to feet or hours to minutes).
- Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent.
- Solve some routine two-step arithmetic problems.
- Solve routine two-step or three-step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and computing with a given average.
- Solve multistep arithmetic problems that involve planning or converting units of measure (e.g., feet per second to miles per hour).
- Solve word problems containing several rates, proportions, or percentages.
- Solve complex arithmetic problems involving percent of increase or decrease and problems requiring integration of several concepts from pre-algebra and/or pre-geometry (e.g., comparing percentages or averages, using several ratios, and finding ratios in geometry settings).

M2 Probability, Statistics, and Data Analysis

- Calculate the average of a list of positive whole numbers.
- Perform a single computation using information from a table or chart.
- Calculate the average of a list of numbers.
- Calculate the average, given the number of data values and the sum of the data values.
- Read tables and graphs.
- Perform computations on data from tables and graphs.

- Use the relationship between the probability of an event and the probability of its complement.
- Calculate the missing data value, given the average and all data values but one.
- Translate from one representation of data to another (e.g., a bar graph to a circle graph).
- Determine the probability of a simple event.
- Exhibit knowledge of simple counting techniques.*
- Calculate the average, given the frequency counts of all the data values.
- Manipulate data from tables and graphs.
- Compute straightforward probabilities for common situations.
- Use Venn diagrams in counting.*
- Calculate or use a weighted average.
- Interpret and use information from figures, tables, and graphs.
- Apply counting techniques.
- Compute a probability when the event and/or sample space is not given or obvious.
- Distinguish between mean, median, and mode for a list of numbers.
- Analyze and draw conclusions based on information from figures, tables, and graphs.
- Exhibit knowledge of conditional and joint probability.

M3 Numbers: Concepts and Properties

- Recognize equivalent fractions and fractions in lowest terms.
- Recognize one-digit factors of a number.
- Identify a digit's place value.
- Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor.
- Find and use the least common multiple.
- Order fractions.
- Work with numerical factors.
- Work with scientific notation.
- Work with squares and square roots of numbers.
- Work problems involving positive integer exponents.*
- Work with cubes and cube roots of numbers.*
- Determine when an expression is undefined.*
- Exhibit some knowledge of the complex numbers.†
- Apply number properties involving prime factorization.
- Apply number properties involving even and odd numbers and factors and multiples.
- Apply number properties involving positive and negative numbers.
- Apply rules of exponents.
- Multiply two complex numbers.†
- Draw conclusions based on number concepts, algebraic properties, and/or relationships between expressions and numbers.
- Exhibit knowledge of logarithms and geometric sequences.
- Apply properties of complex numbers.

M4 Expressions, Equations, and Inequalities

- Exhibit knowledge of basic expressions (e.g., identify an expression for a total as $b + g$).
- Solve equations in the form $x + a = b$, where a and b are whole numbers or decimals.
- Substitute whole numbers for unknown quantities to evaluate expressions.
- Solve one-step equations having integer or decimal answers.
- Combine like terms (e.g., $2x + 5x$).
- Evaluate algebraic expressions by substituting integers for unknown quantities.
- Add and subtract simple algebraic expressions.
- Solve routine first-degree equations.

- Perform straightforward word-to-symbol translations.
- Multiply two binomials.*
- Solve real-world problems using first-degree equations.
- Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions).
- Identify solutions to simple quadratic equations.
- Add, subtract, and multiply polynomials.*
- Factor simple quadratics (e.g., the difference of squares and perfect square trinomials).*
- Solve first-degree inequalities that do not require reversing the inequality sign.*
- Manipulate expressions and equations.
- Write expressions, equations, and inequalities for common algebra settings.
- Solve linear inequalities that require reversing the inequality sign.
- Solve absolute value equations.
- Solve quadratic equations.
- Find solutions to systems of linear equations.
- Write expressions that require planning and/or manipulating to accurately model a situation.
- Write equations and inequalities that require planning, manipulating, and/or solving.
- Solve simple absolute value inequalities.

M5 Graphical Representations

- Identify the location of a point with a positive coordinate on the number line.
- Locate points on the number line and in the first quadrant.
- Locate points in the coordinate plane.
- Comprehend the concept of length on the number line.*
- Exhibit knowledge of slope.*
- Identify the graph of a linear inequality on the number line.*
- Determine the slope of a line from points or equations.*
- Match linear graphs with their equations.*
- Find the midpoint of a line segment.*
- Interpret and use information from graphs in the coordinate plane.
- Match number line graphs with solution sets of linear inequalities.
- Use the distance formula.
- Use properties of parallel and perpendicular lines to determine an equation of a line or coordinates of a point.
- Recognize special characteristics of parabolas and circles (e.g., the vertex of a parabola and the center or radius of a circle).†
- Match number line graphs with solution sets of simple quadratic inequalities.
- Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$.
- Solve problems integrating multiple algebraic and/or geometric concepts.
- Analyze and draw conclusions based on information from graphs in the coordinate plane.

M6 Properties of Plane Figures

- Exhibit some knowledge of the angles associated with parallel lines.
- Find the measure of an angle using properties of parallel lines.
- Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90° , 180° , and 360°).
- Use several angle properties to find an unknown angle measure.
- Recognize Pythagorean triples.*
- Use properties of isosceles triangles.*
- Apply properties of 30° - 60° - 90° , 45° - 45° - 90° , similar, and congruent triangles.
- Use the Pythagorean theorem.
- Draw conclusions based on a set of conditions.

- Solve multistep geometry problems that involve integrating concepts, planning, visualization, and/or making connections with other content areas.
- Use relationships among angles, arcs, and distances in a circle.

M7 Measurement

- Estimate or calculate the length of a line segment based on other lengths given on a geometric figure.
- Compute the perimeter of polygons when all side lengths are given.
- Compute the area of rectangles when whole number dimensions are given.
- Compute the area and perimeter of triangles and rectangles in simple problems.
- Use geometric formulas when all necessary information is given.
- Compute the area of triangles and rectangles when one or more additional simple steps are required.
- Compute the area and circumference of circles after identifying necessary information.
- Compute the perimeter of simple composite geometric figures with unknown side lengths.*
- Use relationships involving area, perimeter, and volume of geometric figures to compute another measure.
- Use scale factors to determine the magnitude of a size change.
- Compute the area of composite geometric figures when planning or visualization is required.

M8 Functions

- Evaluate quadratic functions, expressed in function notation, at integer values.
- Evaluate polynomial functions, expressed in function notation, at integer values.†
- Express the sine, cosine, and tangent of an angle in a right triangle as a ratio of given side lengths.†
- Evaluate composite functions at integer values.†
- Apply basic trigonometric ratios to solve right-triangle problems.†
- Write an expression for the composite of two simple functions.†
- Use trigonometric concepts and basic identities to solve problems.†
- Exhibit knowledge of unit circle trigonometry.†
- Match graphs of basic trigonometric functions with their equations.

Notes

- Students who score in the 1–12 range are most likely beginning to develop the knowledge and skills assessed in the other ranges.
- Standards followed by an asterisk (*) apply to the PLAN and ACT Mathematics tests only.
- Standards followed by a dagger (†) apply to the ACT Mathematics test only.

Reading

R1 Main Ideas and Author's Approach

- Recognize a clear intent of an author or narrator in uncomplicated literary narratives.
- Identify a clear main idea or purpose of straightforward paragraphs in uncomplicated literary narratives.
- Infer the main idea or purpose of straightforward paragraphs in uncomplicated literary narratives.
- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in uncomplicated passages.
- Identify a clear main idea or purpose of any paragraph or paragraphs in uncomplicated passages.
- Infer the main idea or purpose of straightforward paragraphs in more challenging passages.
- Summarize basic events and ideas in more challenging passages.
- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in more challenging passages.
- Infer the main idea or purpose of more challenging passages or their paragraphs.
- Summarize events and ideas in virtually any passage.

- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in virtually any passage.
- Identify clear main ideas or purposes of complex passages or their paragraphs.

R2 Supporting Details

- Locate basic facts (e.g., names, dates, events) clearly stated in a passage.
- Locate simple details at the sentence and paragraph level in uncomplicated passages.
- Recognize a clear function of a part of an uncomplicated passage.
- Locate important details in uncomplicated passages.
- Make simple inferences about how details are used in passages.
- Locate important details in more challenging passages.
- Locate and interpret minor or subtly stated details in uncomplicated passages.
- Discern which details, though they may appear in different sections throughout a passage, support important points in more challenging passages.
- Locate and interpret minor or subtly stated details in more challenging passages.
- Use details from different sections of some complex informational passages to support a specific point or argument.
- Locate and interpret details in complex passages.
- Understand the function of a part of a passage when the function is subtle or complex.

R3 Sequential, Comparative, and Cause—Effect Relationships

- Determine when (e.g., first, last, before, after) or if an event occurred in uncomplicated passages.
- Recognize clear cause—effect relationships described within a single sentence in a passage.
- Identify relationships between main characters in uncomplicated literary narratives.
- Recognize clear cause—effect relationships within a single paragraph in uncomplicated literary narratives.
- Order simple sequences of events in uncomplicated literary narratives.
- Identify clear relationships between people, ideas, and so forth in uncomplicated passages.
- Identify clear cause—effect relationships in uncomplicated passages.
- Order sequences of events in uncomplicated passages.
- Understand relationships between people, ideas, and so forth in uncomplicated passages.
- Identify clear relationships between characters, ideas, and so forth in more challenging literary narratives.
- Understand implied or subtly stated cause—effect relationships in uncomplicated passages.
- Identify clear cause—effect relationships in more challenging passages.
- Order sequences of events in more challenging passages.
- Understand the dynamics between people, ideas, and so forth in more challenging passages.
- Understand implied or subtly stated cause—effect relationships in more challenging passages.
- Order sequences of events in complex passages.
- Understand the subtleties in relationships between people, ideas, and so forth in virtually any passage.
- Understand implied, subtle, or complex cause—effect relationships in virtually any passage.

R4 Meaning of Words

- Understand the implication of a familiar word or phrase and of simple descriptive language.
- Use context to understand basic figurative language.
- Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in uncomplicated passages.
- Use context to determine the appropriate meaning of virtually any word, phrase, or statement in uncomplicated passages.
- Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in more challenging passages.

- Determine the appropriate meaning of words, phrases, or statements from figurative or somewhat technical contexts.
- Determine, even when the language is richly figurative and the vocabulary is difficult, the appropriate meaning of context-dependent words, phrases, or statements in virtually any passage.

R5 Generalizations and Conclusions

- Draw simple generalizations and conclusions about the main characters in uncomplicated literary narratives.
- Draw simple generalizations and conclusions about people, ideas, and so forth in uncomplicated passages.
- Draw generalizations and conclusions about people, ideas, and so forth in uncomplicated passages.
- Draw simple generalizations and conclusions using details that support the main points of more challenging passages.
- Draw subtle generalizations and conclusions about characters, ideas, and so forth in uncomplicated literary narratives.
- Draw generalizations and conclusions about people, ideas, and so forth in more challenging passages.
- Use information from one or more sections of a more challenging passage to draw generalizations and conclusions about people, ideas, and so forth.
- Draw complex or subtle generalizations and conclusions about people, ideas, and so forth, often by synthesizing information from different portions of the passage.
- Understand and generalize about portions of a complex literary narrative.

Science

S1 Interpretation of Data

- Select a single piece of data (numerical or non-numerical) from a simple data presentation (e.g., a table or graph with two or three variables, a food web diagram).
- Identify basic features of a table, graph, or diagram (e.g., headings, units of measurement, axis labels).
- Select two or more pieces of data from a simple data presentation.
- Understand basic scientific terminology.
- Find basic information in a brief body of text.
- Determine how the value of one variable changes as the value of another variable changes in a simple data presentation.
- Select data from a complex data presentation (e.g., a table or graph with more than three variables, a phase diagram).
- Compare or combine data from a simple data presentation (e.g., order or sum data from a table).
- Translate information into a table, graph, or diagram.
- Compare or combine data from two or more simple data presentations (e.g., categorize data from a table using a scale from another table).
- Compare or combine data from a complex data presentation.
- Interpolate between data points in a table or graph.
- Determine how the value of one variable changes as the value of another variable changes in a complex data presentation.
- Identify and/or use a simple (e.g., linear) mathematical relationship between data.
- Analyze given information when presented with new, simple information.
- Compare or combine data from a simple data presentation with data from a complex data presentation.
- Identify and/or use a complex (e.g., nonlinear) mathematical relationship between data.
- Extrapolate from data points in a table or graph.
- Compare or combine data from two or more complex data presentations.
- Analyze given information when presented with new, complex information.

S2 Scientific Investigation

- Understand the methods and tools used in a simple experiment.
- Understand the methods and tools used in a moderately complex experiment.
- Understand a simple experimental design.
- Identify a control in an experiment.
- Identify similarities and differences between experiments.
- Understand the methods and tools used in a complex experiment.
- Understand a complex experimental design.
- Predict the results of an additional trial or measurement in an experiment.
- Determine the experimental conditions that would produce specified results.
- Determine the hypothesis for an experiment.
- Identify an alternate method for testing a hypothesis.
- Understand precision and accuracy issues.
- Predict how modifying the design or methods of an experiment will affect results.
- Identify an additional trial or experiment that could be performed to enhance or evaluate experimental results.

S3 Evaluation of Models, Inferences, and Experimental Results

- Select a simple hypothesis, prediction, or conclusion that is supported by a data presentation or a model.
- Identify key issues or assumptions in a model.
- Select a simple hypothesis, prediction, or conclusion that is supported by two or more data presentations or models.
- Determine whether given information supports or contradicts a simple hypothesis or conclusion and why.
- Identify strengths and weaknesses in one or more models.
- Identify similarities and differences between models.
- Determine which model(s) is/are supported or weakened by new information.
- Select a data presentation or a model that supports or contradicts a hypothesis, prediction, or conclusion.
- Select a complex hypothesis, prediction, or conclusion that is supported by a data presentation or model.
- Determine whether new information supports or weakens a model and why.
- Use new information to make a prediction based on a model.
- Select a complex hypothesis, prediction, or conclusion that is supported by two or more data presentations or models.
- Determine whether given information supports or contradicts a complex hypothesis or conclusion and why.

Writing

W1 Expressing Judgments

- Show a little understanding of the persuasive purpose of the task, but neglect to take or to maintain a position on the issue in the prompt.
- Show limited recognition of the complexity of the issue in the prompt.
- Show a basic understanding of the persuasive purpose of the task by taking a position on the issue in the prompt but may not maintain that position.
- Show a little recognition of the complexity of the issue in the prompt by acknowledging, but only briefly describing, a counterargument to the writer's position.
- Show understanding of the persuasive purpose of the task by taking a position on the issue in the prompt.
- Show some recognition of the complexity of the issue in the prompt by doing the following:
 - Acknowledging counterarguments to the writer's position
 - Providing some response to counterarguments to the writer's position
- Show clear understanding of the persuasive purpose of the task by taking a position on the specific issue in the prompt and offering a broad context for discussion.

- Show recognition of the complexity of the issue in the prompt by doing the following:
 - Partially evaluating implications and/or complications of the issue
 - Posing and partially responding to counterarguments to the writer's position
- Show clear understanding of the persuasive purpose of the task by taking a position on the specific issue in the prompt and offering a critical context for discussion.
- Show understanding of the complexity of the issue in the prompt by doing the following:
 - Examining different perspectives
 - Evaluating implications or complications of the issue
 - Posing and fully discussing counterarguments to the writer's position

W2 Focusing on the Topic

- Maintain a focus on the general topic in the prompt through most of the essay.
- Maintain a focus on the general topic in the prompt throughout the essay.
- Maintain a focus on the general topic in the prompt throughout the essay, and attempt a focus on the specific issue in the prompt.
- Present a thesis that establishes focus on the topic.
- Maintain a focus on discussion of the specific topic and issue in the prompt throughout the essay.
- Present a thesis that establishes a focus on the writer's position on the issue.
- Maintain a clear focus on discussion of the specific topic and issue in the prompt throughout the essay.
- Present a critical thesis that clearly establishes the focus on the writer's position on the issue.

W3 Developing a Position

- Offer a little development, with one or two ideas; if examples are given, they are general and may not be clearly relevant; resort often to merely repeating ideas.
- Show little or no movement between general and specific ideas and examples.
- Offer limited development of ideas using a few general examples; resort sometimes to merely repeating ideas.
- Show little movement between general and specific ideas and examples.
- Develop ideas by using some specific reasons, details, and examples.
- Show some movement between general and specific ideas and examples.
- Develop most ideas fully, using some specific and relevant reasons, details, and examples.
- Show clear movement between general and specific ideas and examples.
- Develop several ideas fully, using specific and relevant reasons, details, and examples.
- Show effective movement between general and specific ideas and examples.

W4 Organizing Ideas

- Provide a discernible organization with some logical grouping of ideas in parts of the essay.
- Use a few simple and obvious transitions.
- Present a discernible, though minimally developed, introduction and conclusion.
- Provide a simple organization with logical grouping of ideas in parts of the essay.
- Use some simple and obvious transitional words, though they may at times be inappropriate or misleading.
- Present a discernible, though underdeveloped, introduction and conclusion.
- Provide an adequate but simple organization with logical grouping of ideas in parts of the essay but with little evidence of logical progression of ideas.
- Use some simple and obvious, but appropriate, transitional words and phrases.
- Present a discernible introduction and conclusion with a little development.
- Provide unity and coherence throughout the essay, sometimes with a logical progression of ideas.
- Use relevant, though at times simple and obvious, transitional words and phrases to convey logical relationships between ideas.
- Present a somewhat developed introduction and conclusion.

- Provide unity and coherence throughout the essay, often with a logical progression of ideas.
- Use relevant transitional words, phrases, and sentences to convey logical relationships between ideas.
- Present a well-developed introduction and conclusion.

W5 Using Language

- Show limited control of language by doing the following:
 - Correctly employing some of the conventions of standard English grammar, usage, and mechanics but with distracting errors that sometimes significantly impede understanding
 - Using simple vocabulary
 - Using simple sentence structure
 - Correctly employing some of the conventions of standard English grammar, usage, and mechanics but with distracting errors that sometimes impede understanding
 - Using simple but appropriate vocabulary
 - Using a little sentence variety, though most sentences are simple in structure
 - Correctly employing many of the conventions of standard English grammar, usage, and mechanics but with some distracting errors that may occasionally impede understanding
 - Using appropriate vocabulary
 - Using some varied kinds of sentence structures to vary pace
 - Correctly employing most conventions of standard English grammar, usage, and mechanics with a few distracting errors but none that impede understanding
 - Using some precise and varied vocabulary
 - Using several kinds of sentence structures to vary pace and to support meaning
 - Correctly employing most conventions of standard English grammar, usage, and mechanics with just a few, if any, errors
 - Using precise and varied vocabulary
 - Using a variety of kinds of sentence structures to vary pace and to support meaning

Appendix E: Pathway Content Standards

AGRICULTURE, FOOD, AND NATURAL RESOURCES (AFNR) PATHWAY CONTENT STANDARDS AND PERFORMANCE ELEMENTS

The AFNR Pathway Content Standards and Performance Elements are adapted from *National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards*. Reprinted with permission from the National Council for Agricultural Education, 1410 King Street, Suite 400, Alexandria, VA 22314. (800) 772-0939. Copyright © 2009. A complete copy of the National Standards can be downloaded from the Team Ag Ed Learning Center at <https://aged.learn.com>.

AGRIBUSINESS SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of principles and techniques for the development and management of agribusiness systems.

- ABS.01. Utilize economic principles to establish and manage an AFNR enterprise.**
 - ABS.01.01. Apply principles of capitalism in the business environment.
 - ABS.01.02. Apply principles of entrepreneurship in businesses.
- ABS.02. Utilize appropriate management planning principles in AFNR business enterprises.**
 - ABS.02.01. Compose and analyze a business plan for an enterprise.
 - ABS.02.02. Read, interpret, evaluate, and write a mission statement to guide business goals, objectives, and resource allocation.
 - ABS.02.03. Apply appropriate management skills to organize a business.
 - ABS.02.04. Recruit, train, and retain appropriate and productive human resources for business.
- ABS.03. Utilize record keeping to accomplish AFNR business objectives while complying with laws and regulations.**
 - ABS.03.01. Prepare and maintain all files needed to accomplish effective record keeping.
 - ABS.03.02. Implement appropriate inventory management practices.
- ABS.04. Apply generally accepted accounting principles and skills to manage cash budgets, credit budgets, and credit for AFNR businesses.**
 - ABS.04.01. Use accounting fundamentals to accomplish dependable bookkeeping and fiscal management.
- ABS.05. Assess accomplishment of goals and objectives by an AFNR business.**
 - ABS.05.01. Maintain and interpret financial information (income statements, balance sheets, inventory, purchase orders, accounts receivable, and cash-flow analyses) for businesses.
- ABS.06. Use industry-accepted marketing practices to accomplish AFNR business objectives.**
 - ABS.06.01. Conduct appropriate market and marketing research.
 - ABS.06.02. Develop a marketing plan.
 - ABS.06.03. Develop strategies for marketing plan implementation.
 - ABS.06.04. Develop specific tactics to market AFNR products and services.
- ABS.07. Create a production system plan.**
 - ABS.07.01. Prepare a step-by-step production plan that identifies needed resources.
 - ABS.07.02. Develop a production and operational plan.
 - ABS.07.03. Utilize appropriate techniques to determine the most likely strengths, weaknesses, and inconsistencies in a business plan, and relate these to risk management strategies.
 - ABS.07.04. Manage risk and uncertainty.

ANIMAL SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and practices to the production and management of animals.

AS.01. Examine the components, historical development, global implications, and future trends of the animal systems industry.

AS.01.01. Evaluate the development and implications of animal origin, domestication, and distribution.

AS.02. Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics.

AS.02.01. Classify animals according to hierarchical taxonomy and agricultural use.

AS.02.02. Apply principles of comparative anatomy and physiology to uses within various animal systems.

AS.02.03. Select animals for specific purposes and maximum performance based on anatomy and physiology.

AS.03. Provide for the proper health care of animals.

AS.03.01. Prescribe and implement a prevention and treatment program for animal diseases, parasites, and other disorders.

AS.03.02. Provide for the biosecurity of agricultural animals and production facilities.

AS.04. Apply principles of animal nutrition to ensure the proper growth, development, reproduction, and economic production of animals.

AS.04.01. Formulate feed rations to provide for the nutritional needs of animals.

AS.04.02. Prescribe and administer animal feed additives and growth promotants in animal production.

AS.05. Evaluate and select animals based on scientific principles of animal production.

AS.05.01. Evaluate the male and female reproductive systems in selecting animals.

AS.05.02. Evaluate animals for breeding readiness and soundness.

AS.05.03. Apply scientific principles in the selection and breeding of animals.

AS.06. Prepare and implement animal handling procedures for the safety of animals, producers and consumers of animal products.

AS.06.01. Demonstrate safe animal handling and management techniques.

AS.06.02. Implement procedures to ensure that animal products are safe.

AS.07. Select animal facilities and equipment that provide for the safe and efficient production, housing, and handling of animals.

AS.07.01. Design animal housing, equipment, and handling facilities for the major systems of animal production.

AS.07.02. Comply with government regulations and safety standards for facilities used in animal production.

AS.08. Analyze environmental factors associated with animal production.

AS.08.01. Reduce the effects of animal production on the environment.

AS.08.02. Evaluate the effects of environmental conditions on animals.

BIOTECHNOLOGY

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to biotechnology in agriculture.

BS.01. Recognize the historical, social, cultural, and potential applications of biotechnology.

BS.01.01. Distinguish major innovators, historical developments, and potential applications of biotechnology in agriculture.

BS.01.02. Determine regulatory issues, and identify agencies associated with biotechnology.

BS.01.03. Analyze the ethical, legal, social, and cultural issues relating to biotechnology.

BS.02 Demonstrate laboratory skills as applied to biotechnology.

BS.02.01. Maintain and interpret biotechnology laboratory records.

BS.02.02. Operate biotechnology laboratory equipment according to standard procedures.

BS.02.03. Demonstrate proper laboratory procedures using biological materials.

BS.02.04. Safely manage biological materials, chemicals, and wastes used in the laboratory.

BS.02.05. Perform microbiology, molecular biology, enzymology, and immunology procedures.

BS.03. Demonstrate the application of biotechnology to Agriculture, Food, and Natural Resources (AFNR).

BS.03.01. Evaluate the application of genetic engineering to improve products of AFNR systems.

BS.03.02. Perform biotechnology processes used in AFNR systems.

BS.03.03. Use biotechnology to monitor and evaluate procedures performed in AFNR systems.

ENVIRONMENTAL SERVICE SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the management of environmental service systems.

ESS.01. Use analytical procedures to plan and evaluate environmental service systems.

ESS.01.01. Analyze and interpret samples.

ESS.02. Assess the impact of policies and regulations on environmental service systems.

ESS.02.01. Interpret laws affecting environmental service systems.

ESS.03. Apply scientific principles to environmental service systems.

ESS.03.01. Apply meteorology principles to environmental service systems.

ESS.03.02. Apply soil science principles to environmental service systems.

ESS.03.03. Apply hydrology principles to environmental service systems.

ESS.03.04. Apply best management techniques associated with the properties, classifications, and functions of wetlands.

ESS.03.05. Apply chemistry principles to environmental service systems.

ESS.03.06. Apply microbiology principles to environmental service systems.

ESS.04. Operate environmental service systems to manage a facility environment.

ESS.04.01. Use pollution control measures to maintain a safe facility environment.

ESS.04.02. Manage safe disposal of all categories of solid waste.

ESS.04.03. Apply the principles of public drinking water treatment operations to ensure safe water at a facility.

ESS.04.04. Apply principles of wastewater treatment to manage wastewater disposal in keeping with rules and regulations.

ESS.04.05. Manage hazardous materials to assure a safe facility and to comply with applicable regulations.

ESS.05. Examine the relationships between energy sources and environmental service systems.

ESS.05.01. Compare and contrast the impact of conventional and alternative energy sources on the environment.

ESS.06. Use tools, equipment, machinery, and technology to accomplish tasks in environmental service systems.

ESS.06.01. Use technological and mathematical tools to map land, facilities, and infrastructure.

ESS.06.02. Maintain tools, equipment, and machinery in safe working order for tasks in environmental service systems.

FOOD PRODUCTS AND PROCESSING SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles, practices, and techniques in the processing, storage, and development of food products.

FPP.01. Examine components of the food industry and historical development of food products and processing.

FPP.01.01. Evaluate the significance and implications of changes and trends in the food products and processing industry.

FPP.01.02. Work effectively with industry organizations, groups, and regulatory agencies affecting the food products and processing industry.

FPP.02. Apply safety principles, recommended equipment, and facility management techniques to the food products and processing industry.

FPP.02.01. Manage operational procedures, and create equipment and facility maintenance plans.

FPP.02.02. Implement Hazard Analysis and Critical Control Point (HACCP) procedures to establish operating parameters.

FPP.02.03. Apply safety and sanitation procedures in the handling, processing, and storing of food products.

FPP.02.04. Demonstrate worker safety procedures with food product and processing equipment and facilities.

FPP.03. Apply principles of science to the food products and processing industry.

FPP.03.01. Apply principles of science to food processing to provide a safe, wholesome, and nutritious food supply.

FPP.04. Select and process food products for storage, distribution, and consumption.

FPP.04.01. Utilize harvesting, selection, and inspection techniques to obtain quality food products for processing.

FPP.04.02. Evaluate, grade, and classify processed food products.

FPP.04.03. Process, preserve, package, and present food and food products for sale and distribution.

NATURAL RESOURCE SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the management of natural resources.

NRS.01. Explain interrelationships between natural resources and humans necessary to conduct management activities in natural environments.

NRS.01.01. Apply knowledge of natural resource components to the management of natural resource systems.

- NRS01.02. Classify natural resources.
- NRS.02. Apply scientific principles to natural resource management activities.**
 - NRS.02.01. Develop a safety plan for work with natural resources.
 - NRS.02.02. Demonstrate cartographic skills to aid in developing, implementing, and evaluating natural resource management plans.
 - NRS.02.03. Measure and survey natural resource status to obtain planning data.
 - NRS.02.04. Demonstrate natural resource enhancement techniques.
 - NRS.02.05. Interpret laws related to natural resource management and protection.
 - NRS.02.06. Apply ecological concepts and principles to natural resource systems.
- NRS.03. Apply knowledge of natural resources to production and processing industries.**
 - NRS.03.01. Produce, harvest, process, and use natural resource products.
- NRS.04. Demonstrate techniques used to protect natural resources.**
 - NRS.04.01. Manage fires in natural resource systems.
 - NRS.04.02. Diagnose plant and wildlife diseases, and follow protocol to prevent their spread.
 - NRS.04.03. Manage insect infestations of natural resources.
- NRS.05. Use effective methods and venues to communicate natural resource processes to the public.**
 - NRS.05.01. Communicate natural resource information to the public.

PLANT SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the production and management of plants.

- PS.01. Apply knowledge of plant classification, plant anatomy, and plant physiology to the production and management of plants.**
 - PS.01.01. Classify agricultural plants according to taxonomy systems.
 - PS.01.02. Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.
 - PS.01.03. Apply knowledge of plant physiology and energy conversion to plant systems.
- PS.02. Prepare and implement a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.**
 - PS.02.01. Determine the influence of environmental factors on plant growth.
 - PS.02.02. Prepare growing media for use in plant systems.
 - PS.02.03. Develop and implement a fertilization plan for specific plants or crops.
- PS.03. Propagate, culture, and harvest plants.**
 - PS.03.01. Demonstrate plant propagation techniques.
 - PS.03.02. Develop and implement a plant management plan for crop production.
 - PS.03.03. Develop and implement a plan for integrated pest management.
 - PS.03.04. Apply principles and practices of sustainable agriculture to plant production.
 - PS.03.05. Harvest, handle, and store crops.
- PS.04. Employ elements of design to enhance an environment.**
 - PS.04.01. Create designs using plants.

POWER, STRUCTURAL AND TECHNICAL SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of principles and techniques for the development and management of power, structural, and technical systems.

- PST.01. Use physical science principles and engineering applications with power, structural, and technical systems to solve problems and improve performance.**
- PST.01.01. Select energy sources in power generation appropriate to the situation.
 - PST.01.02. Apply physical science laws and principles to identify, classify, and use lubricants.
 - PST.01.03. Identify and use hand and power tools and equipment for service, construction, and fabrication.
- PST.02. Design, operate, and maintain mechanical equipment, structures, biological systems, land treatment, power, and technology.**
- PST.02.01. Perform service routines to maintain power units and equipment.
 - PST.02.02. Operate, service, and diagnose the condition of power units and equipment.
- PST.03. Service and repair mechanical equipment and power systems.**
- PST.03.01. Troubleshoot and repair internal combustion engines.
 - PST.03.02. Utilize manufacturers' guidelines to service and repair the power transmission systems of equipment.
 - PST.03.03. Service and repair hydraulic and pneumatic systems.
 - PST.03.04. Troubleshoot and service electrical systems.
 - PST.03.05. Service vehicle heating and air-conditioning systems.
 - PST.03.06. Service and repair steering, suspension, traction, and vehicle performance systems.
- PST.04. Plan, build and maintain agricultural structures.**
- PST.04.01. Create sketches and plans of agricultural structures.
 - PST.04.02. Apply structural plans, specifications, and building codes.
 - PST.04.03. Examine structural requirements for materials and procedures, and estimate construction cost.
 - PST.04.05. Follow architectural and mechanical plans to construct and/or repair equipment, buildings, and facilities.
- PST.05. Apply technology principles in the use of agricultural technical systems.**
- PST.05.01. Use instruments and meters to test and monitor electrical and electronic processes.
 - PST.05.02. Prepare and/or use electrical drawings to design, install, and troubleshoot control systems.
 - PST.05.03. Use geospatial technologies in agricultural applications.

Appendix F:

National Educational Technology Standards for Students

- T1** Creativity and Innovation
- T2** Communication and Collaboration
- T3** Research and Information Fluency
- T4** Critical Thinking, Problem Solving, and Decision Making
- T5** Digital Citizenship
- T6** Technology Operations and Concepts

T1 Creativity and Innovation

Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students do the following:

- a. Apply existing knowledge to generate new ideas, products, or processes.
- b. Create original works as a means of personal or group expression.
- c. Use models and simulations to explore complex systems and issues.
- d. Identify trends and forecast possibilities.

T2 Communication and Collaboration

Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students do the following:

- a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media.
- b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats.
- c. Develop cultural understanding and global awareness by engaging with learners of other cultures.
- d. Contribute to project teams to produce original works or solve problems.

T3 Research and Information Fluency

Students apply digital tools to gather, evaluate, and use information. Students do the following:

- a. Plan strategies to guide inquiry.
- b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
- c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks.
- d. Process data and report results.

T4 Critical Thinking, Problem Solving, and Decision Making

Students use critical-thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. Students do the following:

- a. Identify and define authentic problems and significant questions for investigation.
- b. Plan and manage activities to develop a solution or complete a project.
- c. Collect and analyze data to identify solutions and/or make informed decisions.
- d. Use multiple processes and diverse perspectives to explore alternative solutions.

T5 Digital Citizenship

Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior. Students do the following:

- a. Advocate and practice safe, legal, and responsible use of information and technology.
- b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity.

- c. Demonstrate personal responsibility for lifelong learning.
- d. Exhibit leadership for digital citizenship.

T6 Technology Operations and Concepts

Students demonstrate a sound understanding of technology concepts, systems, and operations. Students do the following:

- a. Understand and use technology systems.
- b. Select and use applications effectively and productively.
- c. Troubleshoot systems and applications.
- d. Transfer current knowledge to learning of new technologies.

Concepts of Agriscience

Program CIP: 01.9999

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The Research and Curriculum Unit, located in Starkville, MS, as part of Mississippi State University, was established to foster educational enhancements and innovations. In keeping with the land grant mission of Mississippi State University, the RCU is dedicated to improving the quality of life for Mississippians. The RCU enhances intellectual and professional development of Mississippi students and educators while applying knowledge and educational research to the lives of the people of the state. The RCU works within the contexts of curriculum development and revision, research, assessment, professional development, and industrial training.

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Mr. William Harold Jones, Chair
Mr. Charles McClelland, Vice Chair
Ms. Kami Bumgarner
Mr. Howell "Hal" N. Gage
Dr. O. Wayne Gann
Mr. Claude Hartley
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Ms. Rosetta Richards
Dr. Sue Matheson

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Standards in the *Concepts of Agriscience Curriculum Framework and Supporting Materials* are based on the following documents:

National Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards

The National AFNR Career Cluster Content Standards were developed by the National Council on Agricultural Education to serve as a guide for what students should know or be able to do through a study of agriculture in grades 9–12 and 2-year postsecondary programs. The standards were extensively researched and reviewed by leaders in the agricultural industry, secondary and postsecondary instructors, and university specialists. The standards consist of a pathway content standard for each of the eight career pathways. For each content standard, performance elements representing major topic areas with accompanying performance indicators were developed. Measurements of assessment of the performance elements and performance indicators were developed at the basic, intermediate, and advanced levels. A complete copy of the standards can be accessed at <https://aged.learn.com>. The National AFNR Career Cluster Content Standards are copyrighted to the National Council for Agricultural Education and are used by permission.

Applied Academic Credit Benchmarks

Mississippi Department of Education 2010 Mississippi Science Framework

21st Century Skills and Information and Communication Technologies Literacy Standards

In defining 21st century learning, the Partnership for 21st Century Skills has embraced five content and skill areas that represent the essential knowledge for the 21st century: global awareness; civic engagement; financial, economic, and business literacy; learning skills that encompass problem-solving, critical-thinking, and self-directional skills; and Information and Communication Technology (ICT) literacy.

National Educational Technology Standards for Students

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ACT College Readiness Standards



The College Readiness Standards are sets of statements intended to help students understand what is expected of them in preparation for the ACT. These standards are integrated into teaching and assessment strategies throughout the curriculum framework.

Preface

Secondary vocational–technical education programs in Mississippi are faced with many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing true learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, Mississippi Code of 1972, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, ch. 487, §14; Laws, 1991, ch. 423, §1; Laws, 1992, ch. 519, §4 eff. from and after July 1, 1992; Carl D. Perkins Vocational Education Act IV, 2007; and No Child Left Behind Act of 2001).

Research Synopsis

Agricultural and Environmental Science and Technology Research

The Agricultural Sciences Career Cluster covers the broad field of occupations related to the production and use of plants and animals for food, fiber, aesthetic, and environmental purposes. According to the U.S. Department of Labor, the growing interest in worldwide standardization of agricultural equipment should result in increased employment of agricultural engineers. Job opportunities should also result from the increasing demand for agricultural products, the continued efforts for more efficient agricultural production, and the increasing emphasis on the conservation of resources. The sales of food and fiber products amounted to \$5.8 billion in 2005 according to U.S. Department of Agriculture (USDA) statistics. Additionally, the Mississippi Department of Agriculture and Commerce estimates that 30% of the state's workforce is employed in jobs relating directly or indirectly to agriculture.

Agriculture and Environmental Science and Technology will target careers at the professional and technical levels in agriculture. Students enrolled in these courses should be better prepared to pursue degrees at the community college and 4-year-college level.

Employment Projections

Data for this synopsis were compiled from employment projections prepared by the Mississippi Department of Employment Security and the U. S. Department of Labor. The National Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards developed by the National Council for Agricultural Education and scholarly research articles were also reviewed as a guide for the redesign of the Agriculture and Natural Resources Cluster.

Industry Job Data – Employment Projections 2006 to 2016 for Mississippi

Occupational Title	Employment, 2006	Projected Employment, 2016	Change 2006– 2016		Total Projected Avg. Annual Job Openings
			Number	Percent	
Animal Breeders	9,770	9,870	100	1.0	165
Agricultural and Food Science Technicians	260	310	50	19.2	10
Agricultural Equipment Operators	1,090	1,190	100	9.2	40
Agricultural Sciences Teachers, Postsecondary	190	240	50	26.3	20
Conservation Scientists	790	890	100	12.7	30
Custodial and Caretaking Supervisors and Workers	46,920	54,110	7,190	15.3	2,320
Environmental Engineers	270	320	50	18.5	10
Environmental Engineering Technicians	50	100	50	100.0	0

Occupational Title	Employment, 2006	Projected Employment, 2016	Change 2006– 2016		Total Projected Avg. Annual Job Openings
			Number	Percent	
Environmental Scientists and Specialists	420	470	50	11.9	10
Environmental Science and Protection Technicians	100	150	50	50.0	5
Farmworkers and Laborers, Crop, Nursery, and Greenhouse	5,160	5,810	650	12.6	225
Farmworkers, Farm and Ranch Animals	1,400	1,550	150	10.7	65
First-Line Supervisors/Managers of Farming, Fishing, and Forestry Workers	1,390	1,540	150	10.8	40
Food Processing Workers	14,920	18,320	3,400	22.8	680
Foresters	470	520	50	10.6	20
Forest and Conservation Technicians	390	440	50	12.8	15
Forest and Conservation Workers	880	980	100	11.4	30
Grounds Maintenance Workers	10,310	11,810	1,500	14.5	375
Logging Equipment Operators	3,910	4,210	300	7.7	100
Purchasing Agents and Buyers, Farm Products	80	130	50	62.5	5
Soil and Plant Scientists	430	480	50	11.6	10
Veterinarians	540	640	100	18.5	25
Veterinary Assistants and Laboratory Animal Caretakers	690	890	200	29.0	35
Veterinary Technologists and Technicians	440	540	100	22.7	15

Note: Compiled by Mississippi Department of Employment Security and Labor Market Information Department 2009)

Occupational Employment and Wage Estimates for Mississippi, May 2006

Occupation	Employment, 2006	Avg. Hourly Wage	Average Annual Wage
Farmers and Ranchers	2,760	\$17.85	\$43,560.00
Farm Managers and Supervisors	2,640	\$23.23	\$48,360.00
Logging Equipment Operators	3,890	\$14.28	\$30,880.00
Landscaping Supervisors	2,990	\$17.93	\$40,240.00
Landscape Workers	8,560	\$10.22	\$23,010.00
Agricultural Scientists/Technicians	29,680	\$18.33	\$38,555.00

Note: Data were retrieved from the U.S. Bureau of Labor Statistics (2009).

Curriculum Content

In compiling the research for the Agricultural Sciences cluster, face-to-face and telephone interviews were conducted with representatives of agricultural employers and agricultural agencies. The following comments summarize the results of these interviews:

- While opportunities to enter farming on a full-scale commercial enterprise basis are limited, opportunities do exist and are expected to increase as current operators retire and begin to rent their land to companies and individuals. Opportunities are also expected to increase for consultants and technicians who support production enterprises by providing specialized services to producers.
- There was general agreement among all persons interviewed that all students need to better develop skills related to leadership, teamwork, communication, and work ethics, habits, and values. All respondents also indicated that a basic knowledge of economics, recordkeeping, budgeting, and business decision-making skills will be essential in today's "lean" environment.
- Opportunities for high school graduates in all fields of agriculture are limited to the basic entry-level positions. More abundant opportunities exist for students who have received advanced training at the community college or 4-year college.
- All respondents agreed that a common core of knowledge and skills existed across all three major pathways related to the following themes: leadership and personal development; principles of plant science and production; principles of soil science and air and water quality; principles of agricultural power, structures, and technology; and principles of economics and management. A sixth theme, principles of animal science and production, exists for students in the AEST and Agriculture and Natural Resources pathway.
- All respondents agreed that students in all three pathways should be exposed to the process by which agricultural products are grown, managed, harvested, processed, and marketed. As students study this process, they should also be exposed to the different careers that are involved in all segments of the industry.
- The role of federal and state agencies including the USDA, OSHA, FDA, EPA, and so forth should be discussed. Also, the role of agricultural organizations such as the Poultry Association, Nurseryman's Association, and Farm Bureau needs to be investigated.

Results of the survey of employers and agricultural agency representatives show that there are six major themes or topics that apply to a majority of occupations in the agriculture and natural resources area. These themes and their respective pathways are listed below.

Theme	AEST	Ag and Nat. Resources	Horticulture/Landscape
Principles of Leadership, Personal Development, and Career Success	X	X	X
Principles of Plant Science and Production	X	X	X
Principles of Animal Science and Production	X	X	
Principles of Soil, Water, and Air Quality, Conservation, and Use	X	X	X
Principles of Agricultural Power, Structures, and Technological Systems	X	X	X
Principles of Management, Economics, and Marketing	X	X	X

Executive Summary

Program Description

Concepts of Agriscience is the foundation course for the Agricultural and Environmental Science and Technology program. All students must complete Concepts of Agriscience before being allowed to enroll in the advanced courses of the program. The course serves as an introduction to the sciences, technologies, and applied practices of the progressive agriculture/agriscience industry. Emphasis is on an active learning environment enriched with technology and science-based applications. The course focuses on providing an opportunity for students to explore the different fields of the agricultural sciences and develop foundation skills and knowledge needed for advancement in other courses and programs. Concepts of Agriscience may be taught to students in grade 9 or 10. The course carries one Carnegie unit of credit that can count as a science elective credit for high school graduation.

Industry Certification

No national industry-recognized certifications are known to exist at this time in the field of agriscience. Competencies and suggested performance indicators in the Concepts of Agriscience course have been correlated, however, to the National Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards that have been reviewed and endorsed at the national level by the National Council on Agricultural Education.

Articulation

There is no articulation for this course at this time.

Assessment

Students will be assessed using the AEST MS-CPAS2 test. All students will be tested on Concepts of Agriscience and the second course that they may take in their chosen paths of study. The second course may be one of the following:

- Science of Agricultural Animals
- Science of Agricultural Environment
- Science of Agricultural Mechanization
- Science of Agricultural Plants

The MS-CPAS2 blueprint can be found at <http://redesign.rcu.msstate.edu/curriculum/>. If there are questions regarding assessment of this program, please contact the instructional design specialist at the Research and Curriculum Unit at 662.325.2510.

Student Prerequisites

Concepts of Agriscience may be taken by any student enrolled in grade 9 or 10. It is suggested that students enrolling in the course possess at least a C average in previous science courses and a TABE reading score at the eighth-grade level or higher.

Applied Academic Credit

Content of the Concepts of Agriscience course has been aligned to the *2010 Mississippi Science Curriculum Framework*. Students who complete Concepts of Agriscience will receive one elective science credit that will count toward high school science graduation requirements.

Licensure Requirements

A 992 endorsement is currently required to teach any course in the Agricultural and Environmental Science and Technology program. In order to receive a 992 endorsement, applicants must do the following:

1. Hold a valid Mississippi Educator License with endorsement #301 – Vocational Agriculture Education Programs or #302 – Agriculture.
2. Possess a baccalaureate degree in an agricultural subject area.
3. Complete the 3-semester-credit-hour course devoted to the teaching of Agricultural and Environmental Science and Technology courses. The course, AIS 6113 - Methods of Teaching Agriscience, is currently offered by Mississippi State University.
4. Enroll immediately in the Vocational Instructor Preparation (VIP) program or the College and Career Readiness Education Program (CCREP).
5. Complete the individualized Professional Development Plan (PDP) requirements of the VIP or CCREP prior to the expiration date of the 3-year vocational license.
6. Successfully complete an MDE-approved computer literacy certification exam.
7. Successfully complete a certification for an online learning workshop, module, or course that is approved by MDE.

Note: If the applicant meets all requirements listed above, that applicant will be issued a 992 endorsement—a 5-year license. If the applicant does not meet **all** requirements, the applicant will be issued a 3-year endorsement (license), and all requirements stated above must be satisfied prior to the ending date of that license.

Professional Learning

The professional learning itinerary for the middle school or individual pathways can be found at <http://redesign.rcu.msstate.edu>. If you have specific questions about the content of each training session provided, please contact the Research and Curriculum Unit at 662.325.2510, and ask for the Professional Learning Specialist.

Course Outlines

Course Description: Concepts of Agriscience is a course to introduce students to the sciences, technologies, and applied practices of the progressive agriculture/agriscience industry. Emphasis is on an active learning environment enriched with technology and science-based applications. The course serves as the entry-level course for other courses in agriculture, including horticulture and forestry. The focus is to begin the preparation of students for further study leading to successful careers in the agricultural industry.

Concepts of Agriscience (One Carnegie Unit) - Course Code: 991000

1	Introduction to Agricultural and Environmental Science and Technology *	5
2	Leadership and Human Relations *	10
3	Supervised Agricultural Experience *	5
4	Science of Agricultural Animals	25
5	Science of Agricultural Plants	25
6	Science of Agricultural Environment	25
7	Science of Agricultural Mechanization	15
Total Hours		110

* Note: These units are not tested by MS-CPAS2.

Using This Document

Unit Number and Title

Suggested Time on Task

An estimated number of clock hours of instruction that should be required to teach the competencies and objectives of the unit. A minimum of 140 hours of instruction is required for each Carnegie unit credit. The curriculum framework should account for approximately 75–80% of the time in the course.

Competencies and Suggested Objectives

A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies. The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.

Suggested Teaching Strategies

This section of each unit indicates research-based strategies that can be used to enable students to master each competency. Emphasis has been placed on strategies that reflect active learning methodologies. Teachers should feel free to modify or enhance these suggestions based on needs of their students and resources available in order to provide optimum learning experiences for their students.

Suggested Assessment Strategies

This section indicates research-based strategies that can be used to measure student mastery. Examples of suggested strategies could include rubrics, class participation, reflection, and journaling. Again, teachers should feel free to modify or enhance these suggested assessment strategies based on local needs and resources.

Integrated Academic Topics, 21st Century Skills and Information and Communication Technology Literacy Standards, ACT College Readiness Standards, and Technology Standards for Students

This section identifies related academic topics as required in the Subject Area Testing Program (SATP) in Algebra I, Biology I, English II, and U.S. History from 1877, which are integrated into the content of the unit. Research-based teaching strategies also incorporate ACT College Readiness standards. This section also identifies the 21st Century Skills and Information and Communication Technology Literacy skills. In addition, national technology standards for students associated with the competencies and suggested objectives for the unit are also identified.

References

A list of suggested references is provided for each unit. The list includes some of the primary instructional resources that may be used to teach the competencies and suggested objectives. Again, these resources are suggested, and the list may be modified or enhanced based on needs and abilities of students and on available resources.

Concepts of Agriscience

Unit 1: Introduction to Agricultural and Environmental Science and Technology

5 Hours

Competency 1: Examine the nature of the agriculture and natural resources industry. AS.01, BS.01, FPP.01

Suggested Enduring Understandings

1. Agriculture in the United States has evolved from subsistence farming into a diverse industry involving the production, marketing, and processing of food and fiber and the conservation and use of natural resources.
2. Advances in technology and techniques have allowed American agriculture to produce more products on reduced acreages and with reduced labor requirements.
3. Agriculture and natural resources in the United States today are responsible for producing a diverse number of products used for food, clothing, shelter, pharmaceutical, energy, and other needs.
4. Education and training opportunities for careers in agriculture and natural resources exist in community/junior colleges, technical institutes, and colleges and universities.
5. Globalization of agriculture has resulted in lowering costs of agricultural and natural resource products, increased competition for U.S. producers, and raised questions over product quality and safety.

Suggested Essential Questions

1. How has the nature of agriculture and natural resources changed over the past century?
2. How have new technologies and practices affected agricultural and natural resources production?
3. What products are manufactured today from agriculture and natural resources enterprises?
4. What education and training opportunities exist in agriculture and natural resources?
5. How has the globalization of trade affected agriculture and natural resources industries in the United States?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Investigate the scope of the agricultural and natural resources industry. (DOK 1)	a. Have students brainstorm their perceptions of agriculture in the modern world. Through class discussion, expand the students' perceptions of agriculture from subsistence farming to a diverse industry involving the production, marketing, and processing of food and fiber products and the conservation and use of natural resources. Have students identify agricultural products that they use on a daily basis. CS1, CS2	a. Monitor the discussion to make sure that all students have a chance to participate.
b. Trace the development of agricultural sciences and technologies in	b. Pair students, and assign a specific agricultural science or technology such as machinery, chemicals, genetics, environmental services, natural resources, biotechnology, and so forth.	b. Use the <i>Agriculture Timeline Graphic Rubric (1.1)</i> to evaluate the

the United States. (DOK 1)	Have each pair research the topic and create a time line that shows at least three important events in the development of science or technology and describe how these developments have affected modern agriculture and natural resources practices. CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, M5, R3, W1, W2, W4, W5	students' performance on the development time line.
c. Associate the major areas of agriculture and natural resources with their products and practices. (DOK 1)	c. Assign each student one of the major areas of agriculture and natural resources. Have him or her prepare a graphic (PowerPoint slide, poster, etc.) that illustrates at least three major products or practices associated with this area. CS1, CS2, CS4, T1, T3, T6	c. Use the <i>Agriculture and Natural Resources Areas Graphic Rubric (1.2)</i> to evaluate the students' performance in creating the graphic.
d. Investigate education and training opportunities in agriculture and natural resources. (DOK 1)	d. Have students begin the process of exploring careers in the agriculture and natural resources industry by conducting searches and visiting Web sites of universities, colleges, community and junior colleges, and technical institutes that offer programs in agriculture and natural resources. Have students identify and compare the entrance requirements and estimated costs for at least one university program and one community/junior college program. CS1, CS2, CS4 T1, T3, T6, R3, W4, W5	d. Evaluate the students' table comparing entrance requirements and costs for accuracy and completeness.
e. Examine the scope of the agricultural and natural resources industry from a global perspective. (DOK 1)	e. Have students go to their local retailers and determine the country of origin for different food, clothing, and other agricultural products. Discuss the implications of global agriculture to the United States and to Mississippi including competition, product quality, and food safety. Use current news stories to illustrate these implications. CS1, CS2, CS4, T1, T3, T6, R3, W4, W5	e. Use a written test to evaluate student understanding.

Competency 2: Examine the relationships between the pure sciences, agriculture, and agriscience. AQ 1, BIOI 1, BIOII 1, BO 1, ES 1, G 1, PS 1, ZO 1

Suggested Enduring Understandings

1. The applied agricultural sciences represent extensions of several of the pure sciences.
2. Both the pure sciences and the agricultural sciences depend upon the scientific method for conducting experiments.

Suggested Essential Questions

1. What is the relationship of the pure sciences to the applied agricultural sciences?
2. What is the scientific method?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies

a. Associate the pure sciences with agricultural and agriscience areas. (DOK 1)	a. Provide students with a listing of the pure sciences (biology, chemistry, physics, and mathematics) and the applied agricultural sciences (agronomy, soils, entomology, animals, plants, etc.). Define each science. Have students correctly identify which pure sciences are associated with each agricultural science. CS2, R4, S2	a. Use <i>Relationship of Pure Sciences to Agricultural Sciences Assignment (1.3)</i> to evaluate student performance.....
b. Develop a plan for conducting an experiment using the scientific method. (DOK 2)	b. Use the video <i>The Scientific Method</i> to define and illustrate the steps in the scientific method. Have students take notes on the major steps in the scientific method and transcribe them into their electronic notebooks or journals. Hold a classroom discussion to make sure that all students have correctly identified the basic steps in the scientific method. Have each student to develop a plan for an experiment illustrating each basic step. Have the students enter their plans in their electronic portfolios. CS1, CS4, T1, T2, T6, M5, W2, S2	b. Use the <i>Planning an Experiment Rubric (1.4)</i> to evaluate student performance.

Competency 3: Apply standard agricultural and natural resources safety practices.

Suggested Enduring Understandings

1. Using proper safety precautions and equipment is the responsibility of every member of a work team or class. Safety precautions are learned and transfer to the workplace.
2. Each student is responsible for understanding the safety rules and practices that must be followed in the AEST classroom and lab, including the use of personal protection devices.
3. Information on the use, storage, and disposal of hazardous materials can be found on a material safety data sheet (MSDS), which an employer is required to have on hand.
4. Workers should be fully aware of safety devices and warnings in the workplace and their meaning or operation.
5. The use of personal protection devices and proper dress is critical to worker safety.
6. There are four different types of fires, and each different type requires different methods of control.

Suggested Essential Questions

1. What are the general safety standards that apply to work teams in the workplace?
2. What are the specific safety rules and practices that must be followed when working in the AEST classroom and laboratory?
3. What information can be obtained from an MSDS?
4. What safety devices and warning devices are used in the Agriculture Mechanization laboratory? What do the warnings mean? How do the devices operate?
5. What personal safety devices and clothing should be worn in the workplace or laboratory?
6. What should be done if a fire breaks out in the lab or workplace?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Apply safety standards in the workplace. (DOK 1)	a. Invite a safety specialist to present a safety demonstration to the class regarding the importance of safety and standard safety	a. Evaluate the students' electronic

		precautions used in the workplace. Have students take notes during the presentation and transcribe them into their electronic journals or notebooks. Follow up the presentation with a class discussion to make sure that all students identified the major points. CS2, CS4, TS1, T2, T6, R1, R5	notebooks or journals to make sure that all major points are covered.
b.	Apply safety standards in the agricultural classroom and laboratory. (DOK 3)	b. Provide students with written guidelines for safety in the AEST classroom and laboratory, including the use of personal safety equipment. Identify the location of safety equipment, and discuss procedures for dealing with accidents, injuries, spills, and so forth. CS2, CS4, T6, R1, R2, R3	b. Use a written test to determine the students' initial understanding of the safety standards that apply to the classroom and lab. Students will be constantly observed while in the laboratory area and periodically evaluated regarding the use of safety rules and equipment using the <i>Laboratory Safety Rubric (1.5)</i> .
c.	Interpret information on a material safety data sheet (MSDS). (DOK 2)	c. Divide students into pairs, and assign each pair a specific chemical material. Have students locate an MSDS on the Internet and complete an assignment to interpret information related to the use of the material. CS1, CS2, CS4, T1, T3, T4, T6, R1, R2, R5	c. Use <i>Interpret a Hazardous Material Safety Data Sheet Assignment (1.6)</i> to evaluate student performance on this indicator.
d.	Describe the use of general safety using hand equipment and indicators to include safety color codes, fire extinguishers, first aid kits, emergency exits, and so forth. (DOK 1)	d. Have students draw a diagram of the Agricultural Mechanization laboratory showing the location of all safety devices and equipment. Have students complete steps 6–8 in Activity 1 in the <i>Agriculture Mechanics</i> module. CS1, CS2, CS4, T6	d. Evaluate the drawing for accuracy and completeness. Use the quiz in the module to evaluate understanding of general safety equipment and color codes.
		Have students identify each tool by its correct name and classify it as being a layout tool, cutting	Use the Tool Test in the module to

		tool, boring tool, driving tool, turning tool, or holding tool. Have students complete Step 3 in Activity 3 of the <i>Agriculture Mechanics</i> module. CS1, CS2, CS4, T2, T3, T6	evaluate student understanding.
e.	Apply safety precautions related to dress and personal protection devices. (DOK 2)	e. Have students complete Step 3 in Activity 2 of the <i>Agriculture Mechanics</i> module and complete Section 1 of the <i>Safety Worksheet</i> in the module. CS1, CS2, CS4, T6, R2, R5	e. Evaluate the <i>Safety Worksheet</i> for accuracy and completeness.
f.	Select procedures for dealing with the different classes of fire. (DOK 2)	f. Have students complete Step 5 in Activity 2 of the <i>Agriculture Mechanics</i> module and complete Section 2 of the <i>Safety Worksheet</i> . CS1, CS2, CS4, T6, R2, R5	f. Evaluate the <i>Safety Worksheet</i> for accuracy and completeness.

Standards

AFNR Industry Standards

- AS.01 Examine the components, historical development, global implications, and future trends of the animal systems industry.
- BS.01 Recognize the historical, social, cultural, and potential applications of biotechnology.
- FPP.01 Examine components of the food industry and historical development of food products and processing.

Applied Academic Credit Standards

Aquatic Science

- AQ 1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.

Biology I

- BIOI 1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.

Biology II

- BIOII 1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.

Botany

- BO 1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.

Environmental Science

- ES 1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.

Genetics

- G 1 Use critical thinking and scientific problem solving in designing and performing biological research and experimentation.

Physical Science

- PS 1 Demonstrate the proper use of scientific methods and investigative techniques.

Zoology

- ZO 1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.

21st Century Learning Standards

- CS1 Flexibility and Adaptability
- CS2 Initiative and Self-Direction
- CS3 Social and Cross-Cultural Skills
- CS4 Productivity and Accountability

CS5 Leadership and Responsibility

National Educational Technology Standards for Students

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- M5 Graphical Representations
- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R3 Sequential, Comparative, and Cause–Effect Relationships
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- S2 Scientific Investigation
- W1 Expressing Judgments
- W2 Focusing on the Topic
- W4 Organizing Ideas
- W5 Using Language

Suggested References

Barr Films. (2010). *Lab safety: The accident at Jefferson High* [Video]. Retrieved June 8, 2010, from <http://www.ket.org/itvvideos/offering/science/labsafety.htm>

Burton, L. (2010). *Agriscience fundamentals and applications* (5th ed.). Albany, NY: Delmar.

Clearvue, Inc. (2000). *The scientific method* [Video]. Chicago, IL: Author.

Farm Safety of Kids, Inc. (2010). *Farm safety just for kids*. Retrieved June 8, 2010, from <http://www.fs4jk.org/services.htm>

Herren, R. (2007). *The science of animal agriculture* (3rd ed.). Albany, NY: Delmar Publishers.

Herren, R. (2007). *The science of animal agriculture lab manual* (3rd ed.). Albany, NY: Delmar Publishers.

Mississippi Department of Agriculture and Commerce. (2010). *Mississippi agriculture overview*. Retrieved June 8, 2010, from http://www.mdac.state.ms.us/n_library/misc/ag_overview.html

United States Department of Agriculture. (2010). *National agricultural statistics service (NASS)*. Retrieved June 8, 2010, from <http://www.nass.usda.gov/>

For additional references, activities, and Web resources, please refer to the Mississippi Agriculture Education B.R.I.D.G.E. Web site: <http://www.rcu.blackboard.com> (available only to registered users).

Concepts of Agriscience

Unit 2: Leadership and Human Relations

10 Hours

Competency 1: Develop life and career skills for success in the 21st century.

Suggested Enduring Understandings

1. In addition to the technical skills required to obtain a job, people need essential life and career skills to succeed in a career including leadership, team-building, and human relations skills and work ethics and values.

Suggested Essential Questions

1. What are the necessary life and career skills for success in the modern world?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify, describe, and apply essential life and career skills. (DOK 3)	a. Provide students with the listing of <i>21st Century Life and Career Skills (2.1)</i> found in this unit. Lead students in a discussion of how these skills apply to their current careers as students and will apply to their career success after school. Provide students with a copy of the rubric that will be used to evaluate each student's demonstration of life and career skills. Have students self-evaluate their current scores on this rubric and explain that they will be periodically (at least once a grading period) be graded on their ability to demonstrate these skills. CS1, CS2, CS3, CS4, CS5	a. Use <i>21st Century Life and Career Skills Rubric (2.2)</i> for assessing student ability to demonstrate the essential life and career skills.
b. Apply the concepts of team building and team member participation. (DOK 3)	b. Lead a classroom discussion on the basic concepts of team building and team member participation. Explain to the students that they will be working in pairs or on teams in many of the activities related to the AEST program. Provide students with a copy of the rubric that will be used periodically to evaluate their team-building and participation skills. CS1, CS2, CS3, CS4, CS5	b. Use the <i>Rubric for Assessing Team Building and Participation Skills (2.3)</i> to periodically evaluate the team-building and participation skills of all students.
c. Demonstrate basic parliamentary procedures. (DOK 3)	c. Ask students to identify situations in which they have seen parliamentary procedure used, and have them describe their experiences. Identify the purpose and form for a main motion, amendment, and privileged motion. Have students practice these steps in small groups and during FFA chapter and committee meetings. CS5	c. Use the <i>Scorecard for Assessing Parliamentary Procedures Skills (2.4)</i> to evaluate parliamentary procedure skills of students.

Competency 2: Explore the role of the FFA in promoting leadership, personal development, and human relations skills.

Suggested Enduring Understandings

1. The FFA is an integral part of the Agricultural and Environmental Science and Technology program,

Suggested Essential Questions

1. What is the role of the FFA in the AEST

promoting leadership, human relations, and technical skill attainment and providing recognition for accomplishments.		program?
Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Explore the history and nature of the FFA in promoting and developing leadership, personal development, and human relations skills. (DOK 1)	a. Using the history of the FFA, the FFA creed, the FFA opening and closing ceremony, and other FFA activities, identify and discuss with the students the role of the organization in developing leadership, personal development, and human relations skills. CS1, CS2, CS3, CS4, CS5	a. Monitor discussion to ensure that all students are participating and attentive.
b. Identify career-related values and ethics promoted through the FFA. (DOK 1)	b. Have students read the FFA creed and complete an assignment to identify and describe in their own words the values and ethics represented in the creed. Have students share and critique their completed assignments. Hold a class discussion to identify key values and ethics promoted through the FFA. Have students record these values and ethics in their electronic journals. CS1, CS2, CS3, CS4, CS5, T1, T2, T5, T6, E1, E2, E3, E4, E5, E6, W1, W2, W3, W4, W5	b. Evaluate the summaries in the electronic journals for completeness and accuracy.
c. Identify benefits of FFA membership. (DOK 1)	c. Have an officer of the local FFA chapter speak to the class on the benefits of membership. Have the students take notes on the presentation. Following the presentation, lead a class discussion to identify and summarize the benefits. Have students transcribe the findings into their electronic notebooks or journals. CS1, CS2, CS3, CS4, CS5, T2, T5, T6, E1, E2, E3, E4, E5, E6, W1, W2, W3, W4, W5	c. Evaluate the students' electronic notebooks or journals for completeness and accuracy.
d. Select FFA activities that promote personal development and leadership skills. (DOK 1)	d. Have students search the FFA Web site (http://www.ffa.org) and identify and describe an activity or program in which they would like to participate. Have students continue their research to learn what skills and knowledge they must master to participate. Have students complete an assignment on selecting personal development and leadership activities. CS1, CS2, CS3, CS4, CS5, T3, T4, T6	d. Have students peer review and comment on the completed attachment, <i>Select a Personal/Leadership Activity Assignment (2.5)</i> .

Competency 3: Examine the concept of leadership.

Suggested Enduring Understandings

1. Leadership is the ability to influence people to accomplish goals and objectives of an organization.
2. Leadership skills can be learned.

Suggested Essential Questions

1. What is leadership?
2. What are the traits of successful leaders?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies

a. Explain the role of effective leadership. (DOK 1)	a. Have students name people in their lives that they perceive as leaders and describe ways in which these people exhibit leadership. From this discussion, draw out a definition of leadership and the characteristics of leaders. Have students write a summary of findings in their own words and transcribe into their electronic journals or notebooks. CS5, T2, T6, E1, E2, E3, E4, E5, E6, W1, W2, W3, W4, W5	a. Evaluate electronic journals or notebooks for completeness and accuracy.
b. Have students self-evaluate their personal leadership traits and develop a plan for improvement. (DOK 2)	b. Provide the students with a survey instrument that lists major traits and characteristics of successful leaders. (See the <i>Leadership Characteristics Survey [2.6]</i> .) Define and discuss these traits and characteristics. Have students rate their ability to exhibit these characteristics and identify three that they will work on improving over the course of the school year. CS1, CS2, CS3, CS4, CS5	b. Have students peer review other students' surveys and offer comments and recommendations on improvement practices.

Competency 4: Describe the role of work ethics and values in establishing and building a successful career.

Suggested Enduring Understandings

1. Work ethics and values are essential for success in all career fields.

Suggested Essential Questions

1. What is the role of work ethics and values in establishing and building a successful career?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Define and describe universally accepted work ethics and values as applied to agricultural and natural resources careers. (DOK 1)	a. Invite a human resources person from a local industry or business to speak to the class regarding the importance of universally accepted work ethics such as attendance, promptness, responsibility, trustworthiness, loyalty, and so forth. Have students summarize the key points from the presentation and transcribe into their electronic notebooks or journals. CS1, CS2, CS3, CS4, CS5, T2, T6, E1, E2, E3, E4, E5, E6, W1, W2, W3, W4, W5	a. Evaluate electronic notebooks/journals for accuracy and completeness.
b. Practice work ethics and values in the agriscience classroom and lab. (DOK 2)	b. Students will be evaluated on their practice of work ethics and values periodically through the activities and assignments made in the remainder of the course. CS1, CS2, CS3, CS4, CS5	b. Use the <i>Sample Rubric for Evaluating Work Ethics and Values (2.7)</i> to evaluate student work ethics and values periodically, or add indicators of work ethics and values to other rubrics used in the course.

Standards

21st Century Learning Standards

- CS1 Flexibility and Adaptability
- CS2 Initiative and Self-Direction
- CS3 Social and Cross-Cultural Skills
- CS4 Productivity and Accountability
- CS5 Leadership and Responsibility

National Educational Technology Standards for Students

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T5 Digital Citizenship
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- E1 Topic Development in Terms of Purpose and Focus
- E2 Organization, Unity, and Coherence
- E3 Word Choice in Terms of Style, Tone, Clarity, and Economy
- E4 Sentence Structure and Formation
- E5 Conventions of Usage
- E6 Conventions of Punctuation
- W1 Expressing Judgments
- W2 Focusing on the Topic
- W3 Developing a Position
- W4 Organizing Ideas
- W5 Using Language

Suggested References

Burton, L. (2010). *Agriscience fundamentals and applications* (5th ed.). Albany, NY: Delmar.

CORD Communications. (2003). *Necessary skills now: Facilitator's guide*. Waco, TX: Author.

Morgan, E., Lee, J., & Wilson, E. (2004). *Agriscience explorations*. Upper Saddle River, NJ: Prentice Hall.

National FFA Organization. (2010). *Welcome to LifeKnowledge*. Retrieved June 8, 2010, from
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Stewart, M., Lee, J., Hunter, S., Schell, B., Frazee, S., & Terry, R. (2004). *Developing leadership and communications skills* (2nd ed.). Upper Saddle River, NJ: Prentice Hall.

Concepts of Agriscience

Unit 3: Experiential Learning (SAE)

5 Hours

Competency 1: Plan and implement an experiential learning program. ABS.02, ABS.04

Suggested Enduring Understandings

1. Planning is a continuous process in business.
2. Plans must be reviewed and updated on a regular basis.

Suggested Essential Questions

1. What are my goals and plans for an SAE in the coming year?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Update and revise long-range and short-term goals of the experiential learning program. (DOK 3)	a. Students can do a scavenger hunt activity using <i>Experiential Learning Scavenger Hunt (3.2)</i> . Based on the summary and analysis of the students' previous experiential learning activities, have students reflect and revise or amend their experiential learning long-range and short-term goals for the coming year. The goals should be added to the students' electronic portfolios. CS1, CS2, CS4, T1, T3, T4, T6, W1, W2, W4, W5	a. Use an experiential learning planning rubric and record-keeping rubric to evaluate the students' goals. (See the <i>Rubric for Experiential Learning Planning and Record Keeping [3.1]</i> .)
b. Update, revise, and implement the experiential learning plan/training agreement for the coming year. (DOK 3)	b. Based on the revised goals, have students update, amend, and revise their experiential learning plans/training agreements to reflect growth in skill and proficiency levels. The updated plans should be added to the students' electronic portfolios. Students can use <i>Experiential Learning Goals and Plans (3.3)</i> as a guide. CS1, CS2, CS4, T1, T3, T4, T6, W1, W2, W4, W5	b. Use an experiential learning planning rubric and record-keeping rubric to evaluate the students' goals. (See the <i>Rubric for Experiential Learning Planning and Record Keeping [3.1]</i> .)

Competency 2: Maintain records and documentation of experiential learning activities, projects, and enterprises. ABS.02, ABS.03, ABS.04, ABS.06

Suggested Enduring Understandings

1. Records must be maintained and updated on a regular and timely basis to accurately reflect progress.
2. Records should be summarized to give a snapshot of operations on a regular basis that can be used to make decisions.

Suggested Essential Questions

1. How do I update and maintain the records of my experiential learning program?
2. How do I summarize and analyze my experiential learning records?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Update and maintain records of experiential-learning-	a. Review requirements for record keeping for the different types of experiential learning. Have students maintain and update their records	a. Use the <i>Rubric for Experiential Learning Planning and Record</i>

related income, expenses, activities, skills, and supplementary improvement projects. (DOK 3)	electronically throughout the year. CS2, CS4, T3, T4, T6, M1, M2, W4	<i>Keeping (3.1)</i> to evaluate the students' goals.
b. Prepare an annual summary report. (DOK 3)	b. Review procedures for summarizing records. Have students prepare an annual summary of their experiential learning activities at the end of the school year to include income and expense summary and a net worth statement. CS2, CS4, T3, T4, T6, M1, M2, W4	b. Use the <i>Rubric for Experiential Learning Planning and Record Keeping (3.1)</i> to evaluate the students' summaries.

Standards

AFNR Industry Standards

- ABS.02. Utilize appropriate management planning principles in AFNR business enterprises.
- ABS.03. Utilize record keeping to accomplish AFNR business objectives while complying with laws and regulations.
- ABS.04. Apply generally accepted accounting principles and skills to manage cash budgets, credit budgets, and credit for an AFNR business.
- ABS.05. Assess accomplishment of goals and objectives by an AFNR business.

21st Century Learning Standards

- CS1 Flexibility and Adaptability
- CS2 Initiative and Self-Direction
- CS4 Productivity and Accountability

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- M1 Basic Operations and Applications
- M2 Probability, Statistics, and Data Analysis
- W1 Expressing Judgments
- W2 Focusing on the Topic
- W4 Organizing Ideas
- W5 Using Language

Suggested References

Burton, L. (2010). *Agriscience fundamentals and applications* (5th ed.). Albany, NY: Delmar.

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Concepts of Agriscience

Unit 4: Science of Agricultural Animals

25 Hours

Competency 1: Explore the animal agriculture industry and enterprises. AS.01, AS.02, BIO1 5, ZO 1

Suggested Enduring Understandings

- Domesticated animals continue to provide services to humanity in a number of ways including providing meat and dairy products, wool, labor and service, and companionship.
- The production, processing, and marketing of animals and animal products are a major industry in the United States.
- Agricultural producers are concerned about the treatment of animals and take necessary actions to prevent animals from abuse or neglect.

Suggested Essential Questions

- What benefits does humanity obtain from domesticated animals?
- What processes are used in the production, processing, and marketing of animals and animal products?
- How is the agricultural animal industry reacting to the animal rights and welfare issue?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Associate the different classes of domestic animals with ways that each benefits humanity (beef and dairy cattle, horse, swine, poultry, catfish, goats, and sheep). (DOK 1)	a. Have the students construct a chart showing the different classes of domesticated animals, examples of species that fall into each class, and the benefits of each class to humanity. (See the <i>Domesticated Animals Benefits [4.1]</i> assignment in this unit for an example of a chart.) Have students save the chart in their electronic journals. In Activity 1 of the <i>Animal Science</i> and <i>Aquaculture</i> modules, have students watch the introductory video and read the material on the different classes of domestic animals. CS1, CS2,, CS4, T1, T3, T6, W4	a. Evaluate the charts for completeness and accuracy.
b. Explore the production, processing, and marketing of major animal enterprises (beef and dairy cattle, horse, swine, poultry, catfish, goats, and sheep). (DOK 2)	b. These activities deal with beef and dairy cattle, horse, swine, poultry, aquaculture, sheep, and alternative animal production practices. Have students answer the questions in the module related to each enterprise and record their answers in their electronic journals. Have students complete activities 6, 7, and 8 in the <i>Animal Science</i> module and Activity 7 of the <i>Aquaculture</i> module. CS1, CS2, CS4, T1, T3, T6	b. Evaluate the students' electronic journals for accuracy and completeness.
c. Compare the concepts of animal rights and animal welfare as related to agricultural animal enterprises. (DOK 2)	c. Have the students read the chapter on animal welfare in the text. Have the students write a letter to an animal welfare organization that has objected to conditions regarding production practices such as confinement, use of drugs, debeaking, and so forth. (See the <i>Letter of Concern Regarding Production Practices [4.2]</i> in this unit for an example of such a letter.) The letter should report in factual terms the advantages and benefits of these practices. CS1, CS2,	c. Use <i>Sample Rubric for Evaluating a Response to a Letter of Concern (4.3)</i> to evaluate the student mastery.

CS4, T1, T3, T6, W1, W2, W3, W4, W5

Competency 2: Investigate the anatomy and physiology of animals. AS.02, BIOI 2, BIOI 3, BIOII 2, ZO 2, ZO 3

Suggested Enduring Understandings

1. The basic building block of an animal's body is the cell.
2. Through the process of mitosis, cells divide and reproduce to produce an animal.
3. An animal's body is composed of a number of specialized cells that form tissues, organs, and systems to perform specific functions for growth and reproduction.
4. Reproduction begins with the creation of an embryo. Mammalian embryos develop inside the mothers' bodies. Avian embryos develop outside of the mothers' bodies.

Suggested Essential Questions

1. What are the functions of the different parts of a cell?
2. How does mitosis allow cells to divide and reproduce?
3. What are the components and functions of the major systems of an animal's body?
4. How is the reproduction process in mammals and birds similar yet different?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Diagram the major components of an animal cell, and list their functions. (DOK 1)	a. Have the students draw a typical animal cell showing its major parts and describing each part's function or purpose. Have students complete Activity 3 in the <i>Animal Science</i> module. CS1, CS2, CS4, T1, T3, T6, W1, W2, W3, W4, W5	a. Evaluate student drawings for accuracy and completeness.
b. Explain animal growth and reproduction by cell mitosis and meiosis. (DOK 2)	b. Have the students draw diagrams of the process of meiosis and scan them into their electronic notebooks. Using the Microslide viewer and prepare slides provided as part of the <i>Animal Science</i> module, have students view the process of mitosis and meiosis. Have them record their observations in their electronic journals. CS1, CS2, CS4, T1, T3, T6	b. Evaluate journals for accuracy and completeness. Evaluate the accuracy and completeness of the students' drawings of the process of meiosis.
c. Identify the basic anatomical and physiological features of animals and catfish including respiration, digestion, and reproductive processes. (DOK 1)	c. Have students make a table that identifies each body system and its components and explains its function and purpose. Have students complete Step 3 in Activity 4 of the <i>Animal Science</i> module and Activity 7 of the <i>Aquaculture</i> module. CS1, CS2, CS4, T1, T3, T6	c. Evaluate the students' work on the <i>Major Animal Body Systems, Components, and Functions (4.4)</i> and <i>Anatomical Comparison Assignment (4.5)</i> .
d. Compare the reproduction process in mammals, poultry, and catfish. (DOK 2)	d. Have students complete Step 4 in Activity 5 of the <i>Animal Science</i> module and Activity 7 of the <i>Aquaculture</i> module. As students read the material, have them answer the questions in Quiz 2 of the <i>Animal Science</i> module and the <i>Developmental</i>	d. Evaluate accuracy of answers to Quiz 2.

Competency 3: Describe important elements of digestion and nutrition in animals. AS.04, ZO 2, ZO 3

Suggested Enduring Understandings

1. While the end result of digestion is the absorption of nutrients by the bloodstream, the process differs from one species to another. Because of these differences, the ration fed to an animal must be altered.
2. Six different classes of nutrients are needed by an animal for optimum growth and development.
3. A variety of feedstuffs is used in developing animal rations.

Suggested Essential Questions

1. How does the digestive process differ from one species of animal to another?
2. What are the six essential nutrients, and how are they used for growth and development?
3. What are the most commonly used feedstuffs for animal rations, and with which species is each associated?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Compare and contrast the digestive systems and processes in cows and sheep, horses, swine, chickens, and catfish. (DOK 2)	a. Have students develop a chart or table that names the different types of digestive systems and the animals associated with each system. The table should also show similarities and contrasts between the different systems related to ration development and nutritional needs. Have students complete steps 2 and 3 of Activity 5 in the <i>Animal Science</i> module and Activity 6 of the <i>Aquaculture</i> module. CS1, CS2, CS4, T1, T2, T4	a. Evaluate the charts for accuracy and completeness.
b. Associate each of the six major classes of nutrients with their roles and functions. (DOK 1)	b. Have students list the six major classes of nutrients and describe their roles and functions in an animal's growth and development. The six major classes are as follows: • Proteins • Carbohydrates • Vitamins • Fats • Water • Minerals Have students record their findings in their electronic journals. Have students complete Step 3 of the <i>Animal Science</i> module and Activity 6 of the <i>Aquaculture</i> module. CS1, CS2, CS4, T1, T2, T4	b. Evaluate the student notebooks or journals for completeness, accuracy, and grammar.

c. Classify and discuss the use of feedstuffs as roughages, concentrates, and processed feeds. (DOK 1)	c. Have students identify common feedstuffs associated with each class of nutrient and the different species with which each common feedstuff is used. Students will record their findings in their electronic journals or notebooks. Have students complete Activity 6 of the <i>Aquaculture</i> module. ^{CS1, CS2, CS4, T1, T2, T4} Roughage Examples: Hay, cottonseed hulls, and silage Concentrate Examples: Corn, soybeans, and oats	c. Evaluate the student notebooks or journals for completeness, accuracy, and grammar.
d. Select nutritional practices in aquatic production based on types of food, metabolic rates, and nutritional requirements. (DOK 2)	d. Have students complete the steps in Activity 6 that relate to the nutritional requirements for aquatic species. Based on the information from the module, have students complete an exercise to select the most appropriate feed for a given species and conditions. (See the <i>Select an Appropriate Nutritional Practice</i> [4.8].)	d. Evaluate student assignment for accuracy and completeness.

Competency 4: Examine the role of genetics and breeding in animal production. ^{AS.06, BIOI 2, BIOI 4, BIOI 5, BIOII 3, G 1, G 2, G 3, ZO 3}

Suggested Enduring Understandings

1. Many traits and characteristics of an animal are passed to the animal through the genetic makeup of the animal's parents.
2. Sperm and eggs are created through a process called meiosis in which each sperm and each egg receive one half of the chromosomes from the parent.
3. Selective breeding is a process by which desirable characteristics are increased and undesirable characteristics are decreased.

Suggested Essential Questions

1. How are traits passed from the parent to the offspring?
2. Why does an egg or sperm cell contain only half of the parent's chromosomes?
3. What is the process of selective breeding?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Explain basic concepts of heredity and genetics. (DOK 1)	a. Have students read the chapter on Animal Genetics from the text and complete the <i>Worksheet on Basic Principles of Heredity and Genetics</i> (4.5). ^{CS1, CS2, CS4, T1, T3, T5}	a. Evaluate student performance on the assignment on basic principles of heredity and genetics.
b. Describe the processes	b. Have the students complete Step 4 of Activity 4 in	b. Evaluate student

of selective breeding including artificial insemination and embryo transfer. (DOK 3)	the <i>Animal Science</i> module. As the students proceed through this step, have them complete Quiz 2 in the module. CS1, CS2, CS4, T1, T3, T5	responses to questions in Quiz 2 of the <i>Animal Science</i> module.

Standards

AFNR Industry Standards

- AS.01. Examine the components, historical development, global implications, and future trends of the animal systems industry.
- AS.02. Classify animals according to hierarchical taxonomy and agricultural use.
- AS.04. Apply principles of animal nutrition to ensure the proper growth, development, reproduction, and economic production of animals.
- AS.05. Evaluate and select animals based on scientific principles of animal production.

Applied Academic Credit Standards

Biology I

- BIOI 2 Describe the biochemical basis of life, and explain how energy flows within and between the living systems.
- BIOI 4 Analyze and explain the structures and function of the levels of biological organization.
- BIOI 5 Demonstrate an understanding of the molecular basis of heredity.

Biology II

- BIOII 2 Describe and contrast the structures, functions, and chemical processes of the cell.
- BIOII 3 Investigate and discuss the molecular basis of heredity.
- BIOII 5 Develop an understanding of organism classification.

Genetics

- G 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- G 2 Analyze the structure and function of the cell and cellular organelles.
- G 3 Apply the principles of heredity to demonstrate genetic understandings.
- ZO 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ZO 2 Develop an understanding of levels of organization and animal classification.
- ZO 3 Differentiate among animal life cycles, behaviors, adaptations, and relationships.

21st Century Learning Standards

- CS1 Flexibility and Adaptability
- CS2 Initiative and Self-Direction
- CS4 Productivity and Accountability

National Educational Technology Standards for Students

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T5 Digital Citizenship
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- W1 Expressing Judgments
- W2 Focusing on the Topic
- W3 Developing a Position
- W4 Organizing Ideas
- W5 Using Language

Suggested References

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- Burton, L. (2010). *Agriscience fundamentals and applications* (5th ed.). Albany, NY: Delmar.
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Concepts of Agriscience

Unit 5: Science of Agricultural Plants

25 Hours

Competency 1: Explore the anatomical and physiological processes of plants. PS.01, BO 1, BO 2, BO 3, BO 4, BIOI 1, BIOI 2, BIOI 4, CHI 4

Suggested Enduring Understandings

1. Flowering plants are composed of a system of roots, stems, leaves, and reproductive parts that function together to allow the plant to grow and produce food.
2. The processes of respiration, photosynthesis, and transpiration allow a plant to take in nutrients and water and transform these materials into energy, oxygen, and tissues.
3. Plant growth takes place through the processes of cell division, elongation, and differentiation.

Suggested Essential Questions

1. How do the major parts of a flowering plant function together to cause the plant to grow, reproduce, and produce food?
2. How do the processes of respiration, photosynthesis, and transpiration work together in causing a plant to grow and reproduce?
3. How does a plant grow from a single cell to a complete plant?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Draw a diagram of a flowering plant, and label and describe the major parts (roots, stems, leaves, and flowers). (DOK 1)	a. Have the students prepare a chart showing the major parts of a flowering plant and describe each part's structure and function. Have students scan their charts and enter into their electronic journals. Have students complete activities 2 and 3 in the <i>Plant Science</i> module. CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T6, R1, R2, R3, R4, R5	a. Use the <i>Rubric for Evaluating Student Chart of Plant Parts and Functions (5.1)</i> to evaluate the students' charts.
b. Compare the process of respiration, photosynthesis, and transpiration. (DOK 2)	b. Have students prepare a chart showing the steps in the photosynthesis, respiration, and transpiration processes including the relationship and differences of each process to the others. (See <i>Chart for Comparing Photosynthesis, Respiration, and Transpiration [5.2]</i> .) Have students complete Activity 4 in the <i>Plant Science</i> module. CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T6, R1, R2, R3, R4, R5	b. Evaluate charts for accuracy and completeness.
c. Examine the process of plant growth to include cell division, cell elongation, and cell differentiation. (DOK 2)	c. Have students read the section in the text (Biondo & Lee, 2003) related to plant growth and development and cell division, elongation, and differentiation. Have the students summarize their findings in their electronic journals. CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T6, R1, R2, R3, R4, R5, W1, W2, W3, W4, W5	c. Evaluate student electronic journals for accuracy and completeness.

Competency 2: Investigate common methods of plant reproduction. PS.01, PS.02, PS.03, BS.02, BS.03, BIOI 1, BIOI 4, BO 3, BO 5

Suggested Enduring Understandings

1. Seeds are formed through a process of pollination in which pollen grains from the stamen fertilize ova in the pistil.
2. Each part of a seed plays an important role in the development of the young plant.
3. Seed germination is affected by a number of factors including temperature, moisture, light, and oxygen.
4. Plants require regular care for optimum growth and development.
5. Plants can be formed through asexual means such as cutting, layering, separation and division, tissue culture, and grafting.

Suggested Essential Questions

1. What factors affect the process of seed formation?
2. How do the different parts of a seed contribute toward plant growth and development?
3. How can seed germination rates be improved?
4. What types of care are needed for optimum plant growth?
5. What are the differences between asexual and sexual reproduction in plants?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Analyze the process of seed formation to include pollination and fertilization. (DOK 1)	a. Have students complete steps 3–5 in Activity 9 of the <i>Plant Science</i> module. Have students answer the questions in Step 6 of the activity and place in their electronic journals. CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, R1, R2, R3, R4, R5, W1, W2, W3, W4, W5	a. Evaluate electronic journals for accuracy and completeness.
b. Identify the parts of a seed, and associate each part with its function. (DOK 1)	b. Have students read the section on <i>Seed Structures</i> in the text (Biondo & Lee, 2003). Have the students dissect a bean or other large seed and make a drawing of what they see, labeling each part and describing its function. Have students scan their drawings and enter into their electronic journals. CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, R2, R4, R5	b. Evaluate students' drawings and descriptions for accuracy and completeness.
c. Describe and apply factors essential to seed germination. (DOK 2)	c. Have students read the section on <i>Seed Germination</i> in the text (Biondo & Lee, 2003). Have students answer the questions on germination in the assignment <i>Seed Germination (5.4)</i> . Have students conduct germination tests under different temperature, light, oxygen, and moisture conditions and note differences. CS1, CS2 CS3, CS4, CS5, R2, R4, R5	c. Evaluate student assignments for accuracy and completeness.
d. Observe and record data related to plant growth and reproduction. (DOK 2)	d. Using the <i>Wisconsin Fast Plants</i> kit in the <i>Plant Science</i> module, have students plant, thin, and care for plants. Have students record data from their experiments using <i>Plant Growth (5.5)</i> . CS1, CS2 CS3, CS4, CS5, T2, T3, T4, T6, S1, S2, S3, M1, M2, M7	d. Evaluate student assignments for accuracy and completeness.
e. Identify the five methods of asexual	e. Through illustrations, students will identify the following methods of asexual reproduction:	e. Paper and pencil test

reproduction.
(DOK 2)

- Cutting
- Layering
- Separation and division
- Tissue culture
- Grafting

Competency 3: Apply classification methods to plants. PS.01, BIOII 5, BO 3

Suggested Enduring Understandings

1. Life cycle is defined as the length of time over which a plant grows to maturity and is able to reproduce itself.
2. The scientific classification of plants allows each animal to receive a specific formal name and shows relationships between and among different species.

Suggested Essential Questions

1. What are the three most common life cycles in plants?
2. What is the scientific classification system, and why is it needed?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Classify plants based on life cycle. (DOK 1)	a. Have students complete Activity 2 in the <i>Horticulture</i> module. CS1, CS2, CS4, T1, T2, T3, T6, R4	a. Use the quiz at the end of the activity to evaluate the students' mastery of this indicator.
b. Examine the use of scientific classification systems in horticulture. (DOK 2)	b. Have students complete Activity 3 in the <i>Horticulture</i> module. Students will review scientific names of ornamental plants that can grow in the local area. Have students analyze the major components of a scientific name and explain why the scientific name process is necessary in their electronic journals. CS1, CS2, CS4, T1, T2, T3, T6, S1, W1, W4	b. Use the quiz at the end of the activity as well as evaluating student journal entries for accuracy and completeness.

Competency 4: Apply principles of plant nutrition. PS.02, BIOI 2, CHI 1, BO 4

Suggested Enduring Understandings

1. Sixteen essential nutrients are necessary in varying amounts for optimum growth and development in plants.

Suggested Essential Questions

1. What are the essential nutrients required for optimum plant growth and development?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Differentiate between the major plant nutrients (macronutrients) and the minor nutrients	a. Have students construct and complete a chart showing all 16 of the essential plant nutrients and classifying them as organic, primary, secondary, and micronutrients. (See <i>Plant Nutrient Chart [5.3]</i> .) The chart should also show the chemical symbol for each	a. Evaluate the charts for accuracy and completeness.

(micronutrients). (DOK 1)	nutrient, functions of each nutrient (how it is used by the plant), and signs of nutrient deficiency. ^{CS1, CS2} ^{CS3, CS4, CS5, T3, T6, W4}	
b. Identify the chemical symbols of the 16 essential plant nutrients. (DOK 1)	b. Have students construct and complete a chart showing all 16 of the essential plant nutrients and classifying them as organic, primary, secondary, and micronutrients. (See <i>Plant Nutrient Chart [5.3]</i> .) The chart should also show the chemical symbol for each nutrient, functions of each nutrient (how it is used by the plant), and signs of nutrient deficiency. ^{CS1, CS2} ^{CS3, CS4, CS5, T3, T6, W4}	b. Evaluate the charts for accuracy and completeness.

Competency 5: Investigate the chemical properties of soils. ^{PS.02, NRS.01, NRS.02, ESS.02, CHI 5}

Suggested Enduring Understandings

1. An accurate soil test is important in determining the need for additional fertilizer and other soil amendments.
2. As the pH of a soil changes, the availability of existing nutrients in the soil changes.

Suggested Essential Questions

1. How do I obtain a representative sample of soil from a given area for testing purposes?
2. How does the pH of a soil affect its productivity and fertility?
3. How do I correct deficiencies in soil fertility?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Develop a soil testing plan for a given field or area. (DOK 2)	a. Have students complete Activity 7 in the <i>Soil Science</i> module. Following the instructions in the module, have the students prepare a sketch of a plot of land identifying prominent features and differences in soil type and slope. From this sketch, have the students mark 10–20 random spots where soil should be sampled. ^{CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, M5, S1}	a. Use the <i>Checklist for Evaluating a Sketch of a Land Plot (5.12)</i> to evaluate the sketches developed by the students. Essential elements should include a title block, a sketch of the area to be sampled, identifying landmarks and features, and changes in soil texture and surface slope. For small plots, 10 random spots should be marked. For larger plots, 20 random spots should be marked.

b. Take a soil sample for testing purposes. (DOK 2)	b. Have the student use their sketches to collect and process a soil sample for fertility testing purposes. The sample should be properly labeled and include a data sheet. CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, S2, W4	b. Use the <i>Checklist for Soil Sample Collection and Preparation (5.13)</i> to evaluate the students' ability to collect and process a soil sample.
c. Describe how soil pH affects productivity of a soil. (DOK 1)	c. Have the students read the section in the text (Burton, 2010) that deals with soil pH and pH adjustment. Have them discuss in their own words the concept of pH and how it affects soil productivity and nutrients. Have them summarize their findings in their electronic journals. Have the students complete Activity 9 in the <i>Soil Science</i> module that deals with fertility and productivity. CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, R1, R2, R3, R4, R5, W1, W2, W3, W4, W5	c. Evaluate electronic journals for completeness and accuracy.
d. Test a soil for pH and nutritional content, and make recommendations on amendments and fertilizers to be applied. (DOK 3)	d. Using the Rapitest soil testing kit, have the students conduct a test of a soil sample to determine pH and nitrogen, phosphorus, and potassium levels. Have students then make written recommendations as to fertilizers and other soil amendments that should be applied to the plot of land that was sampled. CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, S2	d. Observe students using the Rapitest kit to make sure they are following procedures. Evaluate their recommendations for accuracy.

Competency 6: Explore basic concepts of pest management to include insect damage, weed damage, and diseases. PS.03, BIOI 6, BIOII 4, ZO 2, ZO 3, ZO 4

Suggested Enduring Understandings

1. The control of insects, diseases, and weeds in field crops is a major concern to producers because these pests reduce yields and cause loss.

Suggested Essential Questions

1. What are the different types of field crop pests, and how does each type cause damage or loss to the crop?
2. What types of pest control methods exist, and what are their advantages and disadvantages?
3. How can producers develop the optimum plan for controlling pests in field crops?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify the different types of plant pests, and discuss how each class causes damage or loss to a crop. (DOK 1)	a. Have students construct a table that identifies the three major types of plant pests (insects, weeds, and diseases), and summarize the ways in which each type causes damage or loss to crops. (See <i>Plant Pests and the Damage They Cause Assignment [5.8]</i> in this unit.) Have students complete Activity 6 and Activity 7 in the <i>Crop Science</i> module. CS1, CS2, CS4, T1, T2, T3, T6	a. Evaluate charts for accuracy and completeness.

b. Compare the different types of pest control measures. (DOK 2)	b. Have students compare and contrast pest control strategies: regulatory control, host resistance, biological control, cultural control, physical and mechanical control, and chemical control. Develop an integrated pest management plan on a given crop to include three control practices.	b. Use the quizzes in Activity 8 to evaluate student performance.

Have students complete Activity 8 in the *Crop Science* module. CS1, CS2, CS4, T1, T2, T3, T6, S3

Competency 7: Explore the uses of a greenhouse. PS.02, BIOI 3, BO 5

Suggested Enduring Understandings

1. The design and construction of a greenhouse type should be based on the crops to be grown, cost of construction, and maintenance.
2. For optimum plant growth, the environment of a greenhouse (temperature, moisture/humidity, light intensity/duration, and ventilation) must be closely monitored and controlled.
3. A greenhouse manager is responsible for seeing that plants are properly cared for and that the environment inside the greenhouse is monitored and controlled.

Suggested Essential Questions

1. What are the characteristics of different greenhouse types?
2. What environmental factors inside a greenhouse must be controlled, and how is this control accomplished?
3. What are the primary duties of a greenhouse manager?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify and describe the characteristics of greenhouses: quonset, even span, and ridge and furrow. (DOK 1)	a. Have students complete Activity 3 of the <i>Horticulture</i> module. Have them answer questions found in the module related to the different types of greenhouses and greenhouse construction materials. Students should complete the <i>Survey of Horticultural Enterprises (5.9)</i> . CS1, CS2, CS4, T1, T2, T3, T6, W1, W4	a. Evaluate student answers for accuracy and completeness.
b. Investigate methods for controlling the environment in a greenhouse. (DOK 1)	b. Have students identify each of the major environmental factors (temperature, moisture/humidity, light, ventilation, etc.) that must be controlled in a greenhouse and write a short description of ways in which each is controlled. (See the <i>Greenhouse Environmental Control Assignment [5.10]</i> .) Have students enter their findings in their electronic journals. CS1, CS2, CS4, T1, T2, T3, T6, W1, W4	b. Evaluate student assignments for accuracy and completeness.
c. Explore greenhouse management activities. (DOK 1)	c. Have students watch the video <i>Introduction to Greenhouse Management</i> in Activity 3 of the <i>Horticulture</i> module. Have them make notes of the different duties and responsibilities of a manager and transcribe them into their electronic journals. CS1, CS2, CS4, T1, T2, T3, T6, W1, W4	c. Evaluate student journals for accuracy and completeness.

Standards

AFNR Industry Standards

- PS.01 Apply knowledge of plant classification, plant anatomy, and plant physiology to the production and management of plants.
- PS.02 Prepare and implement a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.
- PS.03 Propagate, culture, and harvest plants.
- BS.02 Demonstrate laboratory skills related to biotechnology.
- BS.03 Demonstrate the application of biotechnology to Agriculture, Food, and Natural Resources (AFNR).

Applied Academic Credit Standards

Biology I

- BIOI 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- BIOI 2 Describe the biochemical basis of life, and explain how energy flows within and between the living systems.
- BIOI 4 Analyze and explain the structures and function of the levels of biological organization.

Botany

- BO 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- BO 2 Distinguish among the characteristics of botanical organization, structure, and function.
- BO 3 Demonstrate an understanding of plant reproduction.
- BO 4 Draw conclusions about the factors that affect the adaptation and survival of plants.
- BO 5 Relate an understanding of plant genetics to its uses in modern living.

Chemistry I

- CHI 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- CHI 4 Analyze the relationship between microscopic and macroscopic models of matter.

21st Century Learning Standards

- CS1 Flexibility and Adaptability
- CS2 Initiative and Self-Direction
- CS3 Social and Cross-Cultural Skills
- CS4 Productivity and Accountability
- CS5 Leadership and Responsibility

National Educational Technology Standards for Students

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- M1 Basic Operations and Applications
- M2 Probability, Statistics, and Data Analysis
- M7 Measurement
- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R3 Sequential, Comparative, and Cause–Effect Relationships
- R4 Meaning of Words

R5	Generalizations and Conclusions
S1	Interpretation of Data
S2	Scientific Investigation
S3	Evaluation of Models, Inferences, and Experimental Results
W1	Expressing Judgments
W2	Focusing on the Topic
W3	Developing a Position
W4	Organizing Ideas
W5	Using Language

Suggested References

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Applied Technologies. (2004). *Horticulture module*. Calhoun, GA: Learning Labs.

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For additional references, activities, and Web resources, please refer to the Mississippi Agriculture Education B.R.I.D.G.E. Web site: <http://www.rcu.blackboard.com> (available only to registered users).

Concepts of Agriscience

Unit 6: Science of Agricultural Environment

25 Hours

Competency 1: Examine the importance of different kinds of natural resources and their relationship to different kinds of ecology. NRS.01, ES 3, BIOII 4

Suggested Enduring Understandings

1. Some natural resources must be preserved for future generations while other natural resources must be managed and conserved.
2. Natural resources may be classified as exhaustible, non-exhaustible, and renewable.
3. In a food web, energy from the sun is passed along from plants to animals.
4. Water is constantly recycled through the hydrologic cycle of evaporation and condensation.
5. Salt water can be converted to fresh water through a process called desalinization.
6. Understanding the chemical and physical properties of water is critical to aquacultural enterprises.
7. Aquacultural producers must constantly monitor water conditions for dissolved gases, pH, temperature, hardness, and nitrate levels.

Suggested Essential Questions

1. What is the difference in conservation and preservation of natural resources?
2. What are the different classes of natural resources?
3. How is energy transmitted in a food web?
4. How is water recycled naturally?
5. How can saltwater be converted into fresh water?
6. How do the chemical and physical properties of water relate to aquacultural production?
7. What water quality tests are necessary for best growth and health of aquaculture species?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Compare and contrast the principles of conservation and preservation of natural resources. (DOK 2)	a. Have students prepare an essay in their electronic journals comparing and contrasting the issues of conservation and preservation including citing examples of resources that should be conserved or preserved. Have students complete steps 4–5 of Activity 1 in the <i>Natural Resources</i> module. CS1, CS2, CS4, T2, T3, T6, R3, R5, W2, W4	a. Evaluate the students' essays using the <i>Preservation versus Conservation Essay Rubric (6.1)</i> .
b. Classify natural resources as exhaustible, non-exhaustible, or renewable. (DOK 2)	b. Provide students with a list of common natural resources, and have them classify each as being exhaustible, non-exhaustible, or renewal. Have students write a one- to two-sentence statement justifying their classification. (See the <i>Exhaustible or Non-Exhaustible [6.2]</i> .) Have students complete Step 3 of Activity 2 in the <i>Natural Resources</i> module. CS2, CS3, CS6, T2, T3, T4, T6, R3, R5, W2, W4	b. Evaluate the student assignments for clarity, completeness, and accuracy.
c. Describe the flow of energy in a food web	c. Have students prepare a diagram showing the flow of energy within the ecosystem. The diagram	c. Evaluate illustrations for accuracy and

within an ecosystem. (DOK 2)	should illustrate the processes of synthesis, photosynthesis, respiration, and decomposition as related to organisms that are producers, transformers, and decomposers. Have students complete Step 4 of Activity 2 in the <i>Natural Resources</i> module. CS2, CS3, CS6, T2, T3, T4, T6, W4	completeness.
d. Describe the hydrologic cycle. (DOK 1)	d. Have students create an illustration of the water cycle showing the relationships among meteoric water, surface water, and groundwater. Have students scan their illustrations into their electronic journals. Have students complete Step 6 in Activity 3 of the <i>Natural Resources</i> module. CS2, CS3, CS6, T2, T3, T4, T6, R3, R5, W4 Have students complete Step 7 in Activity 3 of the <i>Natural Resources</i> module. CS2, CS3, CS6, T2, T3, T4, T6, S2	d. Evaluate illustrations for accuracy and completeness. Use the <i>Checklist for Desalinization Laboratory Exercise (6.3)</i> to evaluate student mastery.
e. Describe the chemical and physical properties of water in its different states. (DOK 2)	e. Have students complete Activity 2 in the <i>Aquaculture</i> module. As students complete the activity, have them summarize important chemical and physical characteristics of water including units of measure, pH, temperature, salinity, dissolved gases, hardness, and nitrate levels in their electronic journals. CS1, CS2, CS4, T1, T3, T6, S2, W4	e. Evaluate student journals for accuracy and completeness.
f. Test a water sample for pH, dissolved oxygen, hardness, and nitrate levels. (DOK 3)	f. Have students use the information and instructions in activities 3, 4, and 5 and the water testing kit to obtain data related to temperature, dissolved oxygen, pH, hardness, and nitrate levels of an aquarium. Have students record their findings on the <i>Water Quality Log</i> sheet. Have students describe why water quality can vary over time in their electronic journals. CS1, CS2, CS4, T1, T3, T6, S2, W4	f. Evaluate each student's <i>Water Quality Log</i> for accuracy and completeness. Observe students' laboratory procedures and rate using the <i>Rubric for Evaluation of Water Quality Exercise (6.10)</i> .

Competency 2: Explore principles of wildlife conservation. NRS.02, NRS.04, BIOI 6, ES 5
Suggested Enduring Understandings

- Wildlife is one of the natural resources that must be managed and conserved but can be renewed indefinitely.

Suggested Essential Questions

- How can wildlife be managed and conserved as a renewable resource?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Examine basic principles of wildlife conservation. (DOK 1)	a. Have students write a short essay on how modern wildlife management practices have helped maintain and restore wildlife species in the United States. Have students complete Activity 5 of the <i>Natural</i>	a. Evaluate the students' essays for accuracy and completeness.

Resources module. CS2, CS3, CS6, T2, T3, T4, T6, R3, R5, W2, W4

Important practices that should be included in the essay include game refuges, habitat development, hunting regulations, and artificial restocking.

Competency 3: Explore energy conservation and alternative energy sources. ESS.05, ES 2, PS 6

Suggested Enduring Understandings

1. As nonrenewable energy sources become increasingly scarce, alternative sources of energy will become more and more important.

Suggested Essential Questions

1. What are the most common sources of alternative energy?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Explore alternative energy sources. (DOK 2)	a. Have students complete Step 4 in Activity 7 and Step 3 in Activity 8. Based on the information found in these two activities, have students write an essay describing alternative energy sources, including their applicability in the local community. CS2, CS3, CS6, T2, T3, T4, T6, R3, R5, W2, W3, W4	a. Use the <i>Alternative Energy Essay Rubric (6.4)</i> to evaluate the student assignment.

Competency 4: Examine principles of waste management. ESS.03, ESS.04, ESS.05

Suggested Enduring Understandings

1. Waste management practices are different for the different types of waste materials.
2. Household waste can be managed more effectively to reduce the amount of waste that must be disposed and to protect the environment.

Suggested Essential Questions

1. What are the three major types of waste materials?
2. How can household waste be managed more efficiently?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe the three major types of waste materials (industrial, construction, and domestic). (DOK 1)	a. Have students read the chapter on <i>Waste Management</i> in the text (Camp & Daugherty, 2003). Have students complete the <i>Types of Waste and Waste Products (6.5)</i> assignment. CS2, CS3, CS6, T2, T3, T4, T6, R2, R3, R4, R5, W2, W4	a. Evaluate the assignments for accuracy and completeness.
b. Develop a household waste management plan. (DOK 2)	b. Have students complete Step 5 in Activity 2, Step 6 in Activity 8, and Step 2 in Activity 9. Have students complete the <i>Reducing, Reusing, and Recycling</i> assignment in Activity 9. CS2, CS3, CS6, T2, T3, T4, T6, S2, S3	b. Evaluate the student assignments for accuracy and completeness.

Competency 5: Explore forest management and production practices.

NRS.02, NRS.03, BIO1 3, BO 4, BO 5, ES 2, ES 3, PS 5,

ZO 2, ZO 3

Suggested Enduring Understandings

1. Reforestation is important from both an environmental and an economical standpoint.
2. Tree growth is measured in terms of diameter and height.
3. Silvicultural practices such as thinning are necessary for optimum growth of timber.
4. Fire results from a combination of heat, oxygen, and fuel, and by controlling just one of these factors a fire can be extinguished.
5. Common pests of forests and trees include insects and diseases.
6. Standing timber is sold either using an estimate of the stumpage or by the weight of timber harvested.

Suggested Essential Questions

1. What are the advantages and disadvantages of the different methods of reforestation?
2. How is tree growth measured?
3. What are the different methods for thinning a stand of timber?
4. What is the fire triangle, and how can it be used to control fire?
5. What are the common pests of forests?
6. How is standing timber sold?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Explore concepts of forestry and forestry management to include reforestation methods and silviculture practices in managing and harvesting forests. (DOK 2)	a. Provide the students with the <i>Reforestation Exercise Scenario (6.7)</i> , and have them write a letter to the timber owner explaining the different options for reforestation and making a recommendation on which method would be most appropriate. Have students complete Activity 6 in the <i>Forestry</i> module. CS1, CS2, CS4, T2, T3, T4, T6, R3, W1, W4, W5	a. Evaluate the students' letters using the <i>Reforestation Exercise Rubric (6.8)</i> .
b. Identify and describe the use of common forest products made from hardwood and softwood trees. (DOK 1)	b. As students participate in the activity, have them build a list of common hardwood and softwood species that are common to Mississippi. For each species, have students classify it as hardwood or softwood, summarize its characteristics, and identify its most common uses. (See the <i>Wood Products and Characteristics [6.6]</i> assignment.) Have them place this assignment in their electronic journals. Have students complete Activity 8 in the <i>Forestry</i> module. CS1, CS2, CS4, T2, T3, T4, T6, R1, R5	b. Evaluate the assignments for accuracy and completeness.
c. Draw and explain the fire triangle. (DOK 1)	c. Have students draw a fire triangle and describe ways in which components can be removed from the triangle to extinguish a fire. Have students scan their work and place in their electronic journals. Have students complete steps 4–5 of Activity 9 in the <i>Forestry</i> module. CS1, CS2, CS4, T2, T3, T4, T6, R3, W1, W4, W5	c. Evaluate journal entries for accuracy and completeness.

Competency 6: Demonstrate an understanding of the impact of soil as a natural resource.

CHI 1, E 4, E 5, ES 3,

Suggested Enduring Understandings

1. Soil is the most important natural resource that must be protected and conserved.
2. Soil is a naturally occurring substance that is formed over centuries through chemical and physical weathering processes.
3. Soil texture refers to the amount of sand, silt, and clay particles that are present in the soil.
4. Native soils are composed of different layers of materials.

Suggested Essential Questions

1. Why is soil an important natural resource?
2. How is soil formed?
3. How do I determine the texture of a soil?
4. What are the different layers of the soil profile?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Associate the definition of soil with its importance. (DOK 2)	a. Have students write short paragraphs for electronic journals that summarize the definition of soil and describe three reasons why soil is important to society. Have students complete Activity 1 in the <i>Soil Science</i> module. CS 1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, R1, R2, R4, R5, W4, W5	a. Use the quiz at the end of Activity 1 to evaluate students' understanding as well as evaluating the journals for accuracy and completeness.
b. Describe the process of soil formation including the effects of chemical and physical weathering. (DOK 1)	b. Summarize the important concepts associated with each of the factors associated with soil formation, and place these in the electronic journals. Have students complete steps 1–5 of Activity 1 in the <i>Soil Science</i> module. CS 1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, R1, R2, R4, R5, W4, W5	b. Evaluate the students' journals for accuracy and completeness.
c. Classify the texture of a soil. (DOK 2)	c. Have students complete Activity 4 of the <i>Soil Science</i> module, including the exercise on determining the general texture of a soil. Have students answer the questions in the <i>Summarize</i> section of the activity and record their answers in their electronic journals. CS 1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, R1, R2, R4, R5, W4, W5	c. Evaluate the students' journals for accuracy and completeness.
d. Identify the different layers of a typical soil profile, and describe their importance. (DOK 1)	d. Have the students complete Activity 3 of the <i>Soil Science</i> module, including the exercise on making a drawing of a soil profile. Have students record their answers to the questions in the <i>Summarize</i> section of the activity in their electronic journals. CS 1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, R1, R2, R4, R5, W4, W5	d. Evaluate the students' journals for accuracy and completeness.

Competency 7: Investigate the use of the land capability classification system.
NRS.01, NRS.02, ESS.03, E 3, ES 3
Suggested Enduring Understandings

1. One important concept of soil conservation is that land can be classified according to its highest productive use.
2. Factors that determine the highest productive

Suggested Essential Questions

1. What is the meaning of the term *highest productive use*?
2. What factors determine the highest

use of a given plot of land include soil texture, slope, fertility, erosion potential, and internal drainage. productive use of a plot of land?		
Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe the concepts of land classification and highest productive use. (DOK 1)	a. In their electronic journals, have students summarize the important concepts regarding land classification and highest productive use. Have the students complete Activity 10 in the <i>Soil Science</i> module. CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, R1, R2, R3, R4, R5, W1, W2, W3, W4, W5	a. Evaluate the students' electronic journal entries for accuracy and completeness.
b. Identify and describe factors that contribute to land capability. (DOK 1)	b. Using the material on <i>Land Capability Classes</i> in the text (Plaster, 2003), have the students construct a chart showing the relationship of slope, internal drainage, erosion potential, and fertility to each of the eight land capability classes. (See <i>Land Capability Classification Chart [6.11]</i> .) CS1, CS2, CS3, CS4, CS5 T2, T3, T4, T6, W4	b. Evaluate the charts for accuracy and completeness.

Standards

AFNR Industry Standards

- NRS.01 Recognize the important interrelationships between natural resources and humans necessary to conduct management activities in natural environments.
- NRS.02 Apply scientific principles to natural resource management activities.
- NRS.03 Apply knowledge of natural resources industries to production practices and processing procedures.
- NRS.04 Demonstrate techniques used to protect natural resources.
- ESS.03 Apply scientific principles to environmental service systems.
- ESS.04 Operate environmental service systems to manage a facility environment.
- ESS.05 Examine the relationships between energy sources and environmental service systems.

Applied Academic Credit Standards

Biology I

- BIOI 3 Investigate and evaluate the interaction between living organisms and their environment.
- BIOI 6 Demonstrate an understanding of principles that explain the diversity of life and biological evolution.

Biology II

- BIOII 4 Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.

Earth and Space Science

- E 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- E 4 Demonstrate an understanding of earth systems relating to weather and climate.
- E 5 Apply an understanding of ecological factors to explain relationships between earth systems.

Environmental Science

- ES 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ES 2 Develop an understanding of the relationship of ecological factors that affect an ecosystem.
- ES 3 Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.

Physical Science

- PS 5 Investigate and apply principles of physical and chemical changes in matter.

21st Century Learning Standards

- CS1 Flexibility and Adaptability
- CS2 Initiative and Self-Direction
- CS4 Productivity and Accountability

National Educational Technology Standards for Students

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- R2 Supporting Details
- R3 Sequential, Comparative, and Cause–Effect Relationships
- R4 Meaning of Words

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- R5 Generalizations and Conclusions
- S2 Scientific Investigation
- S3 Evaluation of Models, Inferences, and Experimental Results
- W2 Focusing on the Topic
- W3 Developing a Position
- W4 Organizing Ideas

References

- Applied Technologies. (2002). *Soil science module* [Computer assisted instructional module]. Calhoun, GA: Author.
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Concepts of Agriscience

Unit 7: Science of Agricultural Mechanization

15 Hours

Competency 1: Examine the applications of mechanical technology in agriscience. PST.01, PST.02

Suggested Enduring Understandings

1. Discoveries and inventions related to agricultural power, structures, and technology have contributed directly to the increase in productivity, efficiency, and quality of agricultural products and enterprises.
2. To be used properly, hand and power tools must be identified and classified as to their use.

Suggested Essential Questions

1. How has mechanization contributed to increased productivity, efficiency, and quality of agricultural enterprises?
2. What are the common hand and power tools used in agriculture mechanization and their classes?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe how mechanical inventions and other discoveries in agriculture have contributed to increased efficiency of production. (DOK 1)	a. Have students read the section on <i>The Mechanics in the World of Agriculture</i> in Unit 1 of the text (Herren, 2010). Based on their reading, have students identify at least five inventions or discoveries related to agriculture mechanization and in their own words describe how these discoveries have contributed to efficiency of agricultural enterprises. Have students enter their findings in their electronic journals. CS1, CS2, CS4, T2, T3, T6	a. Evaluate student journals for accuracy and completeness.

Competency 2: Explore basic principles of electricity. PST.01, PST.05, PHYI 3, PHYI 5, PS 2, PS 4

Suggested Enduring Understandings

1. Electricity is the flow of electrons usually produced by either a magnetic force or chemical reaction. The flow of electricity is measured in volts, amperes or amps, and wattage or watts.
2. In order for electricity to flow, there must be a source, conductors, controllers, and a load that complete a path from the source to the load and back again.
3. Examples of electrical circuits used in buildings include lighting circuits and outlet circuits. Some circuits contain both lights and outlets.

Suggested Essential Questions

1. What is electricity, and how is it measured?
2. What constitutes an electrical circuit?
3. What are some common circuits used for lighting and power in buildings?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Examine basic	a. Have students complete Step 3 in Activity 4 of the	a. Use the quiz in the

principles of electricity including magnetism, circuits, and units of measure. (DOK 1)	<i>Agriculture Mechanics</i> module. CS1, CS2, CS4, T2, T6, R2, R4	module to evaluate student understanding of electrical principles.
b. Draw a diagram of an electrical circuit showing components and common symbols. (DOK 1)	b. Using the information from Step 3, have the students draw a diagram of a simple series circuit for a light controlled by a switch. Have students label each part of the circuit and note its purpose or function. CS1, CS2, CS4, CS6, T2, T6, R2, R4 Have students complete activities 5–7 of the <i>Agriculture Mechanics</i> module to include installing a ground rod, circuit breaker, switches, receptacles, and light fixtures. As students complete each of the different circuits, have them sketch each circuit and scan their sketches into their electronic journals. CS1, CS2, CS4, CS6, T2, T6, R2, R4	b. Evaluate student drawing for accuracy and completeness. Use the <i>Installing Electrical Devices and Circuits Rubric (7.1)</i> to evaluate student performance.

Competency 3: Explore basic principles of plumbing systems. PST.01, PST.03, PST.04

Suggested Enduring Understandings

1. Plumbing codes are enacted to ensure that plumbing systems provide safe and sanitary flow of fluids.
2. Selection of a specific type of pipe for a specific plumbing system is based on cost, strength, and specific job requirements.
3. Pipe fittings including valves are necessary to control the flow of fluids and make connections between different pipes.

Suggested Essential Questions

1. How do plumbing code requirements relate to safety and sanitary conditions?
2. How is a specific type of pipe selected?
3. What fittings and valves are used to join pipe and control flow of liquids in a system?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe common plumbing code requirements. (DOK 1)	a. Have students complete Step 4 of Activity 9 of the <i>Agriculture Mechanics</i> module. Have them summarize their findings in their electronic journals. CS1, CS2, CS4, CS6, T2, T6, R2, R4, W2, W4, W5	a. Use the quiz in the module to evaluate students' understanding of code requirements.
b. Compare the advantages and disadvantages of PVC, C-PVC, polyethylene, and copper types of pipe. (DOK 2)	b. Have students read Chapter 2, <i>Materials</i> , in the text (American Association for Vocational Instructional Materials, 2004). Have them complete the <i>Advantages and Disadvantages of Different Types of Pipe (7.2)</i> . CS1, CS2, CS4, CS6, T2, T6, R2, R4, W2, W4, W5	b. Evaluate the assignments for accuracy and completeness.
c. Select pipe fittings for different applications. (DOK 2)	c. Based on the information provided in Chapter 2 of the text (American Association for Vocational Instructional Materials, 2004), have students complete the questions shown in the <i>Selecting Pipe</i>	c. Evaluate the assignments for accuracy and completeness.

Fittings (7.3). CS1, CS2, CS4, CS6, T2, T6, R2, R4, W2, W4, W5

Examples of pipe fittings:

- Elbow
 - Coupling
 - T
 - Reducer
 - Check valve
-

Standards

AFNR Industry Standards

- PST.01. Use physical science principles and engineering applications with power, structural, and technical systems to solve problems and improve performance.
- PST.02 Design, operate, and maintain mechanical equipment, structures, biological systems, land treatment, power, and technology.
- PST.03 Service and repair mechanical equipment and power systems.
- PST.04 Plan, build, and maintain agricultural structures.
- PST.05 Apply technology principles in the use of agricultural technical systems.

Applied Academic Credit Standards

Physical Science

- PS 2 Describe and explain how forces affect motion.
- PS 4 Develop an understanding of the atom.

Physics I

- PHYI 2 Develop an understanding of concepts related to forces and motion.
- PHYI 3 Develop an understanding of concepts related to work and energy.
- PHYI 5 Apply an understanding of magnetism, electric fields, and electricity.

21st Century Learning Standards

- CS1 Flexibility and Adaptability
- CS2 Initiative and Self-Direction
- CS4 Productivity and Accountability

National Educational Technology Standards for Students

- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- R2 Supporting Details
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- W2 Focusing on the Topic
- W4 Organizing Ideas
- W5 Using Language

Suggested References

American Association for Vocational Instructional Materials. (2004). *Basic plumbing skills*. Winterville, GA: Author.

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Multimedia 2000. (2004). *The home depot: Home improvement 1-2-3* [CD-ROM]. Issaquah, WA: Author.

Shopware. (1999). *Multimedia small engines* [CD-ROM]. Princeton, NJ: Author.

For additional references, activities, and Web resources, please refer to the Mississippi Agriculture Education B.R.I.D.G.E. Web site: <http://www.rcu.blackboard.com> (available only to registered users).

Student Competency Profile

Student Name: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student and can serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Introduction to Agricultural and Environmental Science and Technology

- _____ 1. Examine the nature of the agriculture and natural resources industry.
- _____ 2. Examine the relationships among the pure sciences, agriculture, and agriscience.
- _____ 3. Apply standard agricultural and natural resources safety practices.

Unit 2: Leadership and Human Relations

- _____ 1. Develop life and career skills for success in the 21st century.
Explore the role of the FFA in promoting leadership, personal development, and human
- _____ 2. relations skills.
- _____ 3. Examine the concept of leadership.
Describe the role of work ethics and values in establishing and building a successful
- _____ 4. career.

Unit 3: Experiential Learning (SAE)

- _____ 1. Explore concepts of experiential learning.
- _____ 2. Plan experiential learning experiences.
- _____ 3. Implement and evaluate a Supervised Agricultural Experience Program.

Unit 4: Concepts of Animal Science

- _____ 1. Explore the animal agriculture industry and enterprises.
- _____ 2. Investigate the anatomy and physiology of animals.
- _____ 3. Describe important elements of digestion and nutrition in animals.
- _____ 4. Examine the role of genetics and breeding in animal production.

Unit 5: Concepts of Plant Science

- _____ 1. Explore the anatomical and physiological processes of plants.
- _____ 2. Investigate common methods of plant reproduction.
- _____ 3. Apply classification methods to plants.
- _____ 4. Apply principles of plant nutrition.
- _____ 5. Investigate the chemical properties of soils.
Explore basic concepts of pest management to include insect damage, weed damage,
- _____ 6. and diseases.
- _____ 7. Explore the uses of a greenhouse.

Unit 6: Concepts of Environmental Science

- Examine the importance of different kinds of natural resources and their relationship to
- _____ 1. different kinds of ecology.
 - _____ 2. Explore principles of wildlife conservation.
 - _____ 3. Explore energy conservation and alternative energy sources.
 - _____ 4. Examine principles of waste management.
 - _____ 5. Explore forest management and production practices.
 - _____ 6. Demonstrate an understanding of the impact of soil as a natural resource.
 - _____ 7. Investigate the use of the land capability classification system.

Unit 7: Concepts of Agricultural Mechanics

- _____ 1. Examine the importance of mechanical technology in agriscience.
- _____ 2. Explore basic principles of electricity.
- _____ 3. Explore basic principles of plumbing systems.

Appendix A: Suggested Rubrics, Checklists, and Activities

Name: _____

Date: _____

Period: _____

Agriculture Timeline Graphic Rubric (1.1)

<i>The student did the following:</i>	Excellent	Good	Needs Improvement	Unacceptable
	4	3	2	1
Correctly identified three major practices or technologies associated with agricultural enterprises				
Correctly placed the development of these practices on the time line				
Correctly identified how each technology or practice has affected agricultural productivity				

Name: _____

Date: _____

Period: _____

Agriculture Natural Resources Areas Graphic Rubric (1.2)

Content	Covers all three areas clearly and accurately	Mostly clear, appropriate, and correct	Minor issues with clarity or correctness	Confusing, incorrect, or flawed
Visual Aids	Attractive and accurate	Mostly attractive and accurate	Minor issues with attractiveness or accuracy	Inaccurate and/or unattractive

Name: _____

Date: _____

Period: _____

Relationship of Pure Sciences to Agricultural Sciences Assignment (1.3)

Pure Sciences

- Biology – the study of living plants and animals
- Chemistry – the study of chemical elements and compounds
- Physics – the study of matter and energy and the interactions between the two
- Mathematics – the study of numbers and their relationships to measurement, properties, and quantities

For each of the applied agricultural sciences, indicate the degree of relationship to each of the pure sciences using the following scale:

3 – Highly related

2 – Related

1 – Limited relation

0 – No relation

Entomology

Soil Science

Silviculture

Horticulture

Animal Nutrition

Agricultural Mechanization

Plant Pathology

Animal Genetics

Environmental Science

Name: Date: Period:

Planning an Experiment Rubric (1.4)

The Question	Student posed a specific question in clear, concise language that calls for scientific research.	Student posed a general question that implies the need for scientific research.	Student posed an ambiguous question that could be answered easily without using the scientific method.	Student posed a question that does not require scientific research.
Background Research	Student listed four or more possible sources.	Student listed three possible sources.	Student listed two possible resources.	Student listed only one possible resource.
Hypothesis	Student stated the hypothesis in a way that can be measured to answer the question and identified the independent and dependent variables.	Student stated the hypothesis in a measurable manner to answer the question.	Student stated the hypothesis in a somewhat measureable manner.	Student stated the hypothesis in a manner that could not be measured.
Experimental Method Design	Student clearly identified procedures and controls that would be used to conduct the experiment as well as data collection and analysis procedures.	Student identified general procedures, controls, and data collection and analysis procedures.	Student identified some of the general procedures, controls, and data collection and analysis procedures.	The student offered little or no explanation of procedures, controls, and data collection, and analysis procedures.
Grammar, Spelling, Punctuation, and Accuracy	No mistakes	One to two minor mistakes	Three to five minor mistakes or one major mistake	More than six minor mistakes and/or more than one major mistake

Name: _____

Date: _____

Period: _____

Laboratory Safety Rubric (1.5)

Scoring Criteria				
<i>The student does the following:</i>	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Uses safety equipment				
Selects appropriate PPE				
Wears protective clothing				
Uses ANSI-approved eye protection devices				
Demonstrates fire extinguisher operation				
<i>Subtotal for safety equipment</i>				
Maintains clean facility				
Performs safety inspections				
Keeps traffic area free of debris				
Stores materials properly				
<i>Subtotal for facility cleanliness</i>				
Models appropriate behavior				
Lists safety rules				
Observes safety rules				
Follows written directions				
Follows oral directions				
Plans work in advance				
Observes surroundings				
Maintains appropriate records				

Uses proper lifting techniques				
<i>Subtotal for appropriate behaviors</i>				
Observes safety signage				
Interprets color coding				
Understands safety symbols				
Observes safety zones				
Locates fire extinguishers				
Locates first aid supplies				
<i>Subtotal for safety signage</i>				
Selects and uses tools				
Identifies proper tools				
Uses proper tools				
Rejects unsafe tools				
Carries tools properly				
Cleans tools after use				
Replaces tools upon completion				
Observes electrical safety				
<i>Subtotal for tool selection</i>				
Exercises caution with hazardous chemicals				
Observes label precautions				
Handles chemicals properly				
Provides adequate ventilation				
<i>Subtotal for chemical safety</i>				
Summative Total				

Adapted from *Rubric Toolkit for Agricultural Science and Technology*, Texas A&M University Instructional Materials Service

Notes:

Name: _____

Date: _____

Period: _____

Interpret a Hazardous Material Safety Data Sheet Assignment (1.6)

Your instructor will furnish you with the name of a chemical that is commonly used in agricultural and natural resources occupations. You are to conduct a search of the Internet to locate a material safety data sheet (MSDS) for this material and use it to answer the following questions.

1. What is the Web address of the Internet site on which you found this information?
2. If you accidentally drank some of this material, what would be the first aid procedure you would do first?
3. What special precautions should be taken in storing this material?
4. What is the flash point of this material?
5. If you spilled a small amount of this product, how would you clean it up?
6. What immediate effects would likely happen if you spilled some of this material on your skin?

Name: _____
Date: _____
Period: _____

21st Century Life and Career Skills (2.1)

Today's life and work environments require far more than thinking skills and content knowledge. The ability to navigate the complex life and work environments in the globally competitive information age requires students to pay rigorous attention to developing adequate life and career skills.

CSS1-21st Century Themes

CS1 Global Awareness

1. Using 21st century skills to understand and address global issues
2. Learning from and working collaboratively with individuals representing diverse cultures, religions, and lifestyles in a spirit of mutual respect and open dialogue in personal, work, and community contexts
3. Understanding other nations and cultures, including the use of non-English languages

CS2 Financial, Economic, Business, and Entrepreneurial Literacy

1. Knowing how to make appropriate personal economic choices
2. Understanding the role of the economy in society
3. Using entrepreneurial skills to enhance workplace productivity and career options

CS3 Civic Literacy

1. Participating effectively in civic life through knowing how to stay informed and understanding governmental processes
2. Exercising the rights and obligations of citizenship at local, state, national, and global levels
3. Understanding the local and global implications of civic decisions

CS4 Health Literacy

1. Obtaining, interpreting, and understanding basic health information and services and using such information and services in ways that enhance health
2. Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance, and stress reduction
3. Using available information to make appropriate health-related decisions
4. Establishing and monitoring personal and family health goals
5. Understanding national and international public health and safety issues

CS5 Environmental Literacy

1. Demonstrating knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water, and ecosystems
2. Demonstrating knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.)
3. Investigating and analyzing environmental issues and making accurate conclusions about effective solutions
4. Taking individual and collective action toward addressing environmental challenges (e.g., participating in global actions and designing solutions that inspire action on environmental issues)

CSS2-Learning and Innovation Skills

CS6 Creativity and Innovation

1. Think Creatively
2. Work Creatively with Others
3. Implement Innovations

CS7 Critical Thinking and Problem Solving

1. Reason Effectively
2. Use Systems Thinking
3. Make Judgments and Decisions
4. Solve Problems

CS8 Communication and Collaboration

1. Communicate Clearly
2. Collaborate with Others

CSS3-Information, Media, and Technology Skills

CS9 Information Literacy

1. Access and Evaluate Information
2. Use and Manage Information

CS10 Media Literacy

1. Analyze Media
2. Create Media Products

CS11 ICT Literacy

1. Apply Technology Effectively

CSS4-Life and Career Skills

CS12 Flexibility and Adaptability

1. Adapt to Change
2. Be Flexible

CS13 Initiative and Self-Direction

1. Manage Goals and Time
2. Work Independently
3. Be Self-Directed Learners

CS14 Social and Cross-Cultural Skills

1. Interact Effectively with Others
2. Work Effectively in Diverse Teams

CS15 Productivity and Accountability

1. Manage Projects
2. Produce Results

CS16 Leadership and Responsibility

1. Guide and Lead Others
2. Be Responsible to Others

Name: _____

Date: _____

Period: _____

21st Century Life and Career Skills Rubric (2.2)

The following scale can be used to assess application of each of the Life and Career Skills of students.

Superior	(18–20 points): The student consistently demonstrates all aspects of this skill in classroom and laboratory activities.
Exceptional	(15–17 points): The student consistently demonstrates most of the aspects of this skills in classroom and laboratory activities but lapses at times on one to two of the indicators.
Adequate	(12–14 points): The student demonstrates knowledge of the skill during classroom and laboratory activities but lapses on three or more indicators from time to time.
Improving	(9–11 points): The student is vaguely aware of the skill but shows only marginal evidence of being able to apply it in the classroom or laboratory.
Minimal	(0–8 points): The student consistently fails to demonstrate knowledge or application of the skill.

**Flexibility and
Adaptability**

**Initiative and Self-
Direction**

**Social and Cross-Cultural
Skills**

**Productivity and
Accountability**

**Leadership and
Responsibility**

TOTAL SCORE

Name: _____

Date: _____

Period: _____

Rubric for Assessing Team-Building and Participation Skills (2.3)

<i>The student does the following:</i>	Excellent	Good	Needs Improvement	Unacceptable
	4	3	2	1
Actively participates in team discussions and activities				
Encourages other team members to participate in discussions and activities				
Works with other members to keep the activity on schedule and task				
Shares ideas and thoughts				
Offers constructive recommendations				
Credits others for their contributions and ideas				
Empathizes with other members				
Requests input from others to reach an agreement				
Expresses ideas and thoughts				
Actively listens to other team members				

Notes:

Name: _____
Date: _____
Period: _____

Scorecard for Assessing Parliamentary Procedure Skills (2.4)

Sample Scorecard for Parliamentary Procedure Demonstration

Required motion	5
Discussion (maximum of 5 debates @ 2 pts each)	10
Additional motion (includes main or alternate main motion)	5
Chair	10
Ability to preside	5
Leadership	10
Team's general effect	15
Conclusions reached by team (team's use of motions and discussion support disposal of the main motion)	10
Team effect (degree to which discussion was convincing, logical, realistic, orderly, and efficient)	10
Team's voice, poise, expression, and appearance	5
Completeness and accuracy	5
Format	5
Grammar, style, and legibility	5
SUBTOTAL	100
Deductions for parliamentary mistakes (5 pts for a minor mistake; up to 20 points for a major mistake)	5–20
Deductions for omitting assigned motion	10
TOTAL	

Adapted from FFA CDE Handbook

Name: _____

Date: _____

Period: _____

Select a Personal/Leadership Activity Assignment (2.5)

Which activity did you select?

Why did you select this activity?

When will this activity take place?

What skills and knowledge will you have to learn in order to be successful in this activity?

How will this activity contribute to your personal development and leadership ability?

Name: _____

Date: _____

Period: _____

Leadership Characteristics Survey (2.6)

Rate your leadership ability using the following characteristics. A 5 indicates a high level of this characteristic, and a 1 indicates a low level.

1. Honesty/Integrity – Personally holding a high moral standard and expressing the truth
2. Visionary/Forward looking – The ability see clearly into the future and communicate this vision to others
3. Competence – Knowledge of the organization, its goals, strengths, and limitations
4. Inspiring – The ability to get other people excited about your ideas and plans
5. Intelligence – The ability to locate knowledge and apply it to the current situation
6. Dedication/Commitment – The ability to concentrate and keep on, even if the situation is difficult
7. Openness – The ability to freely express your thoughts and to listen to the thoughts of others
8. Humility – A feeling that as a leader you are no more important than anyone else
9. Willingness to share – The ability to give credit for success to others
10. Fair and equitable – The ability to make decisions and treat other people fairly

What can you do to improve your three weakest indicators?

Name: _____

Date: _____

Period: _____

Sample Rubric for Evaluating Work Ethics and Values (2.7)

<i>Behavior/Skill</i>	Excellent	Good	Needs Improvement	Unacceptable
	4	3	2	1
Punctuality (arrives on time)				
Preparation (completes pre-assignments and brings necessary materials)				
Respects other students/workers				
Listens to supervisor and follows directions				
Accepts responsibility for actions				
Demonstrates positive personality traits (kindness, trustworthiness, and honesty)				
Demonstrates productivity (patience, thoroughness, and hardworking)				
Demonstrates a concern for others				
Remains on task and allows others to remain on task				
Takes initiative as appropriate				

Name: _____

Date: _____

Period: _____

Rubric for Experiential Learning Planning and Record Keeping (3.1)

Scoring Criteria				
	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Long-range and short-term goals reflect the educational and career goals of the student.				
The SAE plan/training agreement reflects growth in student skill and proficiency.				
Records accurately reflect all SAE accomplishments of the student over the year.				
Records are maintained on a timely basis.				
Journals or calendars are maintained on a timely basis and serve as the source for recordkeeping.				
Hours and earnings are recorded based on activities.				
A summary of all activities is provided at the end of each grading period.				
Financial records are maintained accurately.				
Financial records are summarized at the end of the year.				

Name: _____

Date: _____

Period: _____

Experiential Learning Scavenger Hunt (3.2)

Use the FFA SAE Best Practices Guide (<http://www.ffa.org/documents/lpsguide.pdf>) to find the answers to the following questions:

1. Find the name of the agency that sponsored an SAE for a student in Food Science Quality Assurance.
2. Find three things that the student who worked in a veterinary hospital learned.
3. Find the name of the career cluster for an SAE involving scouting field crops.
4. Find the species of trees that a student planted as part of a holiday tree or plant growing SAE.
5. Find how a student who planted a community garden paid for 50% of the cost of the garden.
6. Find how a student who had an SAE raising mice and gerbils solved the problem of space to grow the animals.
7. Find the SAE type for an SAE in which the student worked at a USDA research center conducting complex experiments with DNA.
8. Find the names of the two jobs held by the student who worked at a park riding stable.
9. Find how much the initial cost was for the student who started his or her own horseshoeing business.
10. Find the name of the breeds of goats that a student used in an SAE project involving dairy goats.

Name: _____
Date: _____
Period: _____

Experiential Learning Goals and Plans (3.3)

For School Year 20__ – 20__

Student Name: *(Enter student name here.)*

Student Home Address: *(Enter mailing address, city, state, and zip here.)*

Agriculture Education Course Enrolled In: *(Enter course name here.)*

Grade in School: *(Enter grade.)*

My long-range goal is to:

(Enter long-range goal here.)

My short-range goals are to:

- *(Enter short-range goal #1 here.)*
- *(Enter short-range goal #2 here. Additional short-range goals may be added.)*

For my Supervised Agricultural Experience program for the school year 20__ – 20__ I plan to engage in the following enterprises and activities: *(Check all that apply.)*

- ____ Exploratory
- ____ Research/Experimentation and Analysis
- ____ Ownership/Entrepreneurship
- ____ Placement
- ____ Supplementary Practice(s)
- ____ Improvement Practice(s)

(For each activity or enterprise planned, write a description that includes the name of the enterprise, the nature of the enterprise, number of hours worked, resources required, and expenses and income.)

Name of Enterprise/Activity: *(Enter the name of the enterprise or activity here.)*

Nature of Enterprise/Activity: *(Enter a description of the nature of the enterprise.)*

Scope of Enterprise/Activity: *(Enter a description of the scope of the enterprise, including hours involved, number of units, etc.)*

Resources Required: *(Enter resources, materials, tools, and so forth that will be required to complete the enterprise.)*

Estimated Expenses and Income: *(Enter estimated expenses and income from the enterprise if applicable.)*

Skills to Be Learned: *(Enter a listing of major skills to be learned through the enterprise or activity here.)*

Responsibilities of Parties: *(Enter responsibilities of all parties involved in the enterprise or activity here.)*

- Student: *(Enter student responsibilities here.)*
- Parent: *(Enter parent responsibilities here.)*
- Employer/Supervisor/Mentor: *(Enter employer/supervisor/mentor responsibilities here.)*

Signatures:

Student

Date

Instructor

Date

Parent

Date

Employer/Supervisor/Mentor

Date

Name: _____

Date: _____

Period: _____

Sample Experiential Learning Plan Rubric (3.4)

Occupational Goals	Detailed long-range and short-term goals are identified for reaching an occupational goal in the field of agriculture, food, and natural resources occupations are provided.	General long-range and short-term goals for reaching an occupational goal in the field of agriculture, food, and natural resources occupations are provided.	General long-range and short-term goals for reaching an occupational objective in fields outside of agriculture, food, and natural resources occupations are provided.	Only vague general statements concerning any occupational goal are provided.
Enterprise/ Activity Description	A detailed description of the nature and scope, resources, income and expenses, skills, and responsibilities is provided.	A general description of the nature and scope, resources, income and expenses, skills, and responsibilities is provided.	A limited description of the nature and scope, resources, income and expenses, skills, and responsibilities is provided.	A very limited description of the nature and scope, resources, income and expenses, skills, and responsibilities is provided. Some elements that would apply are not covered.
Responsibilities	Responsibilities of all parties are detailed and complete. Quantifiable indicators are defined.	Responsibilities of all parties are detailed, and general indicators of performance are listed.	Responsibilities of all parties are stated in broad general terms.	Responsibilities of some applicable parties are not listed.

Name: _____

Date: _____

Period: _____

Experiential Learning Record Book Rubric (3.5)

Income and Expense Records	Detailed records of income and expenses are kept in an accurate and timely manner.	Records of income and expenses are accurately kept, but there may be lapses in time.	Records of income and expenses are accurate, but specific details may be missing.	Records of income and expenses are kept but in an inaccurate manner.
Inventory	Detailed inventories of all assets are kept in an accurate and timely manner.	An accurate inventory is kept, but there may be lapses in entries.	An inventory of major equipment is kept and maintained, but inventories of materials and supplies are not present.	A very limited inventory is kept, or there are major inaccuracies in the inventory.
Calendar/Journal	A detailed calendar or journal of activities is kept in an accurate and timely manner.	A calendar or journal is kept in a timely manner describing activities in general associated with the SAE.	A calendar or journal of activities is kept, but there may be slight lapses in time.	The calendar or journal of activities lacks detail or has large lapses of time.
Other Records	All other records that apply to the specific SAE are kept in a detailed, accurate, and timely manner.	All other records are kept in an accurate and timely manner describing general activities.	Other records are kept in a timely manner but may reflect minor inaccuracies or lapses of time.	Other records are not complete or kept in an accurate and timely manner.

Name: _____

Date: _____

Period: _____

Domesticated Animals Benefits (4.1)

Based on your readings, identify the different classes of domesticated animals, name at least three species in each class, and describe at least one benefit of the class to humanity.

Name: _____
Date: _____
Period: _____

Letter of Concern Regarding Production Practices (4.2)

Using the letter shown below, write a letter of response that states the positive benefits of the practices detailed.

To: Brown County Farmers Association

From: Citizens Against Cruelty to Animals (CACA)

Subject: Statements of Concern about Local Production Practices

We the members of the Citizens Against Cruelty to Animals (CACTA) are concerned about the treatment of animals on your members' farms and ranches. Specifically, we are concerned about the following practices:

- Castration of young bull calves and piglets
- Branding of any animal using hot or cold irons
- Dehorning of cattle and calves
- Close confinement of chickens
- Use of any medication or drugs on animal health

We ask that you inform your members of these concerns and adopt a resolution that prohibits any member from following these practices. We feel that all animals have the right to exist with humans in a free and natural state.

Name: _____

Date: _____

Period: _____

Sample Rubric for Evaluating a Response to a Letter of Concern (4.3)

	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Information and Content	Accurate and detailed in documenting why practices are necessary	Information provided is accurate.	Information provided is accurate but needs to be more detailed.	Information is inaccurate and lacks meaningful detail.
Organization	Letter is well organized and logical.	Letter is organized.	Letter has some organization.	Letter is not organized.
Style and Tone	Letter is positive, courteous, and interesting to read.	Letter responds to concerns with facts.	Letter responds to concerns but shows some negative emotions.	Letter is very emotional, discourteous, or lacks facts related to concerns.
Grammar, Spelling, and Punctuation	No mistakes are present in grammar, spelling, and punctuation.	Only one to two minor mistakes are present.	Only three to four minor mistakes are present.	A major mistake is present.
Layout/Design	Letter follows established rules for business letter format.	Letter follows rules with only one to two minor exceptions.	Design is unattractive and only partially follows format.	Letter does not follow format.

Name: _____

Date: _____

Period: _____

Major Animal Body Systems, Components, and Functions (4.4)

Complete the following table using the information found in your module and in the textbook.

Name: _____

Date: _____

Period: _____

Worksheet on Basic Principles of Heredity and Genetics (4.5)

1. The passing of a trait or characteristic of a parent animal to an offspring is called _____.
2. What percent of an animal's characteristics comes from the father? _____%
3. All of the characteristics of an animal are determined by a complex set of molecules, genes, and nucleotides called _____.
4. A specific trait in an animal such as eye or skin color is determined by a unit of DNA called a _____.
5. A pair of genes that produce the same trait is _____, while a pair of genes that can produce different traits is _____.
6. As an embryo develops, the cells begin to change into specialized cells that form muscle, bone, nerves, and other tissues. This process is called _____.
7. If a producer were interested in producing calves that were naturally hornless, what type of bull should be used? _____
8. Describe how a recessive gene can be used to obtain a specific trait in a breed of animal.
9. If you mate a homozygous (PP) bull to a heterozygous (Pp) cow, what are the resulting genotypes? (P=polled; p=horned) _____
10. If you mate a homozygous (PP) bull to a heterozygous (Pp) cow, what percentage of the calves would be polled? (P=polled; p=horned) _____

Name: _____

Date: _____

Period: _____

Anatomical Comparison Assignment (4.6)

Compare the anatomical features of a catfish, poultry, and mammals using the chart below. Show how each species is alike and how each differs.

Skeleton and Skin

Respiratory System

Digestive System

Reproduction System

Name: _____

Date: _____

Period: _____

Select an Appropriate Nutritional Practice (4.8)

For each of the scenarios below, select the most appropriate practice, and state why you selected it.

- You have a small 2-acre pond stocked with catfish weighing about 1/2 lb each. It is in the summer, and the water temperature is 75° F. Which of the following practices would be most appropriate?
 - a. Feed sinking feed using a demand feeder.
 - b. Feed floating feed using a blower type feeder.
 - c. Feed meal using a blower type feeder.
 - d. Feed floating feed by hand.

Justify your answer in the space below:

- You have a large 20-acre pond stocked with catfish weighing about 1 lb each. It is in the winter time, and the water temperature is at 52° F. Which of the following practices would be most appropriate?
 - a. Feed sinking feed by hand.
 - b. Feed sinking feed using a blower type feeder.
 - c. Feed meal using a blower type feeder.
 - d. Feed floating feed by hand.

Justify your answer in the space below:

- You have a large 20-acre pond stocked with catfish weighing about 1 lb each. It is in the summer time, and the water temperature is at 76° F. Which of the following practices would be most appropriate?
 - a. Feed sinking feed by hand.
 - b. Feed sinking feed using a demand type feeder.
 - c. Feed floating feed using a blower type feeder.
 - d. Feed floating feed by hand.

Justify your answer in the space below:

Note: This is a supplemental worksheet based on regional instructional needs.

Name: _____

Date: _____

Period: _____

Calculate Feed Rates (4.9)

Using the information shown in the scenarios below, calculate the feed rate for each situation.

Scenario 1

- Total weight of fish in pond = 7,500 lb
- Feed rate = 2.5% of total weight

Daily feeding rate = _____ lb

Scenario 2

- Total estimated number of fish in pond = 15,000
- Average weight = 1 lb
- Feed rate = 3.0% of total weight

Daily feeding rate = _____ lb

Scenario 3

- Total estimated number of fish in pond = 25,000
- Average weight = 3/4 lb
- Feed rate = 2.5% of total weight

Daily feeding rate = _____ lb

Note: This is a supplemental worksheet based on regional instructional needs.

Name: _____

Date: _____

Period: _____

Rubric for Evaluating Student Chart on Plant Parts and Functions (5.1)

Rate each factor below using the following scale:

5 – Excellent (100%)

4 – Very Good (90–99%)

3 – Good (80–89%)

2 – Acceptable (70–79%)

1 – Needs Improvement (<70%)

- _____ 1. Drew a diagram of a plant and labeled the four major parts (roots, stem, leaves, and flowers)
- _____ 2. Described structure and function of roots
- _____ 3. Described structure and function of stems
- _____ 4. Described structure and function of leaves
- _____ 5. Described structure and function of complete flowers

Name: _____

Date: _____

Period: _____

Chart for Comparing Photosynthesis, Respiration, and Transpiration (5.2)

For each process, identify or describe the following:

Inputs

Outputs

Lighting

Contributing Factors

Primary Difference

Name: _____

Date: _____

Period: _____

Plant Nutrient Chart (5.3)

Enter the element name for each essential nutrient, the chemical symbol, type, and deficiency symptoms.

(O=Organic, P = Primary, S = Secondary, M = Micronutrient)

Name: _____

Date: _____

Period: _____

Seed Germination (5.4)

1. You are planning on raising tomato bedding plants from a packet of seed that has an 85% germination rate. You plant one seed per container for 100 containers, and only 60 seeds emerge. What are three factors that could have caused this decrease in germination?
 - a. _____
 - b. _____
 - c. _____
2. You want to raise 50 cabbage bedding plants in Styrofoam cups. If the germination rate for cabbage seed is 50%, how many cups would you need to prepare to have 50 cups of bedding plants?

3. State three advantages of using seed for plant reproduction.

4. State the differences in scarification and stratification of seeds and the reasons why these processes are used.

Name: _____

Date: _____

Period: _____

Plant Growth (5.5)

Record your observations on plant growth on this sheet.

Date planted: _____ Number of seed planted: _____

Date first plants emerged: _____ Total number of plants that emerged: _____

Average height of plants after 5 days: _____

Average height of plants after 10 days: _____

Number of plants surviving after 10 days: _____

What factors could have contributed to the loss of plants during the growing period?

What factors could have improved the growth rate of plants over the growing period?

What important concepts or knowledge did you learn from this experiment?

Name: _____

Date: _____

Period: _____

Crop Production Plan (5.6)

1. What crop did you select for your plan? Why did you select this crop?
2. What type of climate is required for this crop? (Growing season, rainfall/water requirements, temperature range, etc.)
3. What soil conditions are needed to grow this crop? (Soil texture, depth, permeability, fertility, etc.)
4. What cultural practices will you use in growing this crop? (Seedbed preparation, planting method, fertilization and pest control, etc.)
5. How much labor will be required to grow this crop?
6. What machinery and equipment will be required to grow and harvest this crop?
7. What is the demand for this crop?
8. What is the expected yield for this crop?
9. What are the expected production costs of this crop?

10. When and how will this crop be harvested?
11. How will this crop be marketed?
12. How much money will you make from this crop?

Note: This worksheet can be used for supplemental material.

Name: _____
Date: _____
Period: _____

Rubric for Evaluating Crop Production Plan Assignment (5.7)

Evaluate each of the questions for the Crop Production Plan Assignment using the following scale: 5 – Excellent (contains detailed accurate and complete information); 4 – Very Good (contains information that is accurate and complete but general in nature); 3 – Good (very general in nature with some minor inaccuracies or incomplete items); 2 – Marginal (has limited information but is still mostly accurate and complete); and 1 – Unacceptable (very limited or no information with major inaccuracies).

Note: This worksheet can be used for supplemental material.

Name: _____

Date: _____

Period: _____

Plant Pests and the Damage They Cause (5.8)

Name: _____
Date: _____
Period: _____

Survey of Horticultural Enterprises (5.9)

List the name, location, and nature of horticultural enterprises in your community.

Name: _____

Date: _____

Period: _____

Greenhouse Environmental Control Assignment (5.10)

Write a short paragraph that summarizes how the following environmental factors are controlled in a greenhouse:

Temperature (Heating and Cooling):

Light Intensity and Duration:

Moisture/Humidity:

Ventilation:

Name: _____

Date: _____

Period: _____

Using Scale in Horticultural Drawings (5.11)

Answer the following questions:

1. If a flower bed is to be 12 ft wide by 24 ft long, what would the dimensions of this bed on a drawing using a scale of $1" = 4'$?
2. A home site lot is 160 ft wide and 240 ft long. What would be the dimensions of a drawing of this lot on a drawing using a scale of $1" = 20'$?
3. An area to be sodded is 60 ft wide and 180 ft long. What would be the dimensions of this area using a scale of $1" = 20'$?
4. A flower bed has dimensions of 2 in. in width and 6 in. in length on a drawing using a scale of $1" = 5'$. What would be the actual dimensions of the bed?
5. The backyard of a lot has dimensions of 4 in. in width and 8 in. in length using a scale of $1" = 20'$. What would be the actual dimensions of the yard?

Note: This worksheet can be used for supplemental material.

Name: _____

Date: _____

Period: _____

Checklist for Evaluating a Sketch of a Land Plot (5.12)

Place a check by each step that was accomplished in completing this exercise.

- _____ 1. The student provided a title block containing a description of the plot and the student's name.
- _____ 2. The sketch included prominent features of the plot, including changes in soil surface texture, slope, and major landmarks.
- _____ 3. The student marked 10 random spots where soil should be sampled for small plots (< 1 acre) or 20 random spots where soil should be sampled for large areas.

Name: _____

Date: _____

Period: _____

Checklist for Soil Sample Collection and Preparation (5.13)

Place a check by each step that the student successfully completed.

- _____ 1. The student collected samples at the proper depth (4–6 in.) according to the sketch that was prepared.
- _____ 2. The student allowed the samples to dry and then crushed and mixed them together.
- _____ 3. The student packages a 1-pt box of the mixed samples and correctly labeled it for soil testing.
- _____ 4. The student completely and accurately filled out the Soil Sample Information Sheet for submission to the MSU Soil Testing Laboratory.

Name: _____

Date: _____

Period: _____

Preservation versus Conservation Essay Rubric (6.1)

Evaluate the student's essay on conservation versus preservation using the following rubric indicators and scale:

Writing Quality	There is a strong writing style and ability to express concepts learned. Excellent spelling, grammar, syntax, spelling, and so forth	There are a good writing style and ability to express concepts learned. Very good grammar, syntax, spelling, and so forth	There is a writing style that conveys meaning adequately. Some minor grammatical, syntax, and spelling errors	There is difficulty in expressing concepts. There is limited syntax. There are noticeable grammatical and spelling mistakes.
Content	A clear and complete comparison and contrast of the issues is presented. All major points are covered in detail.	A very good comparison of the issue is recorded. Most major points are documented.	A good comparison of the issue is recorded. Some major points have been omitted.	Limited comparison of the issue is recorded. Very few major points are documented.
Insight and Understanding	Definite insights into the implications of the issue are recorded. Awareness of complexity of issues and situations is present.	Some insight into the issue is recorded. Some sense of complexity is present.	Insight is present from a more simplistic standpoint.	Only limited insight into the issue is recorded.
Application	Content of the essay is connected to the student's personal life and goals.	Content of the essay is connected to the field of agriculture.	Content of the essay is related to life in general.	Only limited connections are made between the content of the essay and the surrounding world.
Total Score:				

Name: _____

Date: _____

Period: _____

Exhaustible or Non-Exhaustible (6.2)

Classify each of the following natural resources as being exhaustible, non-exhaustible, or renewable. Write a one- to two-sentence statement that explains your reason for your selection.

Soil

Fish and Wildlife

Coal

Forests

Surface Water

Iron Ore

Air

Ethanol

Petroleum

Sunlight

Name: _____

Date: _____

Period: _____

Checklist for Desalinization Laboratory Exercise (6.3)

Place a check by each step or indicator that the student successfully completed.

- _____ 1. The student mixed the saline solution and added to the flask following the instructions.
- _____ 2. The student assembled the apparatus according to the instructions.
- _____ 3. The student lit the burner and boiled the water for 10 minutes.
- _____ 4. The student collected the distilled water and measured its amount.
- _____ 5. The student observed all safety rules and procedures at all times.
- _____ 6. The student disassembled the apparatus and stored it according to instructions.

Name: _____

Date: _____

Period: _____

Alternative Energy Essay Rubric (6.4)

Content	A clear and complete description of the major alternative energy sources is presented. All major points for each source are covered in detail.	A clear and complete description of the major alternative energy sources is presented. Most major points for each source are covered in detail.	A clear description of the major alternative energy sources is presented. Some major points for each source are not covered in detail.	A vague description of some of the major alternative energy sources is presented. Specific details are not covered.
Writing Quality	There is a strong writing style and ability to express concepts learned. Excellent spelling, grammar, syntax, spelling, and so forth	There is a good writing style and ability to express concepts learned. Very good grammar, syntax, spelling, and so forth	There is a writing style that conveys meaning adequately. Some minor grammatical, syntax, and spelling errors	There is difficulty in expressing concepts. There is limited syntax. There are noticeable grammatical and spelling mistakes.
Insight and Understanding	Definite insights into the implications of alternative energy are recorded.	Some insight into alternative energy is recorded.	Insight is present from a more simplistic standpoint.	Only limited insight into alternative energy is recorded.
Application	A detailed discussion of the applicability of each source of alternative energy to the local community is included.	A general discussion of the applicability of each source of alternative energy to the local community is included.	Discussion of the applicability of alternative energy sources to the state is included.	Only limited connections are made between alternative energy sources and the surrounding community.
Total Score:				

Name: _____

Date: _____

Period: _____

Types of Waste and Waste Products (6.5)

Sewage

Solid Waste

Poisonous Materials

Name: _____

Date: _____

Period: _____

Wood Products and Characteristics Assignment (6.6)

Classify each of the common types of wood below as hardwood or softwood, describe their main characteristics, and identify their most common uses.

White Oak

Yellow Pine

Ash

Hickory

Sweetgum

Red Oak

Red Cedar

Name: _____
Date: _____
Period: _____

Reforestation Exercise Scenario (6.7)

Janet Ray has a 40-acre tract of timber that is about to be harvested. The land is covered in mostly pine and some oak with most of the trees being 10–16 in. in diameter. After the timber is harvested, she wants to get a new stand of hardwood trees growing as quickly as possible. Your assignment is to write Ms. Ray a letter describing the three most common methods of reforestation and listing the advantages and disadvantages of each method. You should conclude the letter with a recommendation that will allow the land to begin growing trees again as quickly as possible. Ms. Ray's address is Janet Ray, 1333 Smith Road, Clark, MS 39777.

Name: _____

Date: _____

Period: _____

Reforestation Exercise Rubric (6.8)

Layout/Design	Creatively designed, easily read, excellent business letter	Attractive, easy to read, good business letter	Appears busy or boring, difficult to read, needs improvement	Unattractive or inappropriate, very difficult to read, not acceptable
Content Information	Information is accurate and complete, very well written, and presented.	Well written and interesting to read	Some information is provided but is limited or inaccurate.	Poorly written, inaccurate, or incomplete
Format	Complete with all required parts	Some elements may be missing.	Most elements are missing or out of place.	Proper form for a letter is not used.
Grammar, Punctuation, and Wording	Excellent presentation, style, grammar, and punctuation	Fair presentation, style, grammar, and punctuation	Missing information, inaccurate punctuation, and/or grammar	Grammar, punctuation, and wording poor
Recommendation	Recommendations are based on advantages stated in the letter and reflect industry practices.	Recommendations are based on advantages stated in letter.	Recommendations are not fully based on the content of the letter.	Recommendation is not based on content and is incorrect.

Name: _____

Date: _____

Period: _____

Forest Insect Pests, Damage, and Control Assignment (6.9)

For each class of forest pest, list one example and trees affected by the pest, describe the damage it causes, and summarize control measures.

**Boring
Insects**

**Leaf-
Feeding
Insects**

**Sucking
Insects**

**Gall Insects
and Mites**

Fungi

Bacteria

**Parasitic
Plants**

Viruses

Name: _____

Date: _____

Period: _____

Rubric for Evaluation of Water Quality Exercise (6.10)

Safety	25
• Personal safety (glasses, clothing, etc.) • Safe use of tool • Safely performs the task • Handles and disposes of hazardous materials properly	
Performance of the Task	50
• Follows the task instructions • Performs the task efficiently • Performs the task satisfactorily • Records data accurately and correctly	
Lab Maintenance	25
• Area cleanup (clean and tidy) • Area organization (before, during, and after the task)	
Total	100

Comments for deductions:

Name: _____

Date: _____

Period: _____

Land Capability Classification Chart (6.11)

Identify the distinguishing factors for each of the eight land capability classes.

I

II

III

IV

V

VI

VII

VIII

Name: _____

Date: _____

Period: _____

Installing Electrical Devices and Circuits Rubric (7.1)

Use the following scale to rate the student's ability to perform each task: 5 – Performs task consistently without need for oversight or direction, 4 – Performs task consistently with minimum oversight or direction, 3 – Performs tasks but requires a moderate amount of oversight or direction, 2 – Performs task with constant oversight or direction, and 1 – Cannot perform task.

1. Uses proper safety precautions, devices, and clothing
2. Uses the proper tool for the job in a safe and correct manner
3. Shares duties and responsibilities with his or her teammate
4. Uses time efficiently and stays on task
5. Installs electrical ground correctly and safely
6. Prepares cable for connection to devices
7. Attaches devices using proper procedure
8. Installs circuit breaker
9. Installs 120 and 240 outlets
10. Splices wires correctly
11. Installs a receptacle, single pole switch, and junction box
12. Tests circuits for ground and current

Total Score:

Name: _____

Date: _____

Period: _____

Advantages and Disadvantages of Different Types of Pipe (7.2)

Name: _____

Date: _____

Period: _____

Selecting Pipe Fittings (7.3)

Answer each question by writing the name of the fitting and drawing a diagram showing how it is used.

1. What type of fitting would you use to connect two pieces of pipe in a straight line?
2. What type of fitting would you use to connect two pieces of pipe at a 90° angle?
3. What fitting would you use to connect two pieces of pipe so that they could be easily disconnected later?
4. Which fitting would you use to connect a 3/4-in. diameter pipe to a 1/2-in. diameter pipe?
5. Which fitting would you use to join three pieces of pipe?
6. Which valve would be most suitable for use in a location where you wanted to turn the flow of water or gas on and off with one 90° turn?
7. Which valve is most commonly used on faucets to allow for a gradual increase or decrease in flow?
8. Which valve is used to prevent the flow of water or gas from going in the wrong direction?

Appendix B: 21st Century Skills Standards¹

CSS1-21st Century Themes

CS1 Global Awareness

1. Using 21st century skills to understand and address global issues
2. Learning from and working collaboratively with individuals representing diverse cultures, religions, and lifestyles in a spirit of mutual respect and open dialogue in personal, work, and community contexts
3. Understanding other nations and cultures, including the use of non-English languages

CS2 Financial, Economic, Business, and Entrepreneurial Literacy

1. Knowing how to make appropriate personal economic choices
2. Understanding the role of the economy in society
3. Using entrepreneurial skills to enhance workplace productivity and career options

CS3 Civic Literacy

1. Participating effectively in civic life through knowing how to stay informed and understanding governmental processes
2. Exercising the rights and obligations of citizenship at local, state, national, and global levels
3. Understanding the local and global implications of civic decisions

CS4 Health Literacy

1. Obtaining, interpreting, and understanding basic health information and services and using such information and services in ways that enhance health
2. Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance, and stress reduction
3. Using available information to make appropriate health-related decisions
4. Establishing and monitoring personal and family health goals
5. Understanding national and international public health and safety issues

CS5 Environmental Literacy

1. Demonstrating knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water, and ecosystems
2. Demonstrating knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.)
3. Investigating and analyzing environmental issues and making accurate conclusions about effective solutions
4. Taking individual and collective action toward addressing environmental challenges (e.g., participating in global actions and designing solutions that inspire action on environmental issues)

CSS2-Learning and Innovation Skills

CS6 Creativity and Innovation

1. Think Creatively
2. Work Creatively with Others
3. Implement Innovations

CS7 Critical Thinking and Problem Solving

1. Reason Effectively
2. Use Systems Thinking
3. Make Judgments and Decisions
4. Solve Problems

CS8 Communication and Collaboration

1. Communicate Clearly
2. Collaborate with Others

¹ *21st century skills*. (n.d.). Washington, DC: Partnership for 21st Century Skills.

CSS3-Information, Media, and Technology Skills

CS9 Information Literacy

1. Access and Evaluate Information
2. Use and Manage Information

CS10 Media Literacy

1. Analyze Media
2. Create Media Products

CS11 ICT Literacy

1. Apply Technology Effectively

CSS4-Life and Career Skills

CS12 Flexibility and Adaptability

1. Adapt to Change
2. Be Flexible

CS13 Initiative and Self-Direction

1. Manage Goals and Time
2. Work Independently
3. Be Self-Directed Learners

CS14 Social and Cross-Cultural Skills

1. Interact Effectively with Others
2. Work Effectively in Diverse Teams

CS15 Productivity and Accountability

1. Manage Projects
2. Produce Results

CS16 Leadership and Responsibility

1. Guide and Lead Others
2. Be Responsible to Others

Appendix C: Mississippi Academic Standards

MISSISSIPPI SCIENCE FRAMEWORK COMPETENCIES

Marine and Aquatic Science

- AQ 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
AQ 2 Develop an understanding of physical and chemical properties of water and aquatic environments.
AQ 3 Apply an understanding of the diverse organisms found in aquatic environments.
AQ 4 Draw conclusions about the relationships between human activity and aquatic organisms.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
 - a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, and so forth
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
 - b. Formulate questions that can be answered through research and experimental design. (DOK 3)
 - c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, and theory development). (DOK 3)
 - d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, and creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
 - e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
 - g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
2. **Develop an understanding of physical and chemical properties of water and aquatic environments.**
 - a. Analyze the physical and chemical properties of water, and justify why it is essential to living organisms. (DOK 1)
 - b. Explain the causes and characteristics of tides. (DOK 1)
 - c. Research, create diagrams, and summarize principles related to waves and current characteristics and formation. (DOK 2)
 - d. Compare and contrast the physical and chemical parameters of dissolved O₂, pH, temperature, salinity, and results obtained through analysis of different water column depths/zones. (DOK 2)
 - e. Investigate the causes and effects of erosion, and discuss conclusions. (DOK 2)
 - f. Describe and differentiate among the major geologic features of specific aquatic environments. (DOK 1)
 - Plate tectonics
 - Rise, slope, elevation, and depth
 - Formation of dunes, reefs, barrier/volcanic islands, and coastal/flood plains
 - Watershed formation as it relates to bodies of freshwater
 - g. Compare and contrast the unique abiotic and biotic characteristics of selected aquatic ecosystems. (DOK 2)
 - Barrier island, coral reef, tidal pool, and ocean
 - River, stream, lake, pond, and swamp
 - Bay, sound, estuary, and marsh
3. **Apply an understanding of the diverse organisms found in aquatic environments.**
 - a. Analyze and explain the diversity and interactions among aquatic life. (DOK 3)
 - Adaptations of representative organisms for their aquatic environments

- Relationship of organisms in food chains/webs within aquatic environments
- b. Research, calculate, and interpret population data. (DOK 2)
- c. Research and compare reproductive processes in aquatic organisms. (DOK 2)
- d. Differentiate among characteristics of planktonic, nektonic, and benthic organisms. (DOK 1)
- e. Explore the taxonomy of aquatic organisms, and use dichotomous keys to differentiate among the organisms. (DOK 2)
- f. Research and explain the symbiotic relationships in aquatic ecosystems. (DOK 3)
- 4. **Draw conclusions about the relationships between human activity and aquatic organisms.**
 - a. Describe the impact of natural and human activity on aquatic ecosystems, and evaluate the effectiveness of various solutions to environmental problems. (DOK 3)
 - Sources of pollution in aquatic environments and methods to reduce the effects of the pollution
 - Effectiveness of a variety of methods of environmental management and stewardship
 - Effects of urbanization on aquatic ecosystems and the effects of continued expansion
 - b. Research and cite evidence of the effects of natural phenomena such as hurricanes, floods, or drought on aquatic habitats and organisms. (DOK 3)
 - c. Discuss the advantages and disadvantages involved in applications of modern technology in aquatic science. (DOK 2)
 - Careers related to aquatic science
 - Modern technology within aquatic science (e.g., mariculture and aquaculture)
 - Contributions of aquatic technology to industry and government

Biology I

BI01 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BI01 2	Describe the biochemical basis of life, and explain how energy flows within and between the living systems.
BI01 3	Investigate and evaluate the interaction between living organisms and their environment.
BI01 4	Analyze and explain the structures and function of the levels of biological organization.
BI01 5	Demonstrate an understanding of the molecular basis of heredity.
BI01 6	Demonstrate an understanding of principles that explain the diversity of life and biological evolution.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
 - a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, and so forth
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
 - d. Formulate questions that can be answered through research and experimental design. (DOK 3)
 - e. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 2)
 - f. Construct and analyze graphs (e.g., plotting points, labeling x- and y-axis, and creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
 - g. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - h. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
 - i. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
2. **Describe the biochemical basis of life, and explain how energy flows within and between the living systems.**
 - a. Explain and compare with the use of examples the types of bond formation (e.g., covalent, ionic, hydrogen, etc.) between or among atoms. (DOK 2)
 - Subatomic particles and arrangement in atoms

- Importance of ions in biological processes
 - b. Develop a logical argument defending water as an essential component of living systems (e.g., unique bonding and properties including polarity, high specific heat, surface tension, hydrogen bonding, adhesion, cohesion, and expansion upon freezing). (DOK 2)
 - c. Classify solutions as acidic, basic, or neutral, and relate the significance of the pH scale to an organism's survival (e.g., consequences of having different concentrations of hydrogen and hydroxide ions). (DOK 2)
 - d. Compare and contrast the structure, properties, and principle functions of carbohydrates, lipids, proteins, and nucleic acids in living organisms. (DOK 2)
 - Basic chemical composition of each group
 - Building components of each group (e.g., amino acids, monosaccharides, nucleotides, etc.)
 - Basic functions (e.g., energy, storage, cellular, and heredity) of each group
 - e. Examine the life processes to conclude the role enzymes play in regulating biochemical reactions. (DOK 2)
 - Enzyme structure
 - Enzyme function, including enzyme-substrate specificity and factors that affect enzyme function (pH and temperature)
 - f. Describe the role of adenosine triphosphate (ATP) in making energy available to cells. (DOK 1)
 - ATP structure
 - ATP function
 - g. Analyze and explain the biochemical process of photosynthesis and cellular respiration, and draw conclusions about the roles of the reactant and products in each. (DOK 3)
 - Photosynthesis and respiration (reactants and products)
 - Light-dependent reactions and light-independent reactions in photosynthesis, including requirements and products of each
 - Aerobic and anaerobic processes in cellular respiration, including products each and energy differences
3. **Investigate and evaluate the interaction between living organisms and their environment.**
- a. Compare and contrast the characteristics of the world's major biomes (e.g., deserts, tundra, taiga, grassland, temperate forest, and tropical rainforest). (DOK 2)
 - Plant and animal species
 - Climate (temperature and rainfall)
 - Adaptations of organisms
 - b. Provide examples to justify the interdependence among environmental elements. (DOK 2)
 - Biotic and abiotic factors in an ecosystem (e.g., water, carbon, oxygen, mold, and leaves)
 - Energy flow in ecosystems (e.g., energy pyramids and photosynthetic organisms to herbivores, carnivores, and decomposers)
 - Roles of beneficial bacteria
 - Interrelationships of organisms (e.g., cooperation, predation, parasitism, commensalism, symbiosis, and mutualism)
 - c. Examine and evaluate the significance of natural events and human activities on major ecosystems (e.g., succession, population growth, technology, loss of genetic diversity, and consumption of resources). (DOK 2)
4. **Analyze and explain the structures and function of the levels of biological organization.**
- a. Differentiate among plant and animal cells and eukaryotic and prokaryotic cells. (DOK 2)
 - Functions of all major cell organelles and structures (e.g., nucleus, mitochondrion, rough ER, smooth ER, ribosomes, Golgi bodies, vesicles, lysosomes, vacuoles, microtubules, microfilaments, chloroplast, cytoskeleton, centrioles, nucleolus, chromosomes, nuclear membrane, cell wall, cell membrane [active and passive transport], and cytosol)
 - Components of mobility (e.g., cilia, flagella, and pseudopodia)
 - b. Differentiate between types of cellular reproduction. (DOK 1)

- Main events in the cell cycle and cell mitosis (including differences in plant and animal cell divisions)
 - Binary fission (e.g., budding, vegetative propagation, etc.)
 - Significance of meiosis in sexual reproduction
 - Significance of crossing over
 - c. Describe and differentiate among the organizational levels of organisms (e.g., cells, tissues, organs, systems, and types of tissues.) (DOK 1)
 - d. Explain and describe how plant structures (vascular and nonvascular) and cellular functions are related to the survival of plants (e.g., movement of materials and plant reproduction). (DOK 1)
5. **Demonstrate an understanding of the molecular basis of heredity.**
- a. Analyze and explain the molecular basis of heredity and the inheritance of traits to successive generations by using the Central Dogma of Molecular Biology. (DOK 3)
 - Structures of DNA and RNA
 - Processes of replication, transcription, and translation
 - Messenger RNA codon charts
 - b. Utilize Mendel's laws to evaluate the results of monohybrid Punnett squares involving complete dominance, incomplete dominance, codominance, sex linked, and multiple alleles (including outcome percentage of both genotypes and phenotypes). (DOK 2)
 - c. Examine inheritance patterns using current technology (e.g., pedigrees, karyotypes, and gel electrophoresis). (DOK 2)
 - d. Discuss the characteristics and implications of both chromosomal and gene mutations. (DOK 2)
 - Significance of nondisjunction, deletion, substitutions, translocation, and frame shift mutation in animals
 - Occurrence and significance of genetic disorders such as sickle cell anemia, Tay-Sachs disorder, cystic fibrosis, hemophilia, Down syndrome, and color blindness
6. **Demonstrate an understanding of principles that explain the diversity of life and biological evolution.**
- a. Draw conclusions about how organisms are classified into a hierarchy of groups and subgroups based on similarities that reflect their evolutionary relationships. (DOK 2)
 - Characteristics of the six kingdoms
 - Major levels in the hierarchy of taxa (e.g., kingdom, phylum/division, class, order, family, genus, and species)
 - Body plans (symmetry)
 - Methods of sexual reproduction (e.g., conjugation, fertilization, and pollination)
 - Methods of asexual reproduction (e.g., budding, binary fission, regeneration, and spore formation)
 - b. Critique data (e.g., comparative anatomy, Biogeography, molecular biology, fossil record, etc.) used by scientists (e.g., Redi, Needham, Spallanzani, and Pasteur) to develop an understanding of evolutionary processes and patterns. (DOK 3)
 - c. Research and summarize the contributions of scientists (including Darwin, Malthus, Wallace, Lamarck, and Lyell) whose work led to the development of the theory of evolution. (DOK 2)
 - d. Analyze and explain the roles of natural selection, including the mechanisms of speciation (e.g., mutations, adaptations, and geographic isolation) and applications of speciation (e.g., pesticide and antibiotic resistance). (DOK 3)
 - e. Differentiate among chemical evolution, organic evolution, and the evolutionary steps along the way to aerobic heterotrophs and photosynthetic autotrophs. (DOK 2)

Biology II

BIOII 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BIOII 2	Describe and contrast the structures, functions, and chemical processes of the cell.
BIOII 3	Investigate and discuss the molecular basis of heredity.
BIOII 4	Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.
BIOII 5	Develop an understanding of organism classification.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
- Clarify research questions, and design laboratory investigations. (DOK 3)
- Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, and theory development). (DOK 3)
- Organize data to construct graphs (e.g., plotting points, labeling x- and y-axis, and creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
- Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBLs, etc.). (DOK 3)

2. Describe and contrast the structures, functions, and chemical processes of the cell.

- Relate the structure and function of a selectively permeable membrane to its role in diffusion and osmosis. (DOK 2)
- Summarize how cell regulation controls and coordinates cell growth and division. (DOK 2)
- Analyze and describe the function of enzymes in biochemical reactions. (DOK 2)
 - The impact of enzymatic reactions on biochemical processes
 - Factors that affect enzyme function (e.g., pH, concentration, temperature, etc.)
- Differentiate between photosynthesis and cellular respiration. (DOK 2)
 - Cellular sites and major pathways of anaerobic and aerobic respiration (with reactants, products, and ATP per monosaccharide)
 - Cellular respiration with respect to the sites at which they take place, the reactions involved, and the energy input and output in each stage (e.g., glycolysis, Krebs cycle, and electron transport chain)
 - Pigments, absorption, reflection of light, and light-dependent and light-independent reactions of photosynthesis
 - Oxidation and reduction reactions

3. Investigate and discuss the molecular basis of heredity.

- Explain how the process of meiosis clarifies the mechanism underlying Mendel's conclusions about segregation and independent assortment on a molecular level. (DOK 1)
- Research and explain how major discoveries led to the determination of DNA structure. (DOK 2)
- Relate gene expression (e.g., replication, transcription, and translation) to protein structure and function. (DOK 2)
 - Translation of a messenger RNA strand into a protein
 - Processing by organelles so that the protein is appropriately packaged, labeled, and eventually exported by the cell
 - Messenger RNA codon charts to determine the effects of different types of mutations on amino acid sequence and protein structure (e.g., sickle cell anemia resulting from base substitution mutation)
 - Gene expression regulated in organisms so that specific proteins are synthesized only when they are needed by the cell (e.g., allowing cell specialization)
- Assess the potential implications of DNA technology with respect to its impact on society. (DOK 3)

- Modern DNA technologies (e.g., polymerase chain reaction (PCR), gene splicing, gel electrophoresis, transformation, and recombinant DNA) in agriculture, medicine, and forensics
- e. Develop a logical argument defending or refuting bioethical issues arising from applications of genetic technology (e.g., the human genome project, cloning, gene therapy, and stem cell research). (DOK 3)
- 4. **Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.**
 - a. Explain the history of life on earth, and infer how geological changes provide opportunities and constraints for biological evolution. (DOK 2)
 - Main periods of the geologic timetable of earth's history
 - Roles of catastrophic and gradualistic processes in shaping planet Earth
 - b. Provide support for the argument based upon evidence from anatomy, embryology, biochemistry, and paleontology that organisms descended with modification from common ancestry. (DOK 2)
 - c. Identify and provide supporting evidence for the evolutionary relationships among various organisms using phylogenetic trees and cladograms. (DOK 2)
 - d. Formulate a scientific explanation based on fossil records of ancient life forms, and describe how new species could originate as a result of geological isolation and reproductive isolation. (DOK 2)
 - e. Compare and contrast the basic types of selection (e.g., disruptive, stabilizing, directional, etc.). (DOK 2)
 - f. Cite examples to justify behaviors that have evolved through natural selection (e.g., migration, parental care, use of tools, etc.). (DOK 1)
 - g. Research and explain the contributions of 19th century scientists (e.g., Malthus, Wallace, Lyell, and Darwin) on the formulation of ideas about evolution. (DOK 2)
 - h. Develop a logical argument describing ways in which the influences of 20th century science have impacted the development of ideas about evolution (e.g., synthetic theory of evolution and molecular biology). (DOK 3)
 - i. Analyze changes in an ecosystem resulting from natural causes (succession), changes in climate, human activity (pollution and recycling), or introduction of nonnative species. (DOK 2)
- 5. **Develop an understanding of organism classification.**
 - a. Classify organisms according to traditional Linnaean classification characteristics (e.g., cell structure, biochemistry, anatomy, fossil record, and methods of reproduction) and the cladistic approach. (DOK 2)
 - b. Categorize organisms according to the characteristics that distinguish them as Bacteria, Archaea, or Eucarya. (DOK 1)
 - Bacteria, fungi, and protists
 - Characteristics of invertebrates (e.g., habitat, reproduction, body plan, and locomotion) as related to phyla (e.g., Porifera, Cnidarians, Nematoda, Annelida, Platyhelminthes, and Arthropoda) and classes (e.g., Insecta, Crustacea, Arachnida, Mollusca, and Echinodermata)
 - Characteristics of vertebrates (e.g., habitat, reproduction, body plan, and locomotion) as related to classes (e.g., Agnatha, Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, and Mammalia)
 - Nomenclature of various types of plants (e.g., Bryophyta, Tracheophyta, Gymnospermae, Angiospermae, Monocotyledonae, Dicotyledonae, vascular plants, and nonvascular plants)

Botany

BO 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BO 2	Distinguish among the characteristics of botanical organization, structure, and function.
BO 3	Demonstrate an understanding of plant reproduction.
BO 4	Draw conclusions about the factors that affect the adaptation and survival of plants.
BO 5	Relate an understanding of plant genetics to its uses in modern living.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
 - a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, and so forth

- Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
 - b. Formulate questions that can be answered through research and experimental design. (DOK 3)
 - c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, and theory development). (DOK 3)
 - d. Construct and analyze graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
 - e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
 - g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
- 2. Distinguish among the characteristics of botanical organization, structure, and function.**
- a. Relate plant cell structures to their functions (e.g., major organelles, cell wall components, photosynthetic chemical reactions, plant pigments, plant tissues, roots, stems, leaves, and flowers). (DOK 1)
 - b. Differentiate the characteristics found in various plant divisions. (DOK 2)
 - Differences and similarities of nonvascular plants
 - Characteristics of seed-bearing and non-seed-bearing vascular plants relative to taxonomy
 - Major vegetative structures and their modifications in angiosperms and gymnosperms
 - c. Compare and contrast leaf modifications of gymnosperms and angiosperms (e.g., needles, overlapping scales, simple leaves, compound leaves, evergreen trees, and deciduous trees). (DOK 2)
 - d. Apply the modern classification scheme utilized in naming plants to identify plant specimens. (DOK 2)
 - Classification scheme used in botany
 - Classification of native Mississippi plants
 - e. Use inquiry to investigate and discuss the physical and chemical processes of plants. (DOK 3)
 - Relationships among photosynthesis, cellular respiration, and translocation
 - Importance of soil type and soil profiles to plant survival
 - Mechanism of water movement in plants
 - Effects of environmental conditions for plant survival
 - Tropic responses of a plant organ to a given stimulus
- 3. Demonstrate an understanding of plant reproduction.**
- a. Compare and contrast reproductive structures (e.g., cones and flowers). (DOK 2)
 - b. Differentiate among the vegetative organs of monocots, herbaceous dicots, and woody dicots. (DOK 1)
 - c. Differentiate between the structures and processes of sexual and asexual reproduction in plants. (DOK 1)
 - Reproductive structures, their modifications, and the mechanisms involved in plant reproduction
 - Functions of flower parts, seeds, and cones
 - Spore production in bryophytes and ferns
 - d. Explain and provide examples of the concept of alternation of generations and its examples. (DOK 2)
 - e. Categorize types of fruits and methods of seed distribution in plants. (DOK 1)
 - f. Research and compare various methods of plant propagation. (DOK 2)
- 4. Draw conclusions about the factors that affect the adaptation and survival of plants.**
- a. List and assess several adaptations of plants to survive in a given biome. (DOK 2)
 - b. Design and conduct an experiment to determine the effects of environmental factors on photosynthesis. (DOK 3)
 - c. Explain how natural selection and the evolutionary consequences (e.g., adaptation or extinction) support scientific explanations for similarities of ancient life forms in the fossil record and molecular similarities present in living organisms. (DOK 2)
 - d. Research factors that might influence or alter plant stability, and propose actions that may reduce the negative impacts of human activity. (DOK 2)
- 5. Relate an understanding of plant genetics to its uses in modern living.**
- a. Research, prepare, and present a position relating to issues surrounding the current botanical trends involving biotechnology. (DOK 3)

- b. Apply an understanding of the principles of plant genetics to analyze monohybrid and dihybrid crosses, and predict the potential effects the crosses might have on agronomy and agriculture. (DOK 3)
- c. Discuss the effects of genetic engineering of plants on society. (DOK 2)
- d. Describe the chemical compounds extracted from plants, their economical importance, and the impact on humans. (DOK 3)
 - Plant extracts, their function, and origin
 - Impact of the timber industry on local and national economy

Chemistry I

- CHI 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- CHI 2 Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.
- CHI 3 Develop an understanding of the periodic table.
- CHI 4. Analyze the relationship between microscopic and macroscopic models of matter.
- CHI 5 Compare factors associated with acid/base and oxidation/reduction reactions.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
- b. Clarify research questions, and design laboratory investigations. (DOK 3)
- c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, and theory development). (DOK 3)
- d. Organize data to construct graphs (e.g., plotting points, labeling x- and y-axis, and creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
- e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBLs, etc.). (DOK 3)

2. Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.

- a. Describe and classify matter based on physical and chemical properties and interactions between molecules or atoms. (DOK 1)
 - Physical properties (e.g., melting points, densities, and boiling points) of a variety of substances
 - Substances and mixtures
 - Three states of matter in terms of internal energy, molecular motion, and the phase transitions between them
- b. Research and explain crucial contributions and critical experiments of Dalton, Thomson, Rutherford, Bohr, de Broglie, and Schrödinger, and describe how each discovery contributed to the current model of atomic and nuclear structure. (DOK 2)
- c. Develop a model of atomic and nuclear structure based on theory and knowledge of fundamental particles. (DOK 2)
 - Properties and interactions of the three fundamental particles of the atom
 - Laws of conservation of mass, constant composition, definite proportions, and multiple proportions
- d. Write appropriate equations for nuclear decay reactions, describe how the nucleus changes during these reactions, and compare the resulting radiation with regard to penetrating ability. (DOK 1)
 - Three major types of radioactive decay (e.g., alpha, beta, and gamma) and the properties of the emissions (e.g., composition, mass, charge, and penetrating power)
 - The concept of half-life for a radioactive isotope (e.g., carbon-14 dating) based on the principle that the decay of any individual atom is a random process
- e. Compare the properties of compounds according to their type of bonding. (DOK 1)

- Covalent, ionic, and metallic bonding
- Polar and nonpolar covalent bonding
- Valence electrons and bonding atoms
- f. Compare different types of intermolecular forces, and explain the relationship between intermolecular forces, boiling points, and vapor pressure when comparing differences in properties of pure substances. (DOK 1)
- g. Develop a three-dimensional model of molecular structure. (DOK 2)
 - Lewis dot structures for simple molecules and ionic compounds
 - Valence shell electron pair repulsion theory (VSEPR)

3. Develop an understanding of the periodic table.

- a. Calculate the number of protons, neutrons, and electrons in individual isotopes using atomic numbers and mass numbers, write electron configurations of elements and ions following the Aufbau principle, and balance equations representing nuclear reactions. (DOK 1)
- b. Analyze patterns and trends in the organization of elements in the periodic table, and compare their relationship to position in the periodic table. (DOK 2)
 - Atomic number, atomic mass, mass number, and number of protons, electrons, and neutrons in isotopes of elements
 - Average atomic mass calculations
 - Chemical characteristics of each region
 - Periodic properties (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, and atomic/covalent/ionic radius)
- c. Classify chemical reactions by type. (DOK 2)
 - Single displacement, double displacement, synthesis (combination), decomposition, disproportionation, combustion, or precipitation
 - Products (given reactants) or reactants (given products) for each reaction type
 - Solubility rules for precipitation reactions and the activity series for single and double displacement reactions
- d. Use stoichiometry to calculate the amount of reactants consumed and products formed. (DOK 3)
 - Difference between chemical reactions and chemical equations
 - Formulas and calculations of the molecular (molar) masses
 - Empirical formula given the percent composition of elements
 - Molecular formula given the empirical formula and molar mass

4. Analyze the relationship between microscopic and macroscopic models of matter.

- a. Calculate the number of protons, neutrons, and electrons in individual isotopes using atomic numbers and mass numbers, write electron configurations of elements and ions following the Aufbau principle, and balance equations representing nuclear reactions. (DOK 1)
- b. Analyze patterns and trends in the organization of elements in the periodic table, and compare their relationship to position in the periodic table. (DOK 2)
 - Atomic number, atomic mass, mass number, and number of protons, electrons, and neutrons in isotopes of elements
 - Average atomic mass calculations
 - Chemical characteristics of each region
 - Periodic properties (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, and atomic/covalent/ionic radius)
- c. Classify chemical reactions by type. (DOK 2)
 - Single displacement, double displacement, synthesis (combination), decomposition, disproportionation, combustion, or precipitation
 - Products (given reactants) or reactants (given products) for each reaction type
 - Solubility rules for precipitation reactions and the activity series for single and double displacement reactions
- d. Use stoichiometry to calculate the amount of reactants consumed and products formed. (DOK 3)
 - Difference between chemical reactions and chemical equations

- Formulas and calculations of the molecular (molar) masses
 - Empirical formula given the percent composition of elements
 - Molecular formula given the empirical formula and molar mass
5. **Compare factors associated with acid/base and oxidation/reduction reactions.**
- a. Analyze and explain acid/base reactions. (DOK 2)
 - Properties of acids and bases, including how they affect indicators and the relative pH of the solution
 - Formation of acidic and basic solutions
 - Definition of pH in terms of the hydronium ion concentration and the hydroxide ion concentration
 - The pH or pOH from the hydrogen ion or hydroxide ion concentrations of solution
 - How a buffer works and examples of buffer solutions
 - b. Classify species in aqueous solutions according to the Arrhenius and Bronsted–Lowry definitions respectively, and predict products for aqueous neutralization reactions. (DOK 2)
 - c. Analyze a reduction/oxidation reaction (REDOX) to assign oxidation numbers (states) to reaction species, and identify the species oxidized and reduced, the oxidizing agent, and reducing agent. (DOK 2)

Organic Chemistry

- ORGC 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ORGC 2 Demonstrate an understanding of the properties, structure, and function of organic compounds.
- ORGC 3 Discuss the versatility of polymers and the diverse application of organic chemicals.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, and so forth
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
 - b. Formulate questions that can be answered through research and experimental design. (DOK 3)
 - c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, and theory development). (DOK 3)
 - d. Organize data to construct graphs (e.g., plotting points, labeling x- and y-axis, and creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
 - e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - f. Recognize and analyze alternative explanations for experimental results, and make predictions based on observations and prior knowledge. (DOK 3)
 - g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
2. **Demonstrate an understanding of the properties, structure, and function of organic compounds.**
- a. Apply International Union of Pure and Applied Chemistry (IUPAC) nomenclature, and differentiate the structure of aliphatic, aromatic, and cyclic hydrocarbon compounds. (DOK 1)
 - Structures of hydrocarbon compounds
 - Isomerism in hydrocarbon compounds
 - b. Relate structure to physical and chemical properties of hydrocarbon. (DOK 1)
 - c. Apply principles of geometry and hybridization to organic molecules. (DOK 2)
 - Lewis structures for organic molecules
 - Bond angles
 - Hybridization (as it applies to organic molecules)
 - d. Write, complete, and classify common reactions for aliphatic, aromatic, and cyclic hydrocarbons. (DOK 1)
 - e. Construct, solve, and explain equations representing combustion reactions, substitution reactions, dehydrogenation reactions, and addition reactions. (DOK 2)
 - f. Classify functional groups (e.g., alcohols, ethers, aldehydes, ketones, carboxylic acids, esters, amines, amides, and nitriles) by their structure and properties. (DOK 2)

- Structural formulas from functional group names and vice versa
- Chemical and physical properties of compounds containing functional groups
- Equations representing the transformation of one functional group into another

3. Discuss the versatility of polymers and the diverse application of organic chemicals.

- a. Describe and classify the synthesis, properties, and uses of polymers. (DOK 2)
 - Common polymers
 - Synthesis of polymers from monomers by addition or condensation
 - Condensations of plastics according to their commercial types
 - Elasticity and other polymer properties
- b. Develop a logical argument supporting the use of organic chemicals and their application in industry, drug manufacture, and biological chemistry. (DOK 1)
 - Common uses of polymers and organic compounds in medicine, drugs, and personal care products
 - Compounds that have the property to dye materials
 - Petrochemical production
 - Biologically active compounds in terms of functional group substrate interaction
- c. Research and summarize the diversity, applications, and economics of industrial chemicals (solvents, coatings, surfactants, etc.). (DOK 3)

Earth and Space Science

E1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
E2	Develop an understanding of the history and evolution of the universe and earth.
E3	Discuss factors that are used to explain the geological history of earth.
E4	Demonstrate an understanding of earth systems relating to weather and climate.
E5	Apply an understanding of ecological factors to explain relationships between earth systems.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, and so forth
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers.
- b. Formulate questions that can be answered through research and experimental design. (DOK 3)
- c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, and theory development). (DOK 3)
- d. Construct and analyze graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
- f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
- g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. Develop an understanding of the history and evolution of the universe and earth.

- a. Summarize the origin and evolution of the universe. (DOK 2)
 - Big bang theory
 - Microwave background radiation
 - The Hubble constant
 - Evidence of the existence of dark matter and dark energy in the universe and the history of the universe
- b. Differentiate methods used to measure space distances, including astronomical unit, light-year, stellar parallax, Cepheid variables, and the red shift. (DOK 1)

- c. Interpret how gravitational attraction played a role in the formation of the planetary bodies and how the fusion of hydrogen and other processes in “ordinary” stars and supernovae lead to the formation of all other elements. (DOK 2)
 - d. Summarize the early evolution of the earth, including the formation of earth’s solid layers (e.g., core, mantle, and crust), the distribution of major elements, the origin of internal heat sources, and the initiation of plate tectonics. (DOK 2)
 - How the decay of radioactive isotopes is used to determine the age of rocks, earth, and the solar system
 - How Earth acquired its initial oceans and atmosphere
3. **Discuss factors that are used to explain the geological history of earth.**
- a. Develop an understanding of how plate tectonics create certain geological features, materials, and hazards. (DOK 1)
 - Plate tectonic boundaries (e.g., divergent, convergent, and transform)
 - Modern and ancient geological features to each kind of plate tectonic boundary
 - Production of particular groups of igneous and metamorphic rocks and mineral resources
 - Sedimentary basins created and destroyed through time
 - b. Compare and contrast types of mineral deposits/groups (e.g., oxides, carbonates, halides, sulfides, sulfates, silicates, and phosphates). (DOK 2)
 - c. Categorize minerals and rocks by determining their physical and/or chemical characteristics. (DOK 2)
 - d. Justify the causes of certain geological hazards (e.g., earthquakes, volcanoes, and tsunamis) to their effects on specific plate tectonic locations. (DOK 2)
 - e. Interpret and explain how rock relationships and fossils are used to reconstruct the geologic history of the earth. (DOK 2)
 - f. Apply principles of relative age (e.g., superposition, original horizontality, crosscutting relations, and original lateral continuity) to support an opinion related to earth’s geological history. (DOK 3)
 - Types of unconformity (e.g., disconformity, angular unconformity, and nonconformity)
 - Geological timetable
 - g. Apply the principle of uniformitarianism to relate sedimentary rock associations and their fossils to the environments in which the rocks were deposited. (DOK 2)
 - h. Compare and contrast the relative and absolute dating methods (e.g., the principle of fossil succession, radiometric dating, and paleomagnetism) for determining the age of the earth. (DOK 1)
4. **Demonstrate an understanding of earth systems relating to weather and climate.**
- a. Explain the interaction of earth systems that affect weather and climate. (DOK 1)
 - Latitudinal variations in solar heating
 - The effects of Coriolis forces on ocean currents, cyclones, anticyclones, ocean currents, topography, and air masses (e.g., warm fronts, cold fronts, stationary fronts, and occluded fronts).
 - b. Interpret the patterns in temperature and precipitation that produce the climate regions on earth, and relate them to the hazards associated with extreme weather events and climate change (e.g., hurricanes, tornadoes, El Niño/La Niña, and global warming). (DOK 2)
 - c. Justify how changes in global climate and variation in earth/sun relationships contribute to natural and anthropogenic (human-caused) modification of atmospheric composition. (DOK 2)
 - d. Summarize how past and present actions of ice, wind, and water contributed to the types and distributions of erosional and depositional features in landscapes. (DOK 1)
 - e. Research and explain how external forces affect earth’s topography. (DOK 2)
 - How surface water and groundwater act as the major agents of physical and chemical weathering
 - How soil results from weathering and biological processes
 - Processes and hazards associated with both sudden and gradual mass wasting
5. **Apply an understanding of ecological factors to explain relationships between earth systems.**
- a. Draw conclusions about how life on earth shapes earth systems and responds to the interaction of earth systems (lithosphere, hydrosphere, atmosphere, and biosphere). (DOK 3)
 - Nature and distribution of life on earth, including humans, to the chemistry and availability of water
 - Distribution of biomes (e.g., terrestrial, freshwater, and marine) to climate regions through time

- Geochemical and ecological processes (e.g., rock, hydrologic, carbon, and nitrogen) that interact through time to cycle matter and energy and how human activity alters the rates of these processes (e.g., fossil fuel formation and combustion; damming and channeling of rivers)
- b. Interpret the record of shared ancestry (fossils), evolution, and extinction as related to natural selection. (DOK 2)
- c. Identify the cause-and-effect relationships of the evolutionary innovations that most profoundly shaped earth systems. (DOK 1)
 - Photosynthesis and the atmosphere
 - Multicellular animals and marine environments
 - Land plants and terrestrial environments
- d. Cite evidence about how dramatic changes in earth's atmosphere influenced the evolution of life. (DOK 1)

Environmental Science

- ES 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ES 2 Develop an understanding of the relationship of ecological factors that affect an ecosystem.
- ES 3 Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, and so forth
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Formulate questions that can be answered through research and experimental design. (DOK 3)
- c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, and theory development). (DOK 3)
- d. Construct and analyze graphs (e.g., plotting points, labeling x- and y-axis, and creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
- f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
- g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK3)

2. Develop an understanding of the relationship of ecological factors that affect an ecosystem.

- a. Compare ways in which the three layers of the biosphere change over time and their influence on an ecosystem's ability to support life. (DOK 2)
- b. Explain the flow of matter and energy in ecosystems. (DOK 2)
 - Interactions between biotic and abiotic factors
 - Indigenous plants and animals and their roles in various ecosystems
 - Biogeochemical cycles within the environment
- c. Predict the impact of the introduction, removal, and reintroduction of an organism on an ecosystem. (DOK 3)
- d. Develop a logical argument explaining the relationships and changes within an ecosystem. (DOK 2)
 - How a species adapts to its niche
 - Process of primary and secondary succession and its effects on a population
 - How changes in the environment might affect organisms
- e. Explain the causes and effects of changes in population dynamics (e.g., natural selection, exponential growth, and predator/prey relationships) to carrying capacity and limiting factors. (DOK 2)
- f. Research and explain how habitat destruction leads to the loss of biodiversity. (DOK 2)

- g. Compare and contrast the major biomes of the world's ecosystems, including location, climate, adaptations, and diversity. (DOK 1)
- 3. **Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.**
 - a. Summarize the effects of human activities on resources in the local environments. (DOK 2)
 - Sources, uses, quality, and conservation of water
 - Renewable and nonrenewable resources
 - Effects of pollution (e.g., water, noise, air, etc.) on the ecosystem
 - b. Research and evaluate the impacts of human activity and technology on the lithosphere, hydrosphere, and atmosphere, and develop a logical argument to support how communities restore ecosystems. (DOK 3)
 - c. Research and evaluate the use of renewable and nonrenewable resources, and critique efforts to conserve natural resources and reduce global warming in the United States including (but not limited) to Mississippi. (DOK 3)

Genetics

- G 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- G 2 Analyze the structure and function of the cell and cellular organelles.
- G 3 Apply the principles of heredity to demonstrate genetic understandings.

1. Use critical thinking and scientific problem solving in designing and performing biological research and experimentation. (L, P, E)

- a. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
- b. Clarify research questions, and design laboratory investigations. (DOK 3)
- c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, and theory development). (DOK 3)
- d. Organize data to construct graphs (e.g., plotting points, labeling x- and y-axis, creating appropriate titles and legends for pie, bar, and line graphs) to draw conclusions and make inferences. (DOK 3)
- e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBLs, etc.). (DOK 3)

2. Review the structure and function of the cell as it applies to genetics. (L)

- a. Cite evidence to illustrate how the structure and function of cells are involved in the maintenance of life. (DOK 2)
- b. Describe how organic components are integral to biochemical processes. (DOK 2)
- c. Differentiate among the processes by which plants and animals reproduce. (DOK 1)
 - Cell cycle and mitosis
 - Meiosis, spermatogenesis, and oogenesis
- d. Explain the significance of the discovery of nucleic acids. (DOK 1)
- e. Analyze and explain the structure and function of DNA and RNA in replication, transcription, translation, and DNA repair. (DOK 2)
- f. Cite examples to compare the consequences of the different types of mutations. (DOK 1)
- g. Draw conclusions about the importance and potential impacts of the process of gene transfer used in biotechnology. (DOK 3)

3. Analyze the structure and function of DNA and RNA molecules. (L, P)

- a. Cite evidence that supports the significance of Mendel's concept of "particulate inheritance" to explain the understanding of heredity. (DOK 1)
- b. Apply classical genetics principles to solve basic genetic problems. (DOK 2)

- Genes and alleles, dominance, recessiveness, the laws of segregation, and independent assortment
- Inheritance of autosomal and sex-linked traits
- Inheritance of traits influenced by multiple alleles and traits with polygenetic inheritance
- Chromosomal theory of inheritance
- c. Apply population genetic concepts to summarize variability of multicellular organisms. (DOK 2)
 - Genetic variability
 - Hardy–Weinberg formula
 - Migration and genetic drift
 - Natural selection in humans
- d. Distinguish and explain the applications of various tools and techniques used in DNA manipulation. (DOK 1)
 - Steps in genetic engineering experiments
 - Use of restriction enzymes
 - Role of vectors in genetic research
 - Use of transformation techniques
- e. Research and present a justifiable explanation for the practical uses of biotechnology (e.g., chromosome mapping, karyotyping, and pedigrees). (DOK 2)
- f. Develop and present a scientifically based logical argument for or against moral and ethical issues related to genetic engineering. (DOK 3)
- g. Research genomics (human and other organisms), and predict benefits and medical advances that may result from the use of genome projects. (DOK 2)

Geology

GE1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
GE2	Develop an understanding of plate tectonics and geochemical and ecological processes that affect earth.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, and so forth
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Formulate questions that can be answered through research and experimental design. (DOK 3)
- c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, and theory development). (DOK 3)
- d. Construct and analyze graphs (e.g., plotting points, labeling x- and y-axis, and creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
- f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
- g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. Develop an understanding of plate tectonics and geochemical and ecological processes that affect earth.

- a. Differentiate the components of the earth's atmosphere and lithosphere. (DOK 1)
- b. Research and summarize explanations of how earth acquired its initial atmosphere and oceans. (DOK 2)
- c. Compare the causes and effects of internal and external components that shape earth's topography. (DOK 2)
 - Physical weathering (e.g., atmospheric, glacial, etc.)
 - Chemical weathering agents (e.g., acid precipitation, carbon dioxide, oxygen, water, etc.)

- d. Develop an understanding of how plate tectonics create certain geologic features, materials, and hazards. (DOK 2)
 - Types of crustal movements and the resulting landforms (e.g., seafloor spreading, paleomagnetic measurements, and orogenesis)
 - Processes that create earthquakes and volcanoes
 - Asthenosphere
- e. Summarize the theories of plate development and continental drift, and describe the causes and effects involved in each. (DOK 2)
- f. Develop a logical argument to explain how geochemical and ecological processes (e.g., rock, hydrologic, carbon, and nitrogen) interact through time to cycle matter and energy and how human activity alters the rates of these processes (e.g., fossil fuel formation and combustion, damming, and channeling of rivers). (DOK 2)
- g. Interpret how the earth's geological time scale relates to geological history, landforms, and life forms. (DOK 2)
- h. Research and describe different techniques for determining relative and absolute age of the earth (e.g., index of fossil layers, superposition, radiometric dating, etc.) (DOK 1)
- i. Summarize the geological activity of the New Madrid fault line, and compare and contrast it to geological activity in other parts of the world. (DOK 2)
- j. Identify and differentiate the major geological features in Mississippi (e.g., Delta, Coastal Areas, etc.). (DOK 1)
- k. Evaluate an emergency preparedness plan for natural disasters associated with crustal movement. (DOK 3)

Physical Science

PS 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
PS 2	Describe and explain how forces affect motion.
PS 3	Demonstrate an understanding of general properties and characteristics of waves.
PS 4	Develop an understanding of the atom.
PS 5	Investigate and apply principles of physical and chemical changes in matter.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Use appropriate laboratory safety symbols and procedures to design and conduct a scientific investigation. (DOK 2)
 - Safety symbols and safety rules in all laboratory activities
 - Proper use and care of the compound light microscope
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Identify questions that can be answered through scientific investigations. (DOK 3)
- c. Identify and apply components of scientific methods in classroom investigations. (DOK 3)
 - Predicting, gathering data, and drawing conclusions
 - Recording outcomes and organizing data from a variety of sources (e.g., scientific articles, magazines, student experiments, etc.)
 - Critically analyzing current investigations/problems using periodicals and scientific scenarios
- d. Interpret and generate graphs (e.g., plotting points, labeling x- and y-axis, and creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures and data to draw conclusions about the validity of research. (DOK 3)
- f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- g. Communicate effectively to present and explain scientific results, using appropriate terminology and graphics. (DOK 3)

2. Describe and explain how forces affect motion.

- a. Demonstrate and explain the basic principles of Newton's three laws of motion including calculations of acceleration, force, and momentum. (DOK 2)

- Inertia and distance–time graphs to determine average speed
 - Net force (accounting for gravity, friction, and air resistance) and the resulting motion of objects
 - Effects of the gravitational force on objects on earth and effects on planetary and lunar motion
 - Simple harmonic motion (oscillation)
 - b. Explain the connection between force, work, and energy. (DOK 2)
 - Force exerted over a distance (results in work done)
 - Force–distance graph (to determine work)
 - Network on an object that contributes to change in kinetic energy (work-to-energy theorem)
 - c. Describe (with supporting details and diagrams) how the kinetic energy of an object can be converted into potential energy (the energy of position) and how energy is transferred or transformed (conservation of energy). (DOK 2)
 - d. Draw and assess conclusions about charges and electric current. (DOK 2)
 - Static/current electricity and direct current/alternating current
 - Elements in an electric circuit that are in series or parallel
 - Conductors and insulators
 - Relationship between current flowing through a resistor and voltage flowing across a resistor
 - e. Cite evidence and explain the application of electric currents and magnetic fields as they relate to their use in everyday living (e.g., the application of fields in motors and generators and the concept of electric current using Ohm’s law). (DOK 2)
- 3. Demonstrate an understanding of general properties and characteristics of waves.**
- a. Differentiate among transverse, longitudinal, and surface waves as they propagate through a medium (e.g., string, air, water, and steel beam). (DOK 1)
 - b. Compare properties of waves (e.g., superposition, interference, refraction, reflection, diffraction, and Doppler effect), and explain the connection among the quantities (e.g., wavelength, frequency, period, amplitude, and velocity). (DOK 2)
 - c. Classify the electromagnetic spectrum’s regions according to frequency and/or wavelength, and draw conclusions about their impact on life. (DOK 2)
 - The emission of light by electrons when moving from higher to lower levels
 - Energy (photons as quanta of light)
 - Additive and subtractive properties of colors
 - Relationship of visible light to the color spectrum
 - d. Explain how sound intensity is measured and its relationship to the decibel scale. (DOK 1)
- 4. Develop an understanding of the atom.**
- a. Cite evidence to summarize the atomic theory. (DOK 1)
 - Models for atoms
 - Hund’s rule and Aufbau process to specify the electron configuration of elements
 - Building blocks of matter (e.g., proton, neutron, and electron) and elementary particles (e.g., positron, mesons, neutrinos, etc.)
 - Atomic orbitals (s, p, d, f) and their basic shapes
 - b. Explain the difference between chemical and physical changes, and demonstrate how these changes can be used to separate mixtures and compounds into their components. (DOK 2)
 - c. Research the history of the periodic table of the elements, and summarize the contributions that led to the atomic theory. (DOK 2)
 - Contributions of scientists (e.g., John Dalton, J. J. Thomson, Ernest Rutherford, Newton, Einstein, Neils, Bohr, Louis de Broglie, Erwin Schrödinger, etc.)
 - Technology (e.g., X-rays, cathode-ray tubes, and spectroscopes)
 - Experiments (e.g., gold-foil, cathode-ray, etc.)
 - d. Utilize the periodic table to predict and explain patterns and draw conclusions about the structure, properties, and organization of matter. (DOK 2)
 - Atomic composition and valence electron configuration (e.g., atomic number, mass number of protons, neutrons, electrons, isotopes, and ions)
 - Periodic trends using the periodic table (e.g., valence, reactivity, and atomic radius)

- Average atomic mass from isotopic abundance
- Solids, liquids, and gases
- Periodic properties of elements (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, and atomic/covalent/ionic radius) and how they relate to position in the periodic table

5. Investigate and apply principles of physical and chemical changes in matter.

- a. Write chemical formulas for compounds comprising monatomic and polyatomic ions. (DOK 1)
- b. Balance chemical equations. (DOK 2)
- c. Classify types of chemical reactions (e. g., composition, decomposition, single displacement, double displacement, combustion, and acid/base reactions). (DOK 2)

Physics I

PHYI 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
PHYI 2	Develop an understanding of concepts related to forces and motion.
PHYI 3	Develop an understanding of concepts related to work and energy.
PHYI 4	Discuss the characteristics and properties of light and sound.
PHYI 5	Apply an understanding of magnetism, electric fields, and electricity.
PHYI 6	Analyze and explain concepts of nuclear physics.

1. Investigate and apply principles of physical and chemical changes in matter.

- a. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
- b. Clarify research questions, and design laboratory investigations. (DOK 3)
- c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, and theory development). (DOK 3)
- d. Organize data to construct graphs (e.g., plotting points, labeling x- and y-axis, and creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
- e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBLs, etc.). (DOK 3)

2. Develop an understanding of concepts related to forces and motion.

- a. Use inquiry to investigate and develop an understanding of the kinematics and dynamics of physical bodies. (DOK 3)
 - Vector and scalar quantities
 - Vector problems (solved mathematically and graphically)
 - Vector techniques and free-body diagrams to determine the net force on a body when several forces are acting on it
 - Relations among mass, inertia, and weight
- b. Analyze, describe, and solve problems by creating and utilizing graphs of one-dimensional motion (e.g., position, distance, displacement, time, speed, velocity, acceleration, and the special case of freefall). (DOK 2)
- c. Analyze real-world applications to draw conclusions about Newton's three laws of motion. (DOK 2)
- d. Apply the effects of the universal gravitation law to graph and interpret the force between two masses, acceleration due to gravity, and planetary motion. (DOK 2)
 - Situations where g is constant (falling bodies)
 - Concept of centripetal acceleration undergoing uniform circular motion
 - Kepler's third law
 - Oscillatory motion and the mechanics of waves

3. Develop an understanding of concepts related to work and energy.

- a. Explain and apply the conservation of energy and momentum. (DOK 2)
 - Concept of work and applications
 - Concept of kinetic energy, using the elementary work–energy theorem
 - Concept of conservation of energy with simple examples
 - Concepts of energy, work, and power (qualitatively and quantitatively)
 - Principles of impulse in inelastic and elastic collisions
- b. Analyze real-world applications to draw conclusions about mechanical potential energy (the energy of configuration). (DOK 3)
- c. Apply the principles of impulse, and compare conservation of momentum and conservation of kinetic energy in perfectly inelastic and elastic collisions. (DOK 1)
- d. Investigate and summarize the principles of thermodynamics. (DOK 2)
 - How heat energy is transferred from higher temperature to lower temperature until equilibrium is reached
 - Temperature and thermal energy as related to molecular motion and states of matter
 - Problems involving specific heat and heat capacity
 - First and second laws of thermodynamics as related to heat engines, refrigerators, and thermal efficiency
- e. Develop the kinetic theory of ideal gases, and explain the concept of Carnot efficiency. (DOK 2)

4. Discuss the characteristics and properties of light and sound.

- a. Describe and model the characteristics and properties of mechanical waves. (DOK 2)
 - Simple harmonic motion
 - Relationships among wave characteristics such as velocity, period, frequency, amplitude, phase, and wavelength
 - Energy of a wave in terms of amplitude and frequency.
 - Standing waves and waves in specific media (e.g., stretched string, water surface, air, etc.)
- b. Differentiate and explain the Doppler effect as it relates to a moving source and to a moving observer. (DOK 1)
- c. Explain the laws of reflection and refraction, and apply Snell's law to describe the relationship between the angles of incidence and refraction. (DOK 2)
- d. Use ray tracing and the thin lens equation to solve real-world problems involving object distance from lenses. (DOK 2)
- e. Investigate and draw conclusions about the characteristics and properties of electromagnetic waves. (DOK 2)

5. Apply an understanding of magnetism, electric fields, and electricity.

- a. Analyze and explain the relationship between electricity and magnetism. (DOK 2)
 - Characteristics of static charge and how a static charge is generated
 - Electric field, electric potential, current, voltage, and resistance as related to Ohm's law
 - Magnetic poles, magnetic flux and field, Ampère's law, and Faraday's law
 - Coulomb's law
- b. Use schematic diagrams to analyze the current flow in series and parallel electric circuits, given the component resistances and the imposed electric potential. (DOK 2)
- c. Analyze and explain the relationship between magnetic fields and electrical current by induction, generators, and electric motors. (DOK 2)

6. Analyze and explain concepts of nuclear physics.

- a. Analyze and explain the principles of nuclear physics. (DOK 1)
 - The mass number and atomic number of the nucleus of an isotope of a given chemical element
 - The conservation of mass and the conservation of charge
 - Nuclear decay
- b. Defend the wave–particle duality model of light, using observational evidence. (DOK 3)
 - Quantum energy and emission spectra
 - Photoelectric and Compton effects

Spatial Information Science

- SP 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- SP 2 Develop an understanding of geographic information systems.

1. Demonstrate the basic concepts of global positioning systems (GPS). (E)

- a. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
- b. Clarify research questions, and design laboratory investigations. (DOK 3)
- c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, and theory development). (DOK 3)
- d. Organize data to construct graphs (e.g., plotting points, labeling x- and y-axis, and creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences). (DOK 3)
- e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBLs, etc.). (DOK 3)

2. Demonstrate the basic concepts of remote sensing. (E, P)

- a. Describe the characteristics of the electromagnetic spectrum.
- b. Using images and graphs, interpret the absorption/reflection spectrum.
- c. Distinguish between passive and active sensor systems.
- d. Analyze the effects of changes in spatial, temporal, and spectral resolution.
- e. Analyze the effects on images due to changes in scale.
- f. Identify the types of sensor platforms.

Zoology

- ZO 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ZO 2 Develop an understanding of levels of organization and animal classification.
- ZO 3 Differentiate among animal life cycles, behaviors, adaptations, and relationships.
- ZO 4 Demonstrate an understanding of the principles of animal genetic diversity and evolution.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, and so forth
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Formulate questions that can be answered through research and experimental design. (DOK 3)
- c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, and theory development). (DOK 3)
- d. Construct and analyze graphs (e.g., plotting points, labeling x- and y-axis, and creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
- f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
- g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. Develop an understanding of levels of organization and animal classification.

- a. Explain how organisms are classified, and identify characteristics of major groups. (DOK 1)
 - Levels of organization of structures in animals (e.g., cells, tissues, organs, and systems)

- Characteristics used to classify organisms (e.g., cell structure, biochemistry, anatomy, fossil record, and methods of reproduction)
 - b. Identify and describe characteristics of the major phyla. (DOK 1)
 - Symmetry and body plan
 - Germ layers and embryonic development
 - Organ systems (e.g., digestive, circulatory, excretory, and reproductive)
 - Locomotion and coordination
 - c. Distinguish viruses from bacteria and protists, and give examples. (DOK 1)
 - d. Differentiate among the characteristics of bacteria, archaea, and eucarya. (DOK 1)
 - Phylogenetic sequencing of the major phyla
 - Invertebrate characteristics (e.g., habitat, reproduction, body plan, and locomotion) of the following phyla: Porifera, Cnidarians, Nematoda, Annelida, Platyhelminthes, Arthropoda, Insecta, Crustacea, Arachnida, Mollusca [Bivalvia and Gastropoda], and Echinodermata)
 - Vertebrate characteristics (e.g., habitat, reproduction, body plan, and locomotion) of the following classes: Agnatha, Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, and Mammalia
- 3. Differentiate among animal life cycles, behaviors, adaptations, and relationships.**
- a. Describe life cycles, alternation of generations, and metamorphosis of various animals, and evaluate the advantages and disadvantages of asexual and sexual reproduction. (DOK 1)
 - b. Describe and explain concepts of animal behavior, and differentiate between learned and innate behavior. (DOK 1)
 - Division of labor within a group of animals
 - Communication within animals groups
 - Degree of parental care given in animal groups
 - c. Evaluate the unique protective adaptations of animals as they relate to survival. (DOK 2)
 - d. Compare and contrast ecological relationships, and make predictions about the survival of populations under given circumstances. (DOK 3)
 - Terrestrial and aquatic ecosystems
 - Herbivores, carnivores, omnivores, decomposers, and other feeding relationships
 - Symbiotic relationships such as mutualism, commensalisms, and parasitism
 - e. Contrast food chains and food webs. (DOK 2)
- 4. Demonstrate an understanding of the principles of animal genetic diversity and evolution.**
- a. Categorize and explain sources of genetic variation on the cellular level (e.g., mutations, crossing over, and nondisjunction) and the population level (e.g., nonrandom mating, migration, etc.). (DOK 2)
 - Relationship between natural selection and evolution
 - Mutations, crossing over, non-disjunction
 - Nonrandom mating, migration, and so forth
 - Effects of genetic drift on evolution
 - b. Develop a logical argument defending or refuting issues related to genetic engineering of animals. (DOK 3)

Appendix D: ACT College Readiness Standards

English

E1 Topic Development in Terms of Purpose and Focus

- Identify the basic purpose or role of a specified phrase or sentence.
- Delete a clause or sentence because it is obviously irrelevant to the essay.
- Identify the central idea or main topic of a straightforward piece of writing.
- Determine relevancy when presented with a variety of sentence-level details.
- Identify the focus of a simple essay, applying that knowledge to add a sentence that sharpens that focus or to determine if an essay has met a specified goal.
- Delete material primarily because it disturbs the flow and development of the paragraph.
- Add a sentence to accomplish a fairly straightforward purpose such as illustrating a given statement.
- Apply an awareness of the focus and purpose of a fairly involved essay to determine the rhetorical effect and suitability of an existing phrase or sentence or to determine the need to delete plausible but irrelevant material.
- Add a sentence to accomplish a subtle rhetorical purpose such as to emphasize, to add supporting detail, or to express meaning through connotation.
- Determine whether a complex essay has accomplished a specific purpose.
- Add a phrase or sentence to accomplish a complex purpose, often expressed in terms of the main focus of the essay.

E2 Organization, Unity, and Coherence

- Use conjunctive adverbs or phrases to show time relationship in simple narrative essays (e.g., *then*, *this time*, etc.).
- Select the most logical place to add a sentence in a paragraph.
- Use conjunctive adverbs or phrases to express straightforward logical relationships (e.g., *first*, *afterward*, and *in response*).
- Decide the most logical place to add a sentence in an essay.
- Add a sentence that introduces a simple paragraph.
- Determine the need for conjunctive adverbs or phrases to create subtle logical connections between sentences (e.g., *therefore*, *however*, and *in addition*).
- Rearrange the sentences in a fairly uncomplicated paragraph for the sake of logic.
- Add a sentence to introduce or conclude the essay or to provide a transition between paragraphs when the essay is fairly straightforward.
- Make sophisticated distinctions concerning the logical use of conjunctive adverbs or phrases, particularly when signaling a shift between paragraphs.
- Rearrange sentences to improve the logic and coherence of a complex paragraph.
- Add a sentence to introduce or conclude a fairly complex paragraph.
- Consider the need for introductory sentences or transitions, basing decisions on a thorough understanding of both the logic and rhetorical effect of the paragraph and essay.

E3 Word Choice in Terms of Style, Tone, Clarity, and Economy

- Revise sentences to correct awkward and confusing arrangements of sentence elements.
- Revise vague nouns and pronouns that create obvious logic problems.
- Delete obviously synonymous and wordy material in a sentence.
- Revise expressions that deviate from the style of an essay.
- Delete redundant material when information is repeated in different parts of speech (e.g., *alarmingly startled*).

- Use the word or phrase most consistent with the style and tone of a fairly straightforward essay.
- Determine the clearest and most logical conjunction to link clauses.
- Revise a phrase that is redundant in terms of the meaning and logic of the entire sentence.
- Identify and correct ambiguous pronoun references.
- Use the word or phrase most appropriate in terms of the content of the sentence and tone of the essay.
- Correct redundant material that involves sophisticated vocabulary and sounds acceptable as conversational English (e.g., *an aesthetic viewpoint* versus *the outlook of an aesthetic viewpoint*).
- Correct vague and wordy or clumsy and confusing writing containing sophisticated language.
- Delete redundant material that involves subtle concepts or that is redundant in terms of the paragraph as a whole.

E4 Sentence Structure and Formation

- Use conjunctions or punctuation to join simple clauses.
- Revise shifts in verb tense between simple clauses in a sentence or between simple adjoining sentences.
- Determine the need for punctuation and conjunctions to avoid awkward sounding sentence fragments and fused sentences.
- Decide the appropriate verb tense and voice by considering the meaning of the entire sentence.
- Recognize and correct marked disturbances of sentence flow and structure (e.g., participial phrase fragments, missing or incorrect relative pronouns, and dangling or misplaced modifiers).
- Revise to avoid faulty placement of phrases and faulty coordination and subordination of clauses in sentences with subtle structural problems.
- Maintain consistent verb tense and pronoun person on the basis of the preceding clause or sentence.
- Use sentence-combining techniques, effectively avoiding problematic comma splices, run-on sentences, and sentence fragments, especially in sentences containing compound subjects or verbs.
- Maintain a consistent and logical use of verb tense and pronoun person on the basis of information in the paragraph or essay as a whole.
- Work comfortably with long sentences and complex clausal relationships within sentences, avoiding weak conjunctions between independent clauses and maintaining parallel structure between clauses.

E5 Conventions of Usage

- Solve such basic grammatical problems as how to form the past and past participle of irregular but commonly used verbs and how to form comparative and superlative adjectives.
- Solve such grammatical problems as whether to use an adverb or adjective form, how to ensure straightforward subject–verb and pronoun–antecedent agreement, and which preposition to use in simple contexts.
- Recognize and use the appropriate word in frequently confused pairs such as *there* and *their*, *past* and *passed*, and *led* and *lead*.
- Use idiomatically appropriate prepositions, especially in combination with verbs (e.g., *long for* and *appeal to*).
- Ensure that a verb agrees with its subject when there is some text between the two.
- Ensure that a pronoun agrees with its antecedent when the two occur in separate clauses or sentences.
- Identify the correct past and past participle forms of irregular and infrequently used verbs, and form present–perfect verbs by using *have* rather than *of*.
- Correctly use reflexive pronouns, the possessive pronouns *its* and *your*, and the relative pronouns *who* and *whom*.
- Ensure that a verb agrees with its subject in unusual situations (e.g., when the subject–verb order is inverted or when the subject is an indefinite pronoun).
- Provide idiomatically and contextually appropriate prepositions following verbs in situations involving sophisticated language or ideas.
- Ensure that a verb agrees with its subject when a phrase or clause between the two suggests a different number for the verb.

E6 Conventions of Punctuation

- Delete commas that create basic sense problems (e.g., between verb and direct object).
- Provide appropriate punctuation in straightforward situations (e.g., items in a series).
- Delete commas that disturb the sentence flow (e.g., between modifier and modified element).
- Use commas to set off simple parenthetical phrases.
- Delete unnecessary commas when an incorrect reading of the sentence suggests a pause that should be punctuated (e.g., between verb and direct object clause).
- Use punctuation to set off complex parenthetical phrases.
- Recognize and delete unnecessary commas based on a careful reading of a complicated sentence (e.g., between the elements of a compound subject or compound verb joined by *and*).
- Use apostrophes to indicate simple possessive nouns.
- Recognize inappropriate uses of colons and semicolons.
- Use commas to set off a nonessential/nonrestrictive appositive or clause.
- Deal with multiple punctuation problems (e.g., compound sentences containing unnecessary commas and phrases that may or may not be parenthetical).
- Use an apostrophe to show possession, especially with irregular plural nouns.
- Use a semicolon to indicate a relationship between closely related independent clauses.
- Use a colon to introduce an example or an elaboration.

Math

M1 Basic Operations and Applications

- Perform one-operation computation with whole numbers and decimals.
- Solve problems in one or two steps using whole numbers.
- Perform common conversions (e.g., inches to feet or hours to minutes).
- Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent.
- Solve some routine two-step arithmetic problems.
- Solve routine two-step or three-step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and computing with a given average.
- Solve multistep arithmetic problems that involve planning or converting units of measure (e.g., feet per second to miles per hour).
- Solve word problems containing several rates, proportions, or percentages.
- Solve complex arithmetic problems involving percent of increase or decrease and problems requiring integration of several concepts from pre-algebra and/or pre-geometry (e.g., comparing percentages or averages, using several ratios, and finding ratios in geometry settings).

M2 Probability, Statistics, and Data Analysis

- Calculate the average of a list of positive whole numbers.
- Perform a single computation using information from a table or chart.
- Calculate the average of a list of numbers.
- Calculate the average, given the number of data values and the sum of the data values.
- Read tables and graphs.
- Perform computations on data from tables and graphs.
- Use the relationship between the probability of an event and the probability of its complement.
- Calculate the missing data value, given the average and all data values but one.
- Translate from one representation of data to another (e.g., a bar graph to a circle graph).
- Determine the probability of a simple event.
- Exhibit knowledge of simple counting techniques.*
- Calculate the average, given the frequency counts of all the data values.
- Manipulate data from tables and graphs.

- Compute straightforward probabilities for common situations.
- Use Venn diagrams in counting.*
- Calculate or use a weighted average.
- Interpret and use information from figures, tables, and graphs.
- Apply counting techniques.
- Compute a probability when the event and/or sample space is not given or obvious.
- Distinguish between mean, median, and mode for a list of numbers.
- Analyze and draw conclusions based on information from figures, tables, and graphs.
- Exhibit knowledge of conditional and joint probability.

M3 Numbers: Concepts and Properties

- Recognize equivalent fractions and fractions in lowest terms.
- Recognize one-digit factors of a number.
- Identify a digit's place value.
- Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor.
- Find and use the least common multiple.
- Order fractions.
- Work with numerical factors.
- Work with scientific notation.
- Work with squares and square roots of numbers.
- Work problems involving positive integer exponents.*
- Work with cubes and cube roots of numbers.*
- Determine when an expression is undefined.*
- Exhibit some knowledge of the complex numbers.†
- Apply number properties involving prime factorization.
- Apply number properties involving even and odd numbers and factors and multiples.
- Apply number properties involving positive and negative numbers.
- Apply rules of exponents.
- Multiply two complex numbers.†
- Draw conclusions based on number concepts, algebraic properties, and/or relationships between expressions and numbers.
- Exhibit knowledge of logarithms and geometric sequences.
- Apply properties of complex numbers.

M4 Expressions, Equations, and Inequalities

- Exhibit knowledge of basic expressions (e.g., identify an expression for a total as $b + g$).
- Solve equations in the form $x + a = b$, where a and b are whole numbers or decimals.
- Substitute whole numbers for unknown quantities to evaluate expressions.
- Solve one-step equations having integer or decimal answers.
- Combine like terms (e.g., $2x + 5x$).
- Evaluate algebraic expressions by substituting integers for unknown quantities.
- Add and subtract simple algebraic expressions.
- Solve routine first-degree equations.
- Perform straightforward word-to-symbol translations.
- Multiply two binomials.*
- Solve real-world problems using first-degree equations.
- Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions).
- Identify solutions to simple quadratic equations.
- Add, subtract, and multiply polynomials.*

- Factor simple quadratics (e.g., the difference of squares and perfect square trinomials).*
- Solve first-degree inequalities that do not require reversing the inequality sign.*
- Manipulate expressions and equations.
- Write expressions, equations, and inequalities for common algebra settings.
- Solve linear inequalities that require reversing the inequality sign.
- Solve absolute value equations.
- Solve quadratic equations.
- Find solutions to systems of linear equations.
- Write expressions that require planning and/or manipulating to accurately model a situation.
- Write equations and inequalities that require planning, manipulating, and/or solving.
- Solve simple absolute value inequalities.

M5 Graphical Representations

- Identify the location of a point with a positive coordinate on the number line.
- Locate points on the number line and in the first quadrant.
- Locate points in the coordinate plane.
- Comprehend the concept of length on the number line.*
- Exhibit knowledge of slope.*
- Identify the graph of a linear inequality on the number line.*
- Determine the slope of a line from points or equations.*
- Match linear graphs with their equations.*
- Find the midpoint of a line segment.*
- Interpret and use information from graphs in the coordinate plane.
- Match number line graphs with solution sets of linear inequalities.
- Use the distance formula.
- Use properties of parallel and perpendicular lines to determine an equation of a line or coordinates of a point.
- Recognize special characteristics of parabolas and circles (e.g., the vertex of a parabola and the center or radius of a circle).†
- Match number line graphs with solution sets of simple quadratic inequalities.
- Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$.
- Solve problems integrating multiple algebraic and/or geometric concepts.
- Analyze and draw conclusions based on information from graphs in the coordinate plane.

M6 Properties of Plane Figures

- Exhibit some knowledge of the angles associated with parallel lines.
- Find the measure of an angle using properties of parallel lines.
- Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90° , 180° , and 360°).
- Use several angle properties to find an unknown angle measure.
- Recognize Pythagorean triples.*
- Use properties of isosceles triangles.*
- Apply properties of 30° - 60° - 90° , 45° - 45° - 90° , similar, and congruent triangles.
- Use the Pythagorean theorem.
- Draw conclusions based on a set of conditions.
- Solve multistep geometry problems that involve integrating concepts, planning, visualization, and/or making connections with other content areas.
- Use relationships among angles, arcs, and distances in a circle.

M7 Measurement

- Estimate or calculate the length of a line segment based on other lengths given on a geometric figure.
- Compute the perimeter of polygons when all side lengths are given.

- Compute the area of rectangles when whole number dimensions are given.
- Compute the area and perimeter of triangles and rectangles in simple problems.
- Use geometric formulas when all necessary information is given.
- Compute the area of triangles and rectangles when one or more additional simple steps are required.
- Compute the area and circumference of circles after identifying necessary information.
- Compute the perimeter of simple composite geometric figures with unknown side lengths.*
- Use relationships involving area, perimeter, and volume of geometric figures to compute another measure.
- Use scale factors to determine the magnitude of a size change.
- Compute the area of composite geometric figures when planning or visualization is required.

M8 Functions

- Evaluate quadratic functions, expressed in function notation, at integer values.
- Evaluate polynomial functions, expressed in function notation, at integer values.†
- Express the sine, cosine, and tangent of an angle in a right triangle as a ratio of given side lengths.†
- Evaluate composite functions at integer values.†
- Apply basic trigonometric ratios to solve right-triangle problems.†
- Write an expression for the composite of two simple functions.†
- Use trigonometric concepts and basic identities to solve problems.†
- Exhibit knowledge of unit circle trigonometry.†
- Match graphs of basic trigonometric functions with their equations.

Notes

- Students who score in the 1–12 range are most likely beginning to develop the knowledge and skills assessed in the other ranges.
- Standards followed by an asterisk (*) apply to the PLAN and ACT Mathematics tests only.
- Standards followed by a dagger (†) apply to the ACT Mathematics test only.

Reading

R1 Main Ideas and Author's Approach

- Recognize a clear intent of an author or narrator in uncomplicated literary narratives.
- Identify a clear main idea or purpose of straightforward paragraphs in uncomplicated literary narratives.
- Infer the main idea or purpose of straightforward paragraphs in uncomplicated literary narratives.
- Understand the overall approach taken by an author or narrator (e.g., point of view and kinds of evidence used) in uncomplicated passages.
- Identify a clear main idea or purpose of any paragraph or paragraphs in uncomplicated passages.
- Infer the main idea or purpose of straightforward paragraphs in more challenging passages.
- Summarize basic events and ideas in more challenging passages.
- Understand the overall approach taken by an author or narrator (e.g., point of view and kinds of evidence used) in more challenging passages.
- Infer the main idea or purpose of more challenging passages or their paragraphs.
- Summarize events and ideas in virtually any passage.
- Understand the overall approach taken by an author or narrator (e.g., point of view and kinds of evidence used) in virtually any passage.
- Identify clear main ideas or purposes of complex passages or their paragraphs.

R2 Supporting Details

- Locate basic facts (e.g., names, dates, and events) clearly stated in a passage.
- Locate simple details at the sentence and paragraph level in uncomplicated passages.
- Recognize a clear function of a part of an uncomplicated passage.

- Locate important details in uncomplicated passages.
- Make simple inferences about how details are used in passages.
- Locate important details in more challenging passages.
- Locate and interpret minor or subtly stated details in uncomplicated passages.
- Discern which details, though they may appear in different sections throughout a passage, support important points in more challenging passages.
- Locate and interpret minor or subtly stated details in more challenging passages.
- Use details from different sections of some complex informational passages to support a specific point or argument.
- Locate and interpret details in complex passages.
- Understand the function of a part of a passage when the function is subtle or complex.

R3 Sequential, Comparative, and Cause—Effect Relationships

- Determine when (e.g., first, last, before, and after) or if an event occurred in uncomplicated passages.
- Recognize clear cause—effect relationships described within a single sentence in a passage.
- Identify relationships between main characters in uncomplicated literary narratives.
- Recognize clear cause—effect relationships within a single paragraph in uncomplicated literary narratives.
- Order simple sequences of events in uncomplicated literary narratives.
- Identify clear relationships between people, ideas, and so forth in uncomplicated passages.
- Identify clear cause—effect relationships in uncomplicated passages.
- Order sequences of events in uncomplicated passages.
- Understand relationships between people, ideas, and so forth in uncomplicated passages.
- Identify clear relationships between characters, ideas, and so forth in more challenging literary narratives.
- Understand implied or subtly stated cause—effect relationships in uncomplicated passages.
- Identify clear cause—effect relationships in more challenging passages.
- Order sequences of events in more challenging passages.
- Understand the dynamics between people, ideas, and so forth in more challenging passages.
- Understand implied or subtly stated cause—effect relationships in more challenging passages.
- Order sequences of events in complex passages.
- Understand the subtleties in relationships between people, ideas, and so forth in virtually any passage.
- Understand implied, subtle, or complex cause—effect relationships in virtually any passage.

R4 Meaning of Words

- Understand the implication of a familiar word or phrase and of simple descriptive language.
- Use context to understand basic figurative language.
- Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in uncomplicated passages.
- Use context to determine the appropriate meaning of virtually any word, phrase, or statement in uncomplicated passages.
- Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in more challenging passages.
- Determine the appropriate meaning of words, phrases, or statements from figurative or somewhat technical contexts.
- Determine, even when the language is richly figurative and the vocabulary is difficult, the appropriate meaning of context-dependent words, phrases, or statements in virtually any passage.

R5 Generalizations and Conclusions

- Draw simple generalizations and conclusions about the main characters in uncomplicated literary narratives.
- Draw simple generalizations and conclusions about people, ideas, and so forth in uncomplicated passages.

- Draw generalizations and conclusions about people, ideas, and so forth in uncomplicated passages.
- Draw simple generalizations and conclusions using details that support the main points of more challenging passages.
- Draw subtle generalizations and conclusions about characters, ideas, and so forth in uncomplicated literary narratives.
- Draw generalizations and conclusions about people, ideas, and so forth in more challenging passages.
- Use information from one or more sections of a more challenging passage to draw generalizations and conclusions about people, ideas, and so forth.
- Draw complex or subtle generalizations and conclusions about people, ideas, and so forth, often by synthesizing information from different portions of the passage.
- Understand and generalize about portions of a complex literary narrative.

Science

S1 Interpretation of Data

- Select a single piece of data (numerical or non-numerical) from a simple data presentation (e.g., a table or graph with two or three variables; a food web diagram).
- Identify basic features of a table, graph, or diagram (e.g., headings, units of measurement, and axis labels).
- Select two or more pieces of data from a simple data presentation.
- Understand basic scientific terminology.
- Find basic information in a brief body of text.
- Determine how the value of one variable changes as the value of another variable changes in a simple data presentation.
- Select data from a complex data presentation (e.g., a table or graph with more than three variables; a phase diagram).
- Compare or combine data from a simple data presentation (e.g., order or sum data from a table).
- Translate information into a table, graph, or diagram.
- Compare or combine data from two or more simple data presentations (e.g., categorize data from a table using a scale from another table).
- Compare or combine data from a complex data presentation.
- Interpolate between data points in a table or graph.
- Determine how the value of one variable changes as the value of another variable changes in a complex data presentation.
- Identify and/or use a simple (e.g., linear) mathematical relationship between data.
- Analyze given information when presented with new, simple information.
- Compare or combine data from a simple data presentation with data from a complex data presentation.
- Identify and/or use a complex (e.g., nonlinear) mathematical relationship between data.
- Extrapolate from data points in a table or graph.
- Compare or combine data from two or more complex data presentations.
- Analyze given information when presented with new, complex information.

S2 Scientific Investigation

- Understand the methods and tools used in a simple experiment.
- Understand the methods and tools used in a moderately complex experiment.
- Understand a simple experimental design.
- Identify a control in an experiment.
- Identify similarities and differences between experiments.
- Understand the methods and tools used in a complex experiment.
- Understand a complex experimental design.
- Predict the results of an additional trial or measurement in an experiment.

- Determine the experimental conditions that would produce specified results.
- Determine the hypothesis for an experiment.
- Identify an alternate method for testing a hypothesis.
- Understand precision and accuracy issues.
- Predict how modifying the design or methods of an experiment will affect results.
- Identify an additional trial or experiment that could be performed to enhance or evaluate experimental results.

S3 Evaluation of Models, Inferences, and Experimental Results

- Select a simple hypothesis, prediction, or conclusion that is supported by a data presentation or a model.
- Identify key issues or assumptions in a model.
- Select a simple hypothesis, prediction, or conclusion that is supported by two or more data presentations or models.
- Determine whether given information supports or contradicts a simple hypothesis or conclusion and why.
- Identify strengths and weaknesses in one or more models.
- Identify similarities and differences between models.
- Determine which model(s) is/are supported or weakened by new information.
- Select a data presentation or a model that supports or contradicts a hypothesis, prediction, or conclusion.
- Select a complex hypothesis, prediction, or conclusion that is supported by a data presentation or model.
- Determine whether new information supports or weakens a model and why.
- Use new information to make a prediction based on a model.
- Select a complex hypothesis, prediction, or conclusion that is supported by two or more data presentations or models.
- Determine whether given information supports or contradicts a complex hypothesis or conclusion and why.

Writing

W1 Expressing Judgments

- Show a little understanding of the persuasive purpose of the task, but neglect to take or to maintain a position on the issue in the prompt.
- Show limited recognition of the complexity of the issue in the prompt.
- Show a basic understanding of the persuasive purpose of the task by taking a position on the issue in the prompt but may not maintain that position.
- Show a little recognition of the complexity of the issue in the prompt by acknowledging, but only briefly describing, a counterargument to the writer's position.
- Show understanding of the persuasive purpose of the task by taking a position on the issue in the prompt.
- Show some recognition of the complexity of the issue in the prompt by doing the following:
 - Acknowledging counterarguments to the writer's position
 - Providing some response to counterarguments to the writer's position
- Show clear understanding of the persuasive purpose of the task by taking a position on the specific issue in the prompt and offering a broad context for discussion.
- Show recognition of the complexity of the issue in the prompt by doing the following:
 - Partially evaluating implications and/or complications of the issue
 - Posing and partially responding to counterarguments to the writer's position
- Show clear understanding of the persuasive purpose of the task by taking a position on the specific issue in the prompt and offering a critical context for discussion.
- Show understanding of the complexity of the issue in the prompt by doing the following:
 - Examining different perspectives
 - Evaluating implications or complications of the issue
 - Posing and fully discussing counterarguments to the writer's position

W2 Focusing on the Topic

- Maintain a focus on the general topic in the prompt through most of the essay.
- Maintain a focus on the general topic in the prompt throughout the essay.
- Maintain a focus on the general topic in the prompt throughout the essay, and attempt a focus on the specific issue in the prompt.
- Present a thesis that establishes focus on the topic.
- Maintain a focus on discussion of the specific topic and issue in the prompt throughout the essay.
- Present a thesis that establishes a focus on the writer's position on the issue.
- Maintain a clear focus on discussion of the specific topic and issue in the prompt throughout the essay.
- Present a critical thesis that clearly establishes the focus on the writer's position on the issue.

W3 Developing a Position

- Offer a little development, with one or two ideas; if examples are given, they are general and may not be clearly relevant; resort often to merely repeating ideas.
- Show little or no movement between general and specific ideas and examples.
- Offer limited development of ideas using a few general examples; resort sometimes to merely repeating ideas.
- Show little movement between general and specific ideas and examples.
- Develop ideas by using some specific reasons, details, and examples.
- Show some movement between general and specific ideas and examples.
- Develop most ideas fully, using some specific and relevant reasons, details, and examples.
- Show clear movement between general and specific ideas and examples.
- Develop several ideas fully, using specific and relevant reasons, details, and examples.
- Show effective movement between general and specific ideas and examples.

W4 Organizing Ideas

- Provide a discernible organization with some logical grouping of ideas in parts of the essay.
- Use a few simple and obvious transitions.
- Present a discernible, though minimally developed, introduction and conclusion.
- Provide a simple organization with logical grouping of ideas in parts of the essay.
- Use some simple and obvious transitional words, though they may at times be inappropriate or misleading.
- Present a discernible, though underdeveloped, introduction and conclusion.
- Provide an adequate but simple organization with logical grouping of ideas in parts of the essay but with little evidence of logical progression of ideas.
- Use some simple and obvious, but appropriate, transitional words and phrases.
- Present a discernible introduction and conclusion with a little development.
- Provide unity and coherence throughout the essay, sometimes with a logical progression of ideas.
- Use relevant, though at times simple and obvious, transitional words and phrases to convey logical relationships between ideas.
- Present a somewhat developed introduction and conclusion.
- Provide unity and coherence throughout the essay, often with a logical progression of ideas.
- Use relevant transitional words, phrases, and sentences to convey logical relationships between ideas.
- Present a well-developed introduction and conclusion.

W5 Using Language

- Show limited control of language by doing the following:
 - Correctly employing some of the conventions of standard English grammar, usage, and mechanics but with distracting errors that sometimes significantly impede understanding
 - Using simple vocabulary
 - Using simple sentence structure

- o Correctly employing some of the conventions of standard English grammar, usage, and mechanics but with distracting errors that sometimes impede understanding
- o Using simple but appropriate vocabulary
- o Using a little sentence variety, though most sentences are simple in structure
- o Correctly employing many of the conventions of standard English grammar, usage, and mechanics but with some distracting errors that may occasionally impede understanding
- o Using appropriate vocabulary
- o Using some varied kinds of sentence structures to vary pace
- o Correctly employing most conventions of standard English grammar, usage, and mechanics with a few distracting errors but none that impede understanding
- o Using some precise and varied vocabulary
- o Using several kinds of sentence structures to vary pace and to support meaning
- o Correctly employing most conventions of standard English grammar, usage, and mechanics with just a few, if any, errors
- o Using precise and varied vocabulary
- o Using a variety of kinds of sentence structures to vary pace and to support meaning

Appendix E: Pathway Content Standards

AGRICULTURE, FOOD, AND NATURAL RESOURCES (AFNR) PATHWAY CONTENT STANDARDS AND PERFORMANCE ELEMENTS

The AFNR Pathway Content Standards and Performance Elements are adapted from *National Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards*. Reprinted with permission from the National Council for Agricultural Education, 1410 King Street, Suite 400, Alexandria, VA 22314, 800.772.0939. Copyright © 2009. A complete copy of the National Standards can be downloaded from the Team Ag Ed Learning Center at <https://aged.learn.com>.

AGRIBUSINESS SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of principles and techniques for the development and management of agribusiness systems.

- ABS.01. Utilize economic principles to establish and manage an AFNR enterprise.**
 - ABS.01.01. Apply principles of capitalism in the business environment.
 - ABS.01.02. Apply principles of entrepreneurship in businesses.
- ABS.02. Utilize appropriate management planning principles in AFNR business enterprises.**
 - ABS.02.01. Compose and analyze a business plan for an enterprise.
 - ABS.02.02. Read, interpret, evaluate, and write a mission statement to guide business goals, objectives, and resource allocation.
 - ABS.02.03. Apply appropriate management skills to organize a business.
 - ABS.02.04. Recruit, train, and retain appropriate and productive human resources for business.
- ABS.03. Utilize record keeping to accomplish AFNR business objectives while complying with laws and regulations.**
 - ABS.03.01. Prepare and maintain all files needed to accomplish effective record keeping.
 - ABS.03.02. Implement appropriate inventory management practices.
- ABS.04. Apply generally accepted accounting principles and skills to manage cash budgets, credit budgets, and credit for AFNR businesses.**
 - ABS.04.01. Use accounting fundamentals to accomplish dependable bookkeeping and fiscal management.
- ABS.05. Assess accomplishment of goals and objectives by an AFNR business.**
 - ABS.05.01. Maintain and interpret financial information (income statements, balance sheets, inventory, purchase orders, accounts receivable, and cash-flow analyses) for businesses.
- ABS.06. Use industry-accepted marketing practices to accomplish AFNR business objectives.**
 - ABS.06.01. Conduct appropriate market and marketing research.
 - ABS.06.02. Develop a marketing plan.
 - ABS.06.03. Develop strategies for marketing plan implementation.
 - ABS.06.04. Develop specific tactics to market AFNR products and services.
- ABS.07. Create a production system plan.**
 - ABS.07.01. Prepare a step-by-step production plan that identifies needed resources.
 - ABS.07.02. Develop a production and operational plan.
 - ABS.07.03. Utilize appropriate techniques to determine the most likely strengths, weaknesses, and inconsistencies in a business plan, and relate these to risk management strategies.
 - ABS.07.04. Manage risk and uncertainty.

ANIMAL SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and practices to the production and management of animals.

AS.01. Examine the components, historical development, global implications, and future trends of the animal systems industry.

AS.01.01. Evaluate the development and implications of animal origin, domestication, and distribution.

AS.02. Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics.

AS.02.01. Classify animals according to hierarchical taxonomy and agricultural use.

AS.02.02. Apply principles of comparative anatomy and physiology to uses within various animal systems.

AS.02.03. Select animals for specific purposes and maximum performance based on anatomy and physiology.

AS.03. Provide for the proper health care of animals.

AS.03.01. Prescribe and implement a prevention and treatment program for animal diseases, parasites, and other disorders.

AS.03.02. Provide for the biosecurity of agricultural animals and production facilities.

AS.04. Apply principles of animal nutrition to ensure the proper growth, development, reproduction, and economic production of animals.

AS.04.01. Formulate feed rations to provide for the nutritional needs of animals.

AS.04.02. Prescribe and administer animal feed additives and growth promotants in animal production.

AS.05. Evaluate and select animals based on scientific principles of animal production.

AS.05.01. Evaluate the male and female reproductive systems in selecting animals.

AS.05.02. Evaluate animals for breeding readiness and soundness.

AS.05.03. Apply scientific principles in the selection and breeding of animals.

AS.06. Prepare and implement animal handling procedures for the safety of animals and producers and consumers of animal products.

AS.06.01. Demonstrate safe animal handling and management techniques.

AS.06.02. Implement procedures to ensure that animal products are safe.

AS.07. Select animal facilities and equipment that provide for the safe and efficient production, housing, and handling of animals.

AS.07.01. Design animal housing, equipment, and handling facilities for the major systems of animal production.

AS.07.02. Comply with government regulations and safety standards for facilities used in animal production.

AS.08. Analyze environmental factors associated with animal production.

AS.08.01. Reduce the effects of animal production on the environment.

AS.08.02. Evaluate the effects of environmental conditions on animals.

BIOTECHNOLOGY

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to biotechnology in agriculture.

BS.01. Recognize the historical, social, cultural, and potential applications of biotechnology.

- BS.01.01. Distinguish major innovators, historical developments, and potential applications of biotechnology in agriculture.
- BS.01.02. Determine regulatory issues, and identify agencies associated with biotechnology.
- BS.01.03. Analyze the ethical, legal, social, and cultural issues relating to biotechnology.

BS.02 Demonstrate laboratory skills as applied to biotechnology.

- BS.02.01. Maintain and interpret biotechnology laboratory records.
- BS.02.02. Operate biotechnology laboratory equipment according to standard procedures.
- BS.02.03. Demonstrate proper laboratory procedures using biological materials.
- BS.02.04. Safely manage biological materials, chemicals, and wastes used in the laboratory.
- BS.02.05. Perform microbiology, molecular biology, enzymology, and immunology procedures.

BS.03. Demonstrate the application of biotechnology to Agriculture, Food, and Natural Resources (AFNR).

- BS.03.01. Evaluate the application of genetic engineering to improve products of AFNR systems.
- BS.03.02. Perform biotechnology processes used in AFNR systems.
- BS.03.03. Use biotechnology to monitor and evaluate procedures performed in AFNR systems.

ENVIRONMENTAL SERVICE SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the management of environmental service systems.

ESS.01. Use analytical procedures to plan and evaluate environmental service systems.

- ESS.01.01. Analyze and interpret samples.

ESS.02. Assess the impact of policies and regulations on environmental service systems.

- ESS.02.01. Interpret laws affecting environmental service systems.

ESS.03. Apply scientific principles to environmental service systems.

- ESS.03.01. Apply meteorology principles to environmental service systems.
- ESS.03.02. Apply soil science principles to environmental service systems.
- ESS.03.03. Apply hydrology principles to environmental service systems.
- ESS.03.04. Apply best management techniques associated with the properties, classifications, and functions of wetlands.
- ESS.03.05. Apply chemistry principles to environmental service systems.
- ESS.03.06. Apply microbiology principles to environmental service systems.

ESS.04. Operate environmental service systems to manage a facility environment.

- ESS.04.01. Use pollution control measures to maintain a safe facility environment.
- ESS.04.02. Manage safe disposal of all categories of solid waste.
- ESS.04.03. Apply the principles of public drinking water treatment operations to ensure safe water at a facility.
- ESS.04.04. Apply principles of wastewater treatment to manage wastewater disposal in keeping with rules and regulations.
- ESS.04.05. Manage hazardous materials to assure a safe facility and to comply with applicable regulations.

ESS.05. Examine the relationships between energy sources and environmental service systems.

- ESS.05.01. Compare and contrast the impact of conventional and alternative energy sources on the environment.

ESS.06. Use tools, equipment, machinery, and technology to accomplish tasks in environmental service systems.

- ESS.06.01. Use technological and mathematical tools to map land, facilities, and infrastructure.
- ESS.06.02. Maintain tools, equipment, and machinery in safe working order for tasks in environmental service systems.

FOOD PRODUCTS AND PROCESSING SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles, practices, and techniques in the processing, storage, and development of food products.

FPP.01. Examine components of the food industry and historical development of food products and processing.

- FPP.01.01. Evaluate the significance and implications of changes and trends in the food products and processing industry.
- FPP.01.02. Work effectively with industry organizations, groups, and regulatory agencies affecting the food products and processing industry.

FPP.02. Apply safety principles, recommended equipment, and facility management techniques to the food products and processing industry.

- FPP.02.01. Manage operational procedures, and create equipment and facility maintenance plans.
- FPP.02.02. Implement Hazard Analysis and Critical Control Point (HACCP) procedures to establish operating parameters.
- FPP.02.03. Apply safety and sanitation procedures in the handling, processing, and storing of food products.
- FPP.02.04. Demonstrate worker safety procedures with food product and processing equipment and facilities.

FPP.03. Apply principles of science to the food products and processing industry.

- FPP.03.01. Apply principles of science to food processing to provide a safe, wholesome, and nutritious food supply.

FPP.04. Select and process food products for storage, distribution, and consumption.

- FPP.04.01. Utilize harvesting, selection, and inspection techniques to obtain quality food products for processing.
- FPP.04.02. Evaluate, grade, and classify processed food products.
- FPP.04.03. Process, preserve, package, and present food and food products for sale and distribution.

NATURAL RESOURCE SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the management of natural resources.

NRS.01. Explain interrelationships between natural resources and humans necessary to conduct management activities in natural environments.

- NRS.01.01. Apply knowledge of natural resource components to the management of natural resource systems.
- NRS.01.02. Classify natural resources.

NRS.02. Apply scientific principles to natural resource management activities.

- NRS.02.01. Develop a safety plan for work with natural resources.

- NRS.02.02. Demonstrate cartographic skills to aid in developing, implementing, and evaluating natural resource management plans.
- NRS.02.03. Measure and survey natural resource status to obtain planning data.
- NRS.02.04. Demonstrate natural resource enhancement techniques.
- NRS.02.05. Interpret laws related to natural resource management and protection.
- NRS.02.06. Apply ecological concepts and principles to natural resource systems.

NRS.03. Apply knowledge of natural resources to production and processing industries.

- NRS.03.01. Produce, harvest, process, and use natural resource products.

NRS.04. Demonstrate techniques used to protect natural resources.

- NRS.04.01. Manage fires in natural resource systems.
- NRS.04.02. Diagnose plant and wildlife diseases, and follow protocol to prevent their spread.
- NRS.04.03. Manage insect infestations of natural resources.

NRS.05. Use effective methods and venues to communicate natural resource processes to the public.

- NRS.05.01. Communicate natural resource information to the public.

PLANT SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the production and management of plants.

PS.01. Apply knowledge of plant classification, plant anatomy, and plant physiology to the production and management of plants.

- PS.01.01. Classify agricultural plants according to taxonomy systems.
- PS.01.02. Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.
- PS.01.03. Apply knowledge of plant physiology and energy conversion to plant systems.

PS.02. Prepare and implement a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.

- PS.02.01. Determine the influence of environmental factors on plant growth.
- PS.02.02. Prepare growing media for use in plant systems.
- PS.02.03. Develop and implement a fertilization plan for specific plants or crops.

PS.03. Propagate, culture, and harvest plants.

- PS.03.01. Demonstrate plant propagation techniques.
- PS.03.02. Develop and implement a plant management plan for crop production.
- PS.03.03. Develop and implement a plan for integrated pest management.
- PS.03.04. Apply principles and practices of sustainable agriculture to plant production.
- PS.03.05. Harvest, handle, and store crops.

PS.04. Employ elements of design to enhance an environment.

- PS.04.01. Create designs using plants.

POWER, STRUCTURAL, AND TECHNICAL SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of principles and techniques for the development and management of power, structural, and technical systems.

PST.01. Use physical science principles and engineering applications with power, structural, and technical systems to solve problems and improve performance.

- PST.01.01. Select energy sources in power generation appropriate to the situation.
- PST.01.02. Apply physical science laws and principles to identify, classify, and use lubricants.
- PST.01.03. Identify and use hand and power tools and equipment for service, construction, and fabrication.
- PST.02. Design, operate, and maintain mechanical equipment, structures, biological systems, land treatment, power, and technology.**
 - PST.02.01. Perform service routines to maintain power units and equipment.
 - PST.02.02. Operate, service, and diagnose the condition of power units and equipment.
- PST.03. Service and repair mechanical equipment and power systems.**
 - PST.03.01. Troubleshoot and repair internal combustion engines.
 - PST.03.02. Utilize manufacturers' guidelines to service and repair the power transmission systems of equipment.
 - PST.03.03. Service and repair hydraulic and pneumatic systems.
 - PST.03.04. Troubleshoot and service electrical systems.
 - PST.03.05. Service vehicle heating and air-conditioning systems.
 - PST.03.06. Service and repair steering, suspension, traction, and vehicle performance systems.
- PST.04. Plan, build, and maintain agricultural structures.**
 - PST.04.01. Create sketches and plans of agricultural structures.
 - PST.04.02. Apply structural plans, specifications, and building codes.
 - PST.04.03. Examine structural requirements for materials and procedures, and estimate construction cost.
 - PST.04.05. Follow architectural and mechanical plans to construct and/or repair equipment, buildings, and facilities.
- PST.05. Apply technology principles in the use of agricultural technical systems.**
 - PST.05.01. Use instruments and meters to test and monitor electrical and electronic processes.
 - PST.05.02. Prepare and/or use electrical drawings to design, install, and troubleshoot control systems.
 - PST.05.03. Use geospatial technologies in agricultural applications.

Appendix F:

National Educational Technology Standards for Students

- T1** Creativity and Innovation
- T2** Communication and Collaboration
- T3** Research and Information Fluency
- T4** Critical Thinking, Problem Solving, and Decision Making
- T5** Digital Citizenship
- T6** Technology Operations and Concepts

T1 Creativity and Innovation

Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students do the following:

- a. Apply existing knowledge to generate new ideas, products, or processes.
- b. Create original works as a means of personal or group expression.
- c. Use models and simulations to explore complex systems and issues.
- d. Identify trends and forecast possibilities.

T2 Communication and Collaboration

Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students do the following:

- a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media.
- b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats.
- c. Develop cultural understanding and global awareness by engaging with learners of other cultures.
- d. Contribute to project teams to produce original works or solve problems.

T3 Research and Information Fluency

Students apply digital tools to gather, evaluate, and use information. Students do the following:

- a. Plan strategies to guide inquiry.
- b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
- c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks.
- d. Process data and report results.

T4 Critical Thinking, Problem Solving, and Decision Making

Students use critical-thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. Students do the following:

- a. Identify and define authentic problems and significant questions for investigation.
- b. Plan and manage activities to develop a solution or complete a project.
- c. Collect and analyze data to identify solutions and/or make informed decisions.
- d. Use multiple processes and diverse perspectives to explore alternative solutions.

T5 Digital Citizenship

Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior. Students do the following:

- a. Advocate and practice safe, legal, and responsible use of information and technology.
- b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity.

- c. Demonstrate personal responsibility for lifelong learning.
- d. Exhibit leadership for digital citizenship.

T6 Technology Operations and Concepts

Students demonstrate a sound understanding of technology concepts, systems, and operations. Students do the following:

- a. Understand and use technology systems.
- b. Select and use applications effectively and productively.
- c. Troubleshoot systems and applications.
- d. Transfer current knowledge to learning of new technologies.

Science of Agricultural Environment

Program CIP: 03.0104

Ordering Information

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The Research and Curriculum Unit (RCU), located in Starkville, MS, as part of Mississippi State University, was established to foster educational enhancements and innovations. In keeping with the land grant mission of Mississippi State University, the RCU is dedicated to improving the quality of life for Mississippians. The RCU enhances intellectual and professional development of Mississippi students and educators, while applying knowledge and educational research to the lives of the people of the state. The RCU works within the contexts of curriculum development and revision, research, assessment, professional development, and industrial training.

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Mr. Charles McClelland, Vice Chair
Ms. Kami Bumgarner
Mr. Howell "Hal" N. Gage
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Finally, standards in the *Science of Agricultural Environment Curriculum Framework and Supporting Materials* are based on the following:

National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards

The National AFNR Career Cluster Content Standards were developed by the National Council on Agricultural Education to serve as a guide for what students should know or be able to do through a study of agriculture in grades 9–12 and 2-year postsecondary programs. The standards were extensively researched and reviewed by leaders in the agricultural industry, secondary and postsecondary instructors, and university specialists. The standards consist of a pathway content standard for each of the eight career pathways. For each content standard, performance elements representing major topic areas with accompanying performance indicators were developed. Measurements of assessment of the performance elements and performance indicators were developed at the basic, intermediate, and advanced levels. A complete copy of the standards can be accessed at <https://aged.learn.com>. The National AFNR Career Cluster Content Standards are copyrighted to the National Council for Agricultural Education and are used by permission.

Applied Academic Credit Benchmarks

Mississippi Department of Education 2010 Mississippi Science Framework

21st Century Skills and Information and Communication Technologies Literacy Standards

In defining 21st century learning, the Partnership for 21st Century Skills has embraced five content and skill areas that represent the essential knowledge for the 21st century: global awareness; civic engagement; financial, economic, and business literacy; learning skills that encompass problem-solving, critical-thinking, and self-directional skills; and Information and Communication Technology (ICT) literacy.

National Educational Technology Standards for Students

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ACT College Readiness Standards



The College Readiness Standards are sets of statements intended to help students understand what is expected of them in preparation for the ACT. These standards are integrated into teaching and assessment strategies throughout the curriculum framework.

Preface

Secondary vocational–technical education programs in Mississippi are faced with many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing true learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, Mississippi Code of 1972, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, ch. 487, §14; Laws, 1991, ch. 423, §1; Laws, 1992, ch. 519, §4 eff. from and after July 1, 1992; Carl D. Perkins Vocational Education Act IV, 2007; and No Child Left Behind Act of 2001).

Research Synopsis

Agricultural and Environmental Science and Technology Research

The Agricultural Sciences Career Cluster covers the broad field of occupations related to the production and use of plants and animals for food, fiber, aesthetic, and environmental purposes. According to the U.S. Department of Labor, the growing interest in worldwide standardization of agricultural equipment should result in increased employment of agricultural engineers. Job opportunities should also result from the increasing demand for agricultural products, the continued efforts for more efficient agricultural production, and the increasing emphasis on the conservation of resources. The sales of food and fiber products amounted to 5.8 billion dollars in 2005 according to USDA statistics. Additionally, the Mississippi Department of Agriculture and Commerce estimates that 30% of the state's workforce is employed in jobs relating directly or indirectly to agriculture.

Agriculture and Environmental Science and Technology will target careers at the professional and technical levels in agriculture. Students enrolled in these courses should be better prepared to pursue degrees at the community college and 4-year college levels.

Employment Projections

Data for this synopsis were compiled from employment projections prepared by the Mississippi Department of Employment Security and the U. S. Department of Labor. The National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards developed by the National Council for Agricultural Education and scholarly research articles were also reviewed as a guide for the redesign of the Agriculture and Natural Resources Cluster.

Industry Job Data – Employment Projections 2006 to 2016 for Mississippi

Note: Compiled by Mississippi Department of Employment Security and Labor Market Information Department

Occupational title	Employment, 2006	Projected employment, 2016	Change 2006– 2016		Total Projected Avg. Annual Job Openings
			Number	Percent	
Animal Breeders	9,770	9,870	100	1.0	165
Agricultural and Food Science Technicians	260	310	50	19.2	10
Agricultural Equipment Operators	1,090	1,190	100	9.2	40
Agricultural Sciences Teachers, Postsecondary	190	240	50	26.3	20
Conservation Scientists	790	890	100	12.7	30
Custodial and Caretaking Supervisors and Workers	46,920	54,110	7,190	15.3	2,320
Environmental Engineers	270	320	50	18.5	10
Environmental Engineering	50	100	50	100.0	0

Occupational title	Employment, 2006	Projected employment, 2016	Change 2006– 2016		Total Projected Avg. Annual Job Openings
			Number	Percent	
Technicians					
Environmental Scientists and Specialists	420	470	50	11.9	10
Environmental Science and Protection Technicians	100	150	50	50.0	5
Farmworkers and Laborers, Crop, Nursery, and Greenhouse	5,160	5,810	650	12.6	225
Farmworkers, Farm and Ranch Animals	1,400	1,550	150	10.7	65
First-Line Supervisors / Managers of Farming, Fishing, and Forestry Workers	1,390	1,540	150	10.8	40
Food Processing Workers	14,920	18,320	3,400	22.8	680
Foresters	470	520	50	10.6	20
Forest and Conservation Technicians	390	440	50	12.8	15
Forest and Conservation Workers	880	980	100	11.4	30
Grounds Maintenance Workers	10,310	11,810	1,500	14.5	375
Logging Equipment Operators	3,910	4,210	300	7.7	100
Purchasing Agents and Buyers, Farm Products	80	130	50	62.5	5
Soil and Plant Scientists	430	480	50	11.6	10
Veterinarians	540	640	100	18.5	25
Veterinary Assistants and Laboratory Animal Caretakers	690	890	200	29.0	35
Veterinary Technologists and Technicians	440	540	100	22.7	15

Note: Data was retrieved from the Mississippi Department of Employment Security (2009).

Occupational Employment and Wage Estimates for Mississippi May 2006

Occupation	Employment, 2006	Avg. Hourly Wage	Average Annual Wage
Farmers and Ranchers	2,760	\$17.85	\$43,560.00
Farm Managers and Supervisors	2,640	\$23.23	\$48,360.00
Logging Equipment Operators	3,890	\$14.28	\$30,880.00
Landscaping Supervisors	2,990	\$17.93	\$40,240.00
Landscape Workers	8,560	\$10.22	\$23,010.00
Agricultural Scientists/Technicians	29,680	\$18.33	\$38,555.00

Note: Data was retrieved from the U.S. Bureau of Labor Statistics (2009)

Curriculum Content

In compiling the research for the Agricultural Sciences cluster, face-to-face and telephone interviews were conducted with representatives of agricultural employers and agricultural agencies. The following comments summarize the results of these interviews:

- While opportunities to enter farming on a full-scale commercial enterprise basis are limited, opportunities do exist and are expected to increase as current operators retire and begin to rent their land to companies and individuals. Opportunities are also expected to increase for consultants and technicians who support production enterprises by providing specialized services to producers.
- There was general agreement among all persons interviewed that all students need to better develop skills related to leadership, teamwork, communication, and work ethics, habits, and values. All respondents also indicated that a basic knowledge of economics, recordkeeping, budgeting, and business decision-making skills will be essential in today's "lean" environment.
- Opportunities for high school graduates in all fields of agriculture are limited to the basic entry-level positions. More abundant opportunities exist for students who have received advanced training at the community college or 4-year colleges.
- All respondents agreed that a common core of knowledge and skills existed across all three major pathways related to the following themes: leadership and personal development; principles of plant science and production; principles of soil science and air and water quality; principles of agricultural power, structures, and technology; and principles of economics and management. A sixth theme, principles of animal science and production, exists for students in the AEST and Agriculture and Natural Resources pathway.
- All respondents agreed that students in all three pathways should be exposed to the process by which agricultural products are grown, managed, harvested, processed, and marketed. As students study this process, they should be also exposed to the different careers that are involved in all segments of the industry.
- The role of federal and state agencies including the USDA, OSHA, FDA, EPA, and so forth should be discussed. Also, the role of agricultural organizations such as the Poultry Association, Nurseryman's Association, and Farm Bureau needs to be investigated.

Results of the survey of employers and agricultural agency representatives show that there are six major themes or topics that apply to a majority of occupations in the agriculture and natural resources area. These themes and their respective pathways are listed below.

Theme	AEST	Ag and Nat. Resources	Horticulture/Landscape
Principles of Leadership, Personal Development, and Career Success	X	X	X
Principles of Plant Science and Production	X	X	X
Principles of Animal Science and Production	X	X	
Principles of Soil, Water, and Air Quality, Conservation, and Use	X	X	X
Principles of Agricultural Power, Structures, and Technological Systems	X	X	X
Principles of Management, Economics, and Marketing	X	X	X

Executive Summary

Program Description

Science of Agricultural Environment is an advanced level course for the Agricultural and Environmental Science and Technology Program. All students must complete *Concepts of Agriscience* before being allowed to enroll in the advanced courses of the program. The course focuses on the development of skills and knowledge related to the management, conservation, and responsible use of natural resources and on the protection and enhancement of the environment. Instruction is provided on soil, air, and water conservation and use; waste management; forest management; local and global environmental issues; and environmental stewardship. The course carries 1 Carnegie unit of credit that can count as a science elective credit for high school graduation. Students may also earn an additional ½ Carnegie unit by completing a successful supervised agricultural experience program.

Industry Certification

No national industry recognized certifications are known to exist at this time in the field of Agriscience. Competencies and suggested performance indicators in the *Science of Agricultural Environment* course have been correlated, however to the National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards, which have been reviewed and endorsed at the national level by the National Council on Agricultural Education.

Articulation

The following articulation plan is in place for the AEST Pathway.

High School Program	Community College Program	Community College Course
Agricultural & Environmental Science & Tech – Animals	Ag Business & Mgmt Tech	AGT 1214 - Applied Principles of Animal Production
Agricultural & Environmental Science & Tech – Plants	Ag Business & Mgmt Tech	AGT 1313 - Applied Principles of Plant Production
Agricultural & Environmental Science & Tech –Agribusiness and Entrepreneurship Technology	Ag Business & Mgmt Tech	AGT 1613 - Agricultural Records
Agriculture & Natural Resources	Ag Business & Mgmt Tech	AGT 1111 - Survey of Agriculture
Horticulture	Horticulture/ Landscaping Cluster	HLT 1214 - Applied Principles of Plant Propagation

Assessment

Students will be assessed using the AEST MS-CPAS2 test. All students will be tested on *Concepts of Agriscience* and the second course that they may take in their chosen path of study. The second course may be one of the following:

- Science of Agricultural Animals
- Science of Agricultural Environment
- Science of Agricultural Mechanization
- Science of Agricultural Plants

The MS-CPAS2 blueprint can be found at <http://redesign.rcu.msstate.edu/curriculum/>. If there are questions regarding assessment of this program, please contact the instructional design specialist at the Research and Curriculum Unit at 662.325.2510.

Student Prerequisites

Prior to enrolling in *Science of Agricultural Environment*, a student must have completed *Concepts of Agriscience*. *Science of Agricultural Environment* may be offered to students in grades 10–12.

Applied Academic Credit

Content of the *Science of Agricultural Environment* course has been aligned to the 2010 Mississippi Science Curriculum Framework. Students who complete *Science of Agricultural Environment* may receive one elective science credit that will count toward high school science graduation requirements. (See *Appendix A: High School Graduation Requirements in Mississippi Public Schools Accountability Standards* for the current school year for current status.)

Licensure Requirements

A 992 endorsement is currently required to teach any course in the Agricultural and Environmental Science and Technology Program. In order to receive a 992 endorsement, applicants must do the following:

1. Hold a valid Mississippi Educator License with endorsement #301 – Vocational Agriculture Education Programs or #302 – Agriculture.
2. Possess a baccalaureate degree in an agricultural subject area.
3. Complete the 3-semester-credit-hour course devoted to the teaching of Agricultural and Environmental Science and Technology courses. The course, AIS 6113 - Methods of Teaching Agriscience, is currently offered by Mississippi State University.
4. Enroll immediately in the Vocational Instructor Preparation (VIP) program or the College and Career Readiness Education Program (CCREP).
5. Complete the individualized Professional Development Plan (PDP) requirements of the VIP or CCREP prior to the expiration date of the 3-year vocational license.
6. Successfully complete an MDE-approved computer literacy certification exam.

7. Successfully complete a certification for an online learning workshop, module, or course that is approved by MDE.

Note: If the applicant meets all requirements listed above, that applicant will be issued a (992) endorsement—a 5-year license. If the applicant does not meet **all** requirements, the applicant will be issued a 3-year endorsement (license), and all requirements stated above must be satisfied prior to the ending date of that license.

Professional Learning

The professional learning itinerary for the middle school or individual pathways can be found at <http://redesign.rcu.msstate.edu>. If you have specific questions about the content of each training session provided, please contact the Research and Curriculum Unit at 662.325.2510, and ask for the Professional Learning Specialist.

Course Outlines

Course Description: Science of Agricultural Environment introduces and develops skills for students in environmental areas related to the use and management of natural resources in the food and fiber systems. New technologies being used to enhance human capabilities to monitor and protect the environment are introduced. The overall focus is on maintaining and protecting resources to assure quality human life. Important relationships of living organisms to land and soil, water, the atmosphere, waste management, forestry, and energy management are included. Stress is on understanding global environmental issues and developing appropriate attitudes of environmental stewardship.

Science of Agricultural Environment (One Carnegie Unit) - Course Code: 991102

Unit	Title	Hours
1	Introduction to the Science of Agricultural Environment	7
2	Experiential Learning (SAE)	5
3	Living Organisms and Ecology	15
4	Land and Soil Management	10
5	Water Quality Management	10
6	The Atmosphere and Environmental Quality	10
7	Forestry and the Environment	10
8	Wildlife and the Environment	10
9	Environmental Stewardship	20
10	Issues in a Global Environment	10
		107

Using This Document

Unit Number and Title

Suggested Time on Task

An estimated number of clock hours of instruction that should be required to teach the competencies and objectives of the unit. A minimum of 140 hours of instruction is required for each Carnegie unit credit. The curriculum framework should account for approximately 75–80% of the time in the course.

Competencies and Suggested Objectives

A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies. The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.

Suggested Teaching Strategies

This section of each unit indicates research-based strategies that can be used to enable students to master each competency. Emphasis has been placed on strategies that reflect active learning methodologies. Teachers should feel free to modify or enhance these suggestions based on needs of their students and resources available in order to provide optimum learning experiences for their students.

Suggested Assessment Strategies

This section indicates research-based strategies that can be used to measure student mastery. Examples of suggested strategies could include rubrics, class participation, reflection, and journaling. Again, teachers should feel free to modify or enhance these suggested assessment strategies based on local needs and resources.

Integrated Academic Topics, 21st Century Skills and Information and Communication Technology Literacy Standards, ACT College Readiness Standards, and Technology Standards for Students

This section identifies related academic topics as required in the Subject Area Testing Program (SATP) in Algebra I, Biology I, English II, and U.S. History from 1877, which are integrated into the content of the unit. Research-based teaching strategies also incorporate ACT College Readiness standards. This section also identifies the 21st Century Skills and Information and Communication Technology Literacy skills. In addition, national technology standards for students associated with the competencies and suggested objectives for the unit are also identified.

References

A list of suggested references is provided for each unit. The list includes some of the primary instructional resources that may be used to teach the competencies and suggested objectives. Again, these resources are suggested, and the list may be modified or enhanced based on needs and abilities of students and on available resources.

Science of Agricultural Environment

Unit 1: Introduction to the Science of Agricultural Environment

7 Hours

Competency 1: Examine the environment and how it is affected by human and agricultural activities.

NRS.01, NRS.03, NRS.04, ESS.01, ESS.02, ESS.05, BIOI 2, BIOI 3, ES 2, ES 3

Suggested Enduring Understandings

1. Natural resources are an integral part of our daily lives.
2. Environmental sustainability is critical in protecting resources for future use.
3. Natural resources are interdependent on one another.
4. The quality and protection of the environment is the responsibility of the agriculture industry.

Suggested Essential Questions

1. What are natural resources, and how are they classified?
2. What does sustainability mean, and how does it affect how we manage our use of the environment?
3. What is a food chain, and how is energy transferred through a food chain?
4. Why does the agriculture industry need to be concerned about environmental quality and protection?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify natural resources, and distinguish between renewable and nonrenewable resources. (DOK 2)	a. Conduct a survey on how students feel about protection of the environment and natural resource use. From the findings of the survey, identify natural resources that the students are aware of, and lead a discussion on how these and other natural resources are used. Define the terms renewable and nonrenewable resources, and classify each resource. Have students distinguish between renewable and nonrenewable resources and justify their decisions. Use the <i>Lecture Notes for Unit 1 (1.2)</i> as a guide. ^{E1, E2, E3, E4, CS2, CS3, CS4, T2, T3}	a. Grade students on completion of the survey using the <i>Rubric for Student Survey on Environmental Protection and Natural Resources Use (1.1)</i> .
b. Discuss the concept of sustainability in environmental and natural resource management. (DOK 2)	b. Define the term sustainability, and provide illustrations of its applications in the environment or in agricultural production. Have students write a paragraph in their own words summarizing the concept of sustainability. ^{E1, CS1, T2, T3, T4}	b. Use paper and pencil test questions to check students' understanding of the concept of sustainability. (See <i>Sample Test Questions (1.6)</i> for sample questions.)

c. Examine relationships of the ecosystem to energy transfer and food chains. (DOK 2)	c. Using class discussion and group assigned research, create a giant food web identifying the role of natural resources and various levels of the food chain throughout the web. Use <i>Construct a Food Web Activity (1.3)</i> as the activity guide. Lead a discussion on the process by which energy from the sun is transformed into other forms of energy through the food chain. E1, E2, CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T4	c. Use the <i>Rubric for Group Activity to Construct a Food Web (1.4)</i> to assess student mastery.
d. Assess the relationship of agriculture to the quality of the environment. (DOK 3)	d. Have students research and prepare a position paper that supports the role of agriculture and natural resources in promoting conservation and responsible use of natural resources and the environment. They can narrow their topic to a specific crop or animal or to a specific area of agriculture related to their chosen career objective. CS1, CS2, CS4, CS5, T1, T2, T3, E1, E2, E3, E4, E5, E6	d. Use the <i>Rubric for Position Paper on Conservation and Responsible Use of Natural Resources (1.5)</i> to assess student mastery. Use a pencil and paper test to assess student mastery. (See <i>Sample Test Questions (1.6)</i> for sample questions.)

Competency 2: Analyze issues affecting the global environment and how these relate to agriculture.

NRS.01, ESS.02, ES 2, ES 3, AQ 4, BIOI 1, BIOI 3

Suggested Enduring Understandings

1. As human population demands change and grow, the environment is impacted.
2. Agriculture production and its impact on the environment are affected as human population demands increase.
3. As the landscape changes to meet human needs, these changes can affect the environment.
4. Protecting our natural resources is everyone's responsibility.

Suggested Essential Questions

1. What changes in population affect the environment?
2. How does agriculture affect the quality of the environment?
3. How do building roads, bridges, and buildings affect the landscape of an area?
4. What can individual homeowners, business people, and farmers do to protect the environment?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Examine trends and factors influencing population changes. (DOK 2)	a. Have students read the chapter 3, Human Population Growth, and chapter 4, Human Population Demands, from the text (Porter et. al., 2006). Lead a discussion on trends and factors that influence population changes. List major trends and factors, and have students	a. Use a student electronic notebook rubric to evaluate student journals

	take notes to be transferred to their electronic notebook. Have students prepare a graph comparing population growth rates in the United States to growth rates in other countries. CS2, T3, M2, M3, M5, S1	and portfolios. Use the <i>Rubric for Student Electronic Notebook (1.7)</i> to assess student mastery. Evaluate the graph assignment for accuracy of data and graphics.
b. Investigate the demands of human population on the environment and how these relate to agriculture. (DOK 1)	b. Use clips from the movie <i>Over the Hedge</i> to illustrate effects of population growth and lead a discussion on how this applies to humans. Have students use census data to create a graph illustrating changes in the population over the last 30 years. Compare general population growth to the growth rate for agricultural producers, and show that data on a poster. CS2, CS4, T1, T3, M3, M5, S1	b. Evaluate the graph and poster for accuracy of data and graphics.
c. Describe the effect of landscape degradation on the environment. (DOK 1)	c. Lead a discussion on the concept of landscape degradation. Have students identify sources of landscape degradation and discuss how they impact the environment and our natural resources. CS2, CS4, T1, T3, M3, M5, S1	c. Use a paper and pencil test to evaluate this indicator.
d. Examine natural resource conservation and interdependency. (DOK 2)	d. Define the terms conservation, preservation, and interdependency. Assign students to research and prepare a written report on agencies, such as the Nature Conservancy, and their efforts to preserve land and the environment. The report should cover the mission and purpose of the organization and cite examples of activities and projects that promote conservation and interdependency of resources. CS1, CS2, T2, T3, T5, T6, R4, W2, W4	d. Use the <i>Rubric for Written Report on Environmental Agencies (1.8)</i> to score the report on the agency and its work to conserve natural resources.

Competency 3: Demonstrate career and leadership skills required for employment in the environmental and natural resources industry. ^{ES 3}

Suggested Enduring Understandings

1. Leadership and human relations skills are key factors in being successful in any career.
2. Involvement in student youth organizations effectively prepares a student for furthering his or her education and employment.

Suggested Essential Questions

1. What leadership and human relations skills are necessary for success in any career?
2. What programs and/or activities does the FFA offer that can prepare students for personal growth and career success?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Demonstrate leadership, human relations, and workplace skills. (DOK 2)	a. Provide students with the listing of <i>21st Century Life and Career Skills (1.9)</i> found in this unit. Lead students in a discussion of how these skills apply to their current career interest as a student and how these skills will apply to their career success after school. Provide students with a copy of the rubric that will be used to evaluate each student's demonstration of life and career skills. Have students self-evaluate their current score on this rubric, and explain that they will be periodically (at least once a grading period) be graded on their ability to demonstrate these skills. CS1, CS2, CS3, CS4, CS5, T4, R5, S3, W1	a. Use the <i>21st Century Life and Career Skills Rubric (1.10)</i> to assess student mastery.
b. Develop a plan for increasing leadership, human relations, and workplace skills through student and youth organizations. (DOK 3)	b. Have an officer of the local FFA chapter speak to the class regarding FFA activities and programs that develop leadership, human relations, and workplace skills (career development events, chapter activities, proficiency awards, degree programs, community service projects, etc.). Have students prepare a personal plan of activities for the coming year that identifies FFA and other youth organization activities that contribute to the development of leadership, human relations, and workplace skills. Have students keep records and documentation of their accomplishments to be incorporated into their SAE record book and electronic portfolio. CS1, CS2, CS3, CS4, CS5, T1, T2, T4, T5, T6, E1, E2, W1, W2, W3, W4	b. Use the <i>Rubric for Personal Plans (1.11)</i> to evaluate the student's personal plan of activities.

Competency 4: Identify general safety precautions for the laboratory and field.

Suggested Enduring Understandings

1. Safety policies and procedures are designed to protect people from injury and must always be followed.
2. Each person is responsible for his or her own personal behavior in a shop or laboratory setting and for using appropriate personal safety devices.

Suggested Essential Questions

1. What are the general safety standards that apply to people in the laboratory and field?
2. What are the specific safety rules and practices that must be followed when working in the AEST classroom and

laboratory?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe procedures for working in and maintaining a safe and orderly workplace. (DOK 1)	a. Provide students with a list of policies and rules related to behavior and activities in the Environmental and Natural Resources lab. (See sample set of rules in the <i>Rubric for Personal Plans (1.11)</i> . These rules are an example only and may be modified or replaced as necessary.) Lead a classroom discussion of these policies and activities, and question students to ensure they understand the importance of following all policies and rules. CS1, CS2, CS4, CS5, T2, T4, M1, M7	a. Describe procedures for working in and maintaining a safe and orderly workplace.
b. Describe personal behavior and personal safety requirements for the laboratory and field. (DOK 1)	b. Identify personal safety behaviors and devices used in the environmental and natural resources laboratory, and demonstrate their use. CS1, CS2, CS4, CS5, T2, T4, M1, M7	b. Describe personal behavior and personal safety requirements for the laboratory and field.
c. Identify common hazards found in laboratory and field work, and apply procedures to prevent injury. (DOK 1)	c. Assign students to groups of two or three to create a presentation on an assigned safety topic to identify and describe common hazards encountered in working in environmental laboratory and field work (poisonous plants, insects, and animals; heat and sun stroke, dehydration, getting lost, allergic reactions, hypothermia, etc). Discuss and demonstrate as practical, prevention, and treatment methods, including first aid. CS1, CS2, CS4, CS5, T2, T3, T4, E1, E2, M1, M7, R3, R4, R5, S1, W4, W5	c. Identify common hazards found in laboratory and field work, and apply procedures to prevent injury.
d. Describe procedures for working in and maintaining a safe and orderly workplace. (DOK 1)	d. Provide students with a list of policies and rules related to behavior and activities in the Environmental and Natural Resources lab. (See sample set of rules in the <i>Rubric for Personal Plans (1.11)</i> . These rules are an example only and may be modified or replaced as necessary.) Lead a classroom discussion of these policies and activities and question students to ensure they understand the importance of following all policies and rules. CS1, CS2, CS4, CS5, T2, T4, M1, M7	d. Describe procedures for working in and maintaining a safe and orderly workplace.

Competency 5: Explore career opportunities in environmental and natural resources areas.

BIOI 1, CHI 1,

PS 1

Suggested Enduring Understandings

1. Careers should be selected based on a student's interests, skills, and job descriptions.
2. Various careers require different kinds of education and training.
3. Potential employers are out there. One just needs to know where to look.

Suggested Essential Questions

1. What skills and qualifications are required for a particular job?
2. What kinds of education and training are required for a particular job?
3. Where can jobs be found in an environmental career?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Analyze careers in environmental agriculture and the skills required by employees. (DOK 3)	a. Have students to research two different environmental careers and develop <i>Need to Know and How to Guide</i> for those particular careers (Job outlook, education, training and skills, work conditions, etc.). One of the careers included in the guide should be a possible job interest for the student. Have the student identify personal interests and how this career matches. The student should locate a local employer and find what characteristics, skills, and expectations the employer wants from a potential employee and highlight these skills in the guide. CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T4, E1, E2, E3, W2, W3, W4, W5, W6	a. Use the <i>Need to Know and How to Guide Report Rubric (1.12)</i> to assess student mastery on the oral report on the job shadow/interview experience.
b. Investigate education and training opportunities in environmental and natural resources. (DOK 2)	b. Invite a representative from a community college, technical institute, college, or university to serve as a resource person in class. Ask him or her to discuss the available educational opportunities in environmental and natural resource occupations, entry requirements, and estimated costs and returns. Have the students add their findings to the <i>Need to Know and How to Guide</i> created in the indicator above. CS1, CS2, CS3, CS4, CS5, T1, T2, T4, E1, E2, E3, W2, W3, W4, W5, W6	b. Use the <i>Need to Know and How to Guide Report Rubric (1.12)</i> to assess student mastery on the oral report on the job shadow/interview experience.
c. Locate potential jobs and employers. (DOK 3)	c. Have students search for environmental and natural resources jobs using the Internet, local	c. Use the <i>Natural Resources Careers</i>

and state newspapers, and other sources. Have them develop a table comparing job descriptions, entry requirements, and salaries for different jobs in different areas of the nation. Have students summarize their findings in a chart and select the job that is a “best fit” for them. A written justification should be provided.

Research Rubric (1.13) to assess student mastery.

Standards

AFNR Industry Standards

- NRS.01 Recognize the important interrelationships between natural resources and humans necessary to conduct management activities in natural environments.
- NRS.03 Apply knowledge of natural resources industries to production practices and processing procedures.
- NRS.04 Demonstrate techniques used to protect natural resources.
- ESS.01 Use analytical procedures to plan and evaluate environmental service systems.
- ESS.02 Identify policies and regulations affecting environmental service systems to determine their impact on facility operation.
- ESS.05 Examine the relationships between energy sources and environmental service systems.

Applied Academic Credit Standards

Aquatic Science

- AQ 4 Draw conclusions about the relationships between human activity and aquatic organisms.

Biology I

- BIOI 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- BIOI 2 Describe the biochemical basis of life, and explain how energy flows within and between the living systems.
- BIOI 3 Investigate and evaluate the interaction between living organisms and their environment.

Chemistry I

- CHI 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.

Environmental Science

- ES 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ES 2 Develop an understanding of the relationship of ecological factors that affect an ecosystem.
- ES 3 Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.

Physical Science

- PS 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS3 Social & Cross-Cultural Skills
- CS4 Productivity & Accountability
- CS5 Leadership & Responsibility

National Educational Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making

- T5 Digital Citizenship
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- E1 Topic Development in Terms of Purpose and Focus
- E2 Organization, Unity, and Coherence
- E3 Word Choice in Terms of Style, Tone, Clarity, and Economy
- E4 Sentence Structure and Formation
- E5 Conventions of Usage
- E6 Conventions of Punctuation
- M2 Probability, Statistics, and Data Analysis
- M3 Numbers: Concepts and Properties
- M5 Graphical Representations
- M7 Measurement
- R3 Sequential, Comparative, and Cause–Effect Relationships
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- S1 Interpretation of Data
- S3 Evaluation of Models, Inferences, and Experimental Results
- W1 Expressing Judgments
- W2 Focusing on the Topic
- W3 Developing a Position
- W4 Organizing Ideas
- W5 Using Language

Suggested References

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Science of Agricultural Environment

Unit 2: Experiential Learning (SAE)

5 Hours

Competency 1: Plan and implement an experiential learning program. ABS.02, ABS.04

Suggested Enduring Understandings

1. Planning is a continuous process in business.
2. Plans must be reviewed and updated on a regular basis.

Suggested Essential Questions

1. What are my goals and plans for an SAE in the coming year?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Update and revise long-range and short-term goals of the experiential learning program. (DOK 3)	a. Based on the summary and analysis of the students' previous experiential learning activities, have students reflect and revise or amend their experiential learning long-range and short-term goals for the coming year. The goals should be added to the students' electronic portfolios. CS1, CS2, CS4, T1, T3, T4, T6, W1, W2, W4, W5	a. Use an experiential learning planning rubric and record keeping rubric to evaluate the students' goals. (See the <i>Rubric for Experiential Learning Planning and Record Keeping (2.1).</i>)
b. Update, revise, and implement the experiential learning plan/training agreement for the coming year. (DOK 3)	b. Based on the revised goals, have students update, amend, and revise their experiential learning plan/training agreement to reflect growth in skill and proficiency levels. The updated plan should be added to the students' electronic portfolios. CS1, CS2, CS4, T1, T3, T4, T6, W1, W2, W4, W5	b. Use an experiential learning planning rubric and record keeping rubric to evaluate the students' goals. (See the <i>Rubric for Experiential Learning Planning and Record Keeping (2.1).</i>)

Competency 2: Maintain records and documentation of experiential learning activities, projects, and enterprises. ABS.02, ABS.03, ABS.04, ABS.06

Suggested Enduring Understandings

1. Records must be maintained and updated on a regular and timely basis to accurately reflect progress.
2. Records should be summarized to give a "snapshot" of operations on a regular basis that can be used to make decisions.

Suggested Essential Questions

1. How do I update and maintain the records of my experiential learning program?
2. How do I summarize and analyze my experiential learning records?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Update and maintain records of experiential learning related income, expenses, activities, skills, and supplementary improvement projects. (DOK 3)	a. Review requirements for record keeping for the different types of experiential learning. Have students maintain and update their records electronically throughout the year. CS2, CS4, T3, T4, T6, M1, M2, W4	a. Use the <i>Rubric for Experiential Learning Planning and Record Keeping (2.1)</i> to evaluate the students' goals.
b. Prepare an annual summary report. (DOK 3)	b. Review procedures for summarizing records. Have students prepare an annual summary of their experiential learning activities at the end of the school year to include income and expense summary and a net worth statement. CS2, CS4, T3, T4, T6, M1, M2, W4	b. Use the <i>Rubric for Experiential Learning Planning and Record Keeping (2.1)</i> to evaluate the students' summaries.

Standards

AFNR Industry Standards

- ABS.02. Utilize appropriate management planning principles in AFNR business enterprises.
- ABS.03. Utilize record keeping to accomplish AFNR business objectives while complying with laws and regulations.
- ABS.04. Apply generally accepted accounting principles and skills to manage cash budgets, credit budgets, and credit for an AFNR business.
- ABS.05. Assess accomplishment of goals and objectives by an AFNR business.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS4 Productivity & Accountability

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- M1 Basic Operations and Applications
- M2 Probability, Statistics, and Data Analysis
- W1 Expressing Judgments
- W2 Focusing on the Topic
- W4 Organizing Ideas
- W5 Using Language

Suggested References

Cooper, E., & Burton, L. (2007). *Agriscience: Fundamentals and applications* (4th ed.). Clifton Park, NJ: Thomson Delmar.

National FFA Organization. (n.d.). *Introduction to SAE* [PowerPoint presentation]. Retrieved June 9, 2010, from http://www.ffa.org/documents/sae_tch_intro.zip

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Texas Tech University. (n.d.). *Supervised agricultural experience*. Retrieved June 9, 2010, from <http://www.depts.ttu.edu/agriculturalteachers/Survival/AGTCHNBK/10SAE.PDF>

Science of Agricultural Environment

Unit 3: Living Organisms and Ecology

15 Hours

Competency 1: Investigate the role of living organisms in the environment. AS.02, AQ 1, AQ 2, AQ 3, BIOI 3, BIOI 6, BIOII 4, BIOII 5, BO 5, ES2, ES 3, ZO 3

Suggested Enduring Understandings

1. Organisms are classified using distinguishing characteristics that separate them into kingdoms.
2. Each of the five kingdoms that define the classification of an organism plays a significant role in maintaining the health of the environment.
3. Microorganisms that exist in the environment can be collected and identified.

Suggested Essential Questions

1. What characteristics are used to classify organisms in the environment?
2. What role does each of the five kingdoms of organisms play in maintaining the health of the environment?
3. How do you collect and examine microorganisms in the environment?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Classify living organisms in the environment. (DOK 1)	a. Have students identify the five kingdoms of organisms found in the environment: Monera, Protista, Fungi, Plantae, and Animalia. Students should be able to distinguish characteristics between each kingdom and identify organisms that are classified within each. CS2, CS4, T2, T3, T4, R5	a. Pencil and paper test
b. Examine the roles of living organisms in the environment. (DOK 2)	b. Lead a discussion with the students identifying the role that each of the five kingdoms of organisms plays in the environment. Have the students list the contributions and the negative impacts that each kingdom can have on the environment. CS2, CS4, T2, T3, T4, R5	b. Pencil and paper test
c. Collect and examine microbiological organisms in the local environment. (DOK 3)	c. Take a walk around the school campus or along a nearby creek, and evaluate the local environment, noting the presence of various organisms and a description of the habitat in which they are found. Collect specimens for evaluation and observation upon returning to the classroom. Prepare wet mount slides of various microorganisms collected in the exercise above or brought from the student's home, and examine them under a microscope. Identify each specimen, and preserve if	c. Use the <i>Microbe Collection and Wet Mount Slide Performance Rubric (3.1)</i> to assess student mastery.

possible. CS2, CS4, CS5, T2, T3, T4, T6, R5, S2, S3

Competency 2: Examine relationships of living organisms and the environment.

NRS.01, AQ 4, BIOI 3, BIOI 6, BIOII 4,

BO 5, ES 2, ES 3, ZO 2, ZO 3, ZO 4

Suggested Enduring Understandings

1. All organisms have unique life spans that progress through five common stages of life.
2. There are eight life processes, plus reproduction, that every organism must go through in order to complete the cycle of life.
3. Organisms have the ability to physically and genetically adapt to changes in their environment.

Suggested Essential Questions

1. What is a life span, and how does it vary among organisms?
2. What are the eight life processes essential for an organism to live?
3. Why is reproduction not an essential life process?
4. How can organisms change their bodies to adjust to changes in the environment?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Explain the concept of a life span and the stages of life. (DOK 2)	a. Explain the concept of life span, and highlight the five stages of life - beginning, growth, maturity, declining, and dying through the use of a PowerPoint presentation. Have students select from a list one species of local wildlife and investigate the life span of that species. Require the student to create a visual aid depicting the life span of that species to include the name of that animal at each stage of its life (fawn, yearling, doe, and buck). E1, E2, R3, R4, R5, CS2, CS4, T1, T3	a. Pencil and paper test Use the <i>Life Span Visual Report Rubric (3.2)</i> to assess student mastery.
b. Investigate the life processes essential for the living condition. (DOK 2)	b. Investigate the basic life processes (growth and repair, food acquisition and use, movement and locomotion, circulation, respiration, secretion, sensation, excretion, and reproduction). Have students associate the anatomy and physiology of living organisms to each life process through the use of student created posters and/or illustrations. Divide students into groups of two to three, and assign each a life process to research and prepare a presentation poster or illustration to share with the class. E1, E2, W2, W3, W4, W5, CS 1, CS2, CS3, CS4, CS5, T1, T2, T3, T4, T6	b. Use the <i>Rubric for Life Process Poster (3.3)</i> to assess student mastery.
c. Discuss how the anatomy and physiology of living organisms adapts	c. Use student input to define heredity and genetics. Relate the concepts of heredity and genetics to biodiversity: genetic diversity, species diversity, and ecological diversity.	c. Use the <i>Grading Checklist for Collection of Specimens and/or</i>

over time to the native environment.
(DOK 3)

Have students identify diversity among similar organisms, through collections of insects, vertebrates, invertebrates, or plankton. Have students collect specimens or pictures of specimens from the local area that illustrate biodiversity. E1, E2, CS1, CS2, CS4, CS5, T2, T3, T4, T5, T6

Photographs that Illustrate Biodiversity (3.4) to assess student mastery.

Competency 3: Discuss the impact of agricultural pests and pest control measures on the environment.

AS.06, ESS.04, NRS.01, NRS.02, NRS.03, NRS.04, AQ 3, AQ 4, BIOI 3, BIOI 6, BIOII 4, BIOII 5, BO 8, ES 2, ES 3

Suggested Enduring Understandings

1. Pests in the environment can cause a lot of expensive damage to agricultural crops.
2. The method of controlling pests has a direct correlation to its impact on the environment.

Suggested Essential Questions

1. What types of damage can agricultural pests cause to the environment?
2. What methods of pest control can be used that will not damage or threaten the quality of the environment?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Analyze the economic impact of agricultural pests on the environment. (DOK 2)	a. Using a PowerPoint presentation, explain the economic impact of agricultural pests in the environment. Include pictures of insect damage in various stages on different aspects of the environment. E1, E2, E3, E4, R1, R2, R3, R4, R5, S1, S2, W1, W2, W3, W4, W5, CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T4, T5, T6	a. Pencil and paper test
b. Relate methods of controlling agricultural pests to impact on the environment. (DOK 3)	b. Have students select from a prepared list an agricultural pest that has an impact on the environment. The student is to research that pest and create an informational pamphlet highlighting the pest, its target, the effects of its impact on the environment, and methods of controlling or prevention of infestation. The pamphlet should include pictures or illustrations and pertinent information. E1, E2, E3, E4, R1, R2, R3, R4, R5, S1, S2, W1, W2, W3, W4, W5, CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T4, T5, T6	b. Use the <i>Rubric for Pest Pamphlet (3.5)</i> to assess student mastery.

Competency 4: Examine principles of ecology as related to environmental quality.

ESS.01, ESS.02, ESS.03, ESS.05, NRS.01, NRS.02, NRS.03, NRS.04, PS.01, PS.02, PST.02, AQ 1, AQ 2, AQ 3, AQ 4, BIOI 3, BIOI 6, BIO II 4, BIO II 5, BIO II 6, BO 5, ES 2, ES 3, ZO 2, ZO 3, ZO 4

Suggested Enduring Understandings

1. Many factors influence the organization of an ecosystem.
2. Although there are similarities, there are distinguishing differences between

Suggested Essential Questions

1. What factors affect the structure of an ecosystem?
2. What makes a wildlife ecosystem different from an agricultural

agricultural ecosystems and wildlife ecosystems. 3. Environmental communities are defined in layers. 4. Maintaining a functioning food chain within a food web is essential to the health of a habitat. 5. Sustaining the environment is essential to conserving our natural resources.			ecosystem? 3. How are environmental communities defined? 4. How is a food chain important to the health of a habitat? 5. What is sustainability, and how does it help to protect the environment?
Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies	
a. Develop a working definition of ecology. (DOK 1)	a. Use class discussion to formulate a definition of ecology using a Wiki through BlackBoard. Have students draw a diagram of the structure of an ecosystem, beginning with the community organization, and explain how habitats, niche, and structures are formed. Students should also distinguish between biotic and abiotic factors that influence an ecosystem. E1, E2, E3, E4, E5, R1, R2, R3, R4, R5, CS2, CS4, T1, T2, T3, T4, T5, T6	a. Use the <i>Grading Checklist for the Wiki on Ecology (3.6)</i> to assess student mastery.	
b. Compare factors associated with agricultural and wildlife ecosystems. (DOK 2)	b. Using the Chapter 11 Microhabitats in an Ecosystem activity (Turner, 1997) as a guide, assign teams of two to three students to study a part of a designated habitat located on the school campus. Students are to make comprehensive observations of the organisms present in that habitat, recording observations of both the biotic and abiotic factors in the microhabitat. Upon completion of observations, have the students compile a list of all the organisms and diagram a food chain for the particular habitat. S1, S2, S3, W1, W2, W3, W4, W5, CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T4	b. Grade the Microhabitat Observation assignment from the lab manual (Turner, 1997).	
c. Explain community organization and structure. (DOK 2)	c. Using the Owl Pellet Lab kit available from Carolina, complete the dissection of a Barn Owl Pellet. Have students identify the prey of the owl according to bones found in the pellet. View the video that accompanies the dissection lab. Diagram the food chain of the owl. Lead a class discussion on how natural selection and succession would impact the life and lifestyle of the Barn Owl. S1, S2, S3, CS1, CS2, CS3, CS4, CS5, T2, T3, T4	c. Use the <i>Grading Rubric for the Owl Pellet Dissection (3.7)</i> to assess student mastery.	
d. Diagram the food chain and web for	d. Use the Adopt a Stream or Globe program for the class to adopt an area for clean up and	d. Use the <i>Grading Rubric for Stream</i>	

organisms in a local agricultural or wildlife ecosystem. (DOK 1)	monitoring. S1, S2, S3, CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6	<i>Monitoring (3.8)</i> to assess student mastery.
e. Identify the roles of natural selection and succession. (DOK 2)	e. Explain the terms natural selection and succession. Give examples of local animals or plants that have adapted to their environment to survive. S1, S2, S3, R4, R5, CS2, T1, T2 Examine an area in the local community in terms of succession, such as a forested area or a portion of a stream in an area that is being developed. Determine the sequence of succession that is underway. Have the students prepare a diagram that illustrates succession in that particular area. S1, S2, S3, R2, R3, R4, R5, CS2, CS4, T1, T2, T3, T4	e. Pencil-paper test

Competency 5: Identify ecological diversity in agricultural and wildlife ecosystems. NRS.01, NRS.02, NRS.03, PS.01, AQ 3, AQ 4, BIOI 6, ES 2, ES 3, ES 4, BIOII 4

Suggested Enduring Understandings

1. Characteristics of the various biome that exist around the world are determined by their location in a climatic zone.
2. Homeostasis is essential to the survival of organisms around the world.
3. The birth rate and death rate of organisms within an ecosystem greatly influence the population ecology of an area.

Suggested Essential Questions

1. How do areas of latitude on the globe define climate zones and biomes?
2. What is homeostasis?
3. Why is population ecology essential to understanding the environment?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Distinguish between terrestrial and aquatic biomes, and give examples of each. (DOK 2)	a. Display a world map or globe, and explain how areas of latitude on the globe are used to define climatic zones on the earth. Further explain that within those zones, there are terrestrial and aquatic biomes, each further diversified and defined by distinctive characteristics. IM5, S1, S2, S3, CS2, CS3, T2, T3, T4 Divide students into groups of two or three, assigning each group a biome to research. Each group will write a report and create a replica of that biome to present to the class. Each report/replica should include a description of	a. Pencil and paper test Evaluate biome report for accuracy and completeness.

the biome, the organisms that live in that biome and their adaptations, and the limiting, abiotic, and biotic factors that characterize that biome. R1, R2, R3, R4, R5, S1, S2, S3, CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T4, T6		
b. Explain the importance of homeostasis in the survival of organisms. (DOK 2)	b. Define homeostasis, and discuss the importance of homeostasis in the survival of organisms. W2, W3, W4, W5, CS1, CS2, T1, T2, T3	b. Pencil and paper test
c. Describe population ecology, including natality and mortality. (DOK 1)	c. Explain the concepts of natality and mortality on population ecology. W2, W3, W4, W5, CS1, CS2	c. Pencil and paper test

Standards

AFNR Industry Standards

- PS.01. Apply knowledge of plant classification, plant anatomy, and plant physiology to the production and management of plants.
- PS.02. Prepare a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.
- AS.02. Classify animals according to hierarchical taxonomy and agricultural use.
- AS.06. Outline handling procedures for safety of animals, producers, and consumers of animal products.
- PST.02. Design, operate and maintain mechanical equipment, structures, biological systems, land treatment, power and technology.
- NRS.01. Recognize the important interrelationships between natural resources and humans necessary to conduct management activities in natural environments.
- NRS.02. Apply scientific principles to natural resource management activities.
- NRS.03. Apply knowledge of natural resources industries to production practices and processing procedures.
- NRS.04. Demonstrate techniques used to protect natural resources.
- ESS.01. Use analytical procedures to plan and evaluate environmental service systems.
- ESS.02. Identify policies and regulations affecting environmental service systems to determine their impact on facility operation.
- ESS.03. Apply scientific principles to environmental service systems.
- ESS.04. Operate environmental service systems to manage a facility environment.
- ESS.05. Examine the relationships between energy sources and environmental service systems.

Applied Academic Credit Standards

Aquatic Science

- AQ 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- AQ 2 Develop an understanding of physical and chemical properties of water and aquatic environments.
- AQ 3 Apply an understanding of the diverse organisms found in aquatic environments.
- AQ 4 Draw conclusions about the relationships between human activity and aquatic organisms.

Biology I

- BIOI 3 Investigate and evaluate the interaction between living organisms and their environment.
- BIOI 6 Demonstrate an understanding of principles that explain the diversity of life and biological evolution.

Biology II

- BIOII 4 Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.
- BIOII 5 Develop an understanding of organism classification.
- BIOII 6 Examine the behavior of organisms.

Botany

- BO 5 Relate an understanding of plant genetics to its uses in modern living.

Chemistry I

- CHI 9 Apply understanding of the interactions of matter and energy.

Environmental Science

- ES 2 Develop an understanding of the relationship of ecological factors that affect an ecosystem.
- ES 3 Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.

Zoology

- ZO 3 Differentiate among animal life cycles, behaviors, adaptations, and relationships.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS3 Social & Cross-Cultural Skills
- CS4 Productivity & Accountability
- CS5 Leadership & Responsibility

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T5 Digital Citizenship
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- E1 Topic Development in Terms of Purpose and Focus
- E2 Organization, Unity, and Coherence
- E3 Word Choice in Terms of Style, Tone, Clarity, and Economy
- E4 Sentence Structure and Formation
- M5 Graphical Representations
- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R3 Sequential, Comparative, and Cause–Effect Relationships
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- S1 Interpretation of Data
- S2 Scientific Investigation
- S3 Evaluation of Models, Inferences, and Experimental Results
- W2 Focusing on the Topic
- W3 Developing a Position
- W4 Organizing Ideas
- W5 Using Language

Suggested References

Bernstein, Winkler, & Zierdt-warshaw. (1996). *Environmental science: Ecology and impact*. Menlow Park, CA: Addison Wesley.

Carolina Biological Supply. (n.d.). *Carolina basic biology biomes cd-rom set*. [CD-ROM software]. Burlington, NC: Carolina Biological.

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Porter, L., Lee, J. S., Turner, D. L., & Hillan, M. (2003). *Environmental science and technology*. Upper Saddle River, NJ: Pearson.

Turner, D. L. (1997). *Environmental science and technology activity manual*. Upper Saddle River, NJ: Pearson

For additional references, activities, and web resources, please refer to: Mississippi Agriculture Education B.R.I.D.G.E. Web site: <http://www.rcu.blackboard.com> (Available only to registered users).

Science of Agricultural Environment

Unit 4: Land and Soil Management

10 Hours

Competency 1: Examine the process of planning for urban and rural land use. NRS 01, BIOI 3, BO 4, BO 5, ES 2, ES 3, PS 1, PS 2, SP 1, SP 2

Suggested Enduring Understandings

1. Land is a valuable environmental resource, and great care should be taken in planning for its use and protection.
2. Skills can be learned in describing and measuring land, reading maps, and making maps.
3. Global positioning is a valuable technological tool used in managing land areas.
4. Basic surveying techniques can assist a landowner in managing his or her land.
5. Some land areas have to be designated for certain uses.

Suggested Essential Questions

1. How do landowners and managers plan for land use?
2. How is land described and measured?
3. How is global positioning used to monitor the environment?
4. How do you pace the boundary of a land area?
5. How is a land area zoned for use?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Explain the concepts of land and land use. (DOK 2)	a. Define land and discuss planning for land use in both rural and urban settings. Invite a representative from the USDA Natural Resources Conservation Service to speak to the class about the work he or she does and how land is classified according to use. E1, R4, CS2, T2, T4	a. Use the <i>Guest Speaker Evaluation Form (4.1)</i> to assess student mastery.
b. Apply skills in describing and measuring land, map reading, and map making. (DOK 3)	b. Guide students through activities on pacing, measurement of land area and land use zoning. Include activities on reading and interpreting legal land descriptions. Use materials from the activity manual (Fortenberry, 2003) and from the text (RCU, 1997). Using the classroom compass set and accompanying materials, lead students through a mapping and orientation exercise. M1, M2, M3, M4, M5, M6, M7, M8, CS1, CS2, CS4, T4, T6	b. Grade activity sheets on pacing, measuring land area, and reading and interpreting legal land descriptions.
c. Apply global positioning skills. (DOK 3)	c. Instruct students on basic concepts of global positioning systems. Have students mark waypoints and utilize GPS tracking to create a map of the school. M1, M2, M3, M4, M5, M6, M7, M8, CS2, CS4, T4, T6	c. Use the <i>Land Measuring Checklist (4.2) Part 1</i> to assess student mastery.

d. Practice basic surveying techniques such as pacing, locating corners and boundaries, reading a compass, sketching a plot, and estimating an area. (DOK 3)	d. Demonstrate and allow students to practice basic surveying techniques. Provide a boundary survey of a given tract of land, and have students identify markers and boundary lines, using GPS technology and compasses. M1, M2, M3, M4, M5, M6, M7, M8, CS2, CS4, T4, T6	d. Use the <i>Land Measuring Checklist (4.2) Part 2</i> to assess student mastery.
e. Describe concepts of land-use planning and zoning. (DOK 3)	e. Invite a representative of a local zoning agency to speak to the class on concepts and principles of land use and zoning. M1, R1, R2, R3, CS4, T2, T4	e. Unit test

Competency 2: Apply principles of soil and land management and use. NRS.01, NRS.04, AQ 2, AQ 3, BIOI 1, BIOI 2, BIOI 3, CHI 1, CHI 5, ORGC 2, ES 1, ES 2, ES 3

Suggested Enduring Understandings

1. Soil is made up of minerals, organic matter, and water and air and is formed over long periods of time as a result of rocks being broken down.
2. Organic matter in soils serves to enhance the fertility and productivity of a soil.
3. Soils in different locations vary in texture, depth, and pH.
4. The highest productive use of a piece of land is dependent on the texture, depth, and surface slope of the land.

Suggested Essential Questions

1. What are the primary components of soil?
2. What is the role of soil organic matter?
3. What influences the chemical and physical makeup of soil?
4. How is the highest productive use of a soil determined?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify the materials in soil and growing media. (DOK 1)	a. Have students bring approximately one pint of <i>dry</i> soil from their local area. Set up laboratory stations with the soil sample, wax paper or paper plates, and water. Have students conduct a “feel” test of the soil samples to determine the texture of the soil. Instruct students to feel of the dry soil to determine smoothness or grittiness of the soil. Have students make observations as to the color of the soil when it is dry and the amount of clods or peds in the soil. Instruct the students to wet the soil just	a. Use the <i>Reflective Writing Rubric (4.3)</i> to assess student mastery.

	enough to make a mud ball. Have students work the wet soil in their hands, making observations about the texture, stickiness, and elasticity of the soil. Have evaluation sheets available for each soil sample for the students to complete after conducting the “feel” test. When students have conducted a test on each soil sample, discuss the characteristics and components of the soil samples, and identify the components that affect the texture of the soil. Instruct students to write a reflective summary of the soil feel test. S1, S2, S3, CS1, CS 2, CS4, T3, T4	
b. Examine the role of soil organic matter. (DOK 2)	b. Lead a class discussion on the role of organic matter in the soil. Discuss the types of organic matter found in soil and the influence of that matter on soil fertility and productivity. Use the Nematode Study Kit to conduct a laboratory activity to extract nematodes from the soil. Use the results of that study to emphasize the importance of organic matter in the soil. S1, S2, S3, CS 1, CS2, CS4, T2, T3	b. Grade Nematode Study Kit Laboratory Worksheets
c. Investigate the physical and chemical nature of soil using appropriate analyses. (DOK 2)	c. Conduct a mechanical analysis of soil to determine the percentages of sand, silt, and clay in selected soil samples. Use the soil textural classification triangle to identify the soil texture classification of the soil sample. Use practice problems of soil percentages to determine textural class prior to using actual mechanical analysis test results on the soil triangle. Give students the <i>Soil Texture Classification Assignment (4.5)</i> to complete for this activity. Measure the pH of the soil using a pH meter. M1, M2, M3, M4, M5, M7, S1, S2, S3, CS1, CS2, CS4, T2, T3	c. Use the <i>Mechanical Analysis of Soil Rubric (4.4)</i> to assess student mastery.
d. Classify land as to its highest productive use. (DOK 2)	d. After reviewing land classification guidelines, use the evaluation forms in a Land Judging Reference guide to evaluate a chosen area of land. S1, S2, S3, CS 1, CS2, CS3, CS4, CS5, T2, T3, T4	d. Evaluate student Land Judging Evaluation sheets.

Competency 3: Assess the impact of agricultural, horticultural, and forestry practices on land and soil.

NRS.01, NRS.02, NRS.03, NRS.04, ESS.02, AQ 4, ES 3, SP 1, SP 2

Suggested Enduring Understandings

1. Soil erosion and soil degradation can be prevented by practicing effective methods of soil conservation.
2. It is important that the soil and land be protected from degradation and erosion because we need the soil we have to

Suggested Essential Questions

1. What are some methods of soil conservation?
2. Why is it important to protect the soil from degradation?

produce plants and trees for many years to come.

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify and select practices that promote soil conservation and prevent soil erosion and degradation. (DOK 2)	a. Assign groups of two or three students to research assigned topics in soil erosion and degradation. The students will write and present an oral report to present to the class, along with visual aids depicting the importance of protecting soil from degradation and erosion. The report will include information on practices that promote soil conservation and prevent erosion. E1, E2, E3, E4, R1, R2, R3, R4, R5, CS1, CS2, CS4, T1, T2, T3, T4	a. Use the <i>Rubric for Evaluating Oral Report on Soil Conservation and Degradation (4.6)</i> to assess student mastery. b. Unit test

Standards

AFNR Industry Standards

- NRS.01. Recognize the important interrelationships between natural resources and humans necessary to conduct management activities in natural environments.
- NRS.02. Apply scientific principles to natural resource management activities.
- NRS.03. Apply knowledge of natural resources industries to production practices and processing procedures.
- NRS.04. Demonstrate techniques used to protect natural resources.
- ESS.02. Identify policies and regulations affecting environmental service systems to determine their impact on facility operation.

Applied Academic Credit Standards

Aquatic Science

- AQ 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- AQ 2 Develop an understanding of physical and chemical properties of water and aquatic environments.
- AQ 3 Apply an understanding of the diverse organisms found in aquatic environments.
- AQ 4 Draw conclusions about the relationships between human activity and aquatic organisms.

Biology I

- BIOI 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- BIOI 2 Describe the biochemical basis of life, and explain how energy flows within and between the living systems.
- BIOI 3 Investigate and evaluate the interaction between living organisms and their environment.

Botany

- BO 4 Draw conclusions about the factors that affect the adaptation and survival of plants.
- BO 5 Relate an understanding of plant genetics to its uses in modern living.

Chemistry I

- CHI 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- CHI 5 Compare factors associated with acid/base and oxidation/reduction reactions.

Chemistry II

- ORGC 2 Demonstrate an understanding of the properties, structure, and function of organic compounds.

Environmental Science

- ES 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ES 2 Develop an understanding of the relationship of ecological factors that affect an ecosystem.
- ES 3 Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.

Physical Science

- PS 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- PS 2 Describe and explain how forces affect motion.

Spatial Information Science

- SP 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- SP 2 Develop an understanding of geographic information systems.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS3 Social & Cross-Cultural Skills
- CS4 Productivity & Accountability
- CS5 Leadership & Responsibility

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- E1 Topic Development in Terms of Purpose and Focus
- E2 Organization, Unity, and Coherence
- E3 Word Choice in Terms of Style, Tone, Clarity, and Economy
- E4 Sentence Structure and Formation
- E5 Conventions of Usage
- E6 Conventions of Punctuation
- M1 Basic Operations and Applications
- M2 Probability, Statistics, and Data Analysis
- M3 Numbers: Concepts and Properties
- M4 Expressions, Equations, and Inequalities
- M5 Graphical Representations
- M6 Properties of Plane Figures
- M7 Measurement
- M8 Functions
- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R3 Sequential, Comparative, and Cause–Effect Relationships
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- S1 Interpretation of Data
- S2 Scientific Investigation
- S3 Evaluation of Models, Inferences, and Experimental Results
- W1 Expressing Judgments
- W2 Focusing on the Topic
- W3 Developing a Position
- W4 Organizing Ideas
- W5 Using Language

Suggested References

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Cooper, E. L., & Burton, L. D. (2008). *Agriscience fundamentals and applications* (4th ed.). Albany, NY: Delmar.

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Science of Agricultural Environment

Unit 5: Water Quality Management

10 Hours

Competency 1: Explore concepts of water usage and quality. NRS.01, NRS.02, NRS.03, AQ 1, AQ 2, AQ 3, AQ 4, ES 3

Suggested Enduring Understandings

1. The availability of water is dependent on its physical state.
2. Water is classified based upon its salt content.
3. Water is essential for all forms of life and is used for many purposes.
4. Water comes from sources below and on the surface of the earth.

Suggested Essential Questions

1. What is the chemical and physical makeup of water?
2. How does the salt content of water affect its usefulness?
3. Why is water so important?
4. What is the difference between surface and ground water?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe the nature and states of water. (DOK 1)	a. Identify the chemical makeup of water, and describe the characteristics of its three physical states (solid, liquid, and gas). Discuss how each physical state affects the availability of water for agricultural use. R3, R4, R5, S1, S2, CS2, T3	a. Use a pencil and paper test to evaluate student understanding.
b. Compare the classifications of water. (DOK 2)	b. Compare and contrast the three classifications of water: freshwater, brackish water, and saltwater. Assign students in groups of two or three to research three examples of fish species that live in each classification and give a general physical description of the type of fish. Students will present their findings to the class. R3, R5, CS2, T2, T3	b. Use the <i>Fish Research Group Project Rubric (5.1)</i> to assess student mastery.
c. Identify important uses of water. (DOK 1)	c. Discuss the major uses of water and its importance (daily living, support of life processes, impacts on climate, manufacturing, transportation, and recreation). Have students keep a daily diary for 1 week listing ways they come into contact with and use water and estimating the amount they used and identifying ways in which water could be conserved. Students can use the <i>Student Water Use Diary (5.2)</i> for this activity. E1, E2, R3, R5, CS2, CS4, T2, T3, T4	c. Have students peer review their daily diaries and comment on additional ways in which water could be conserved.
d. Identify sources of water. (DOK 1)	d. Describe the two major sources of water, surface, and ground water. Explain the path water follows throughout a watershed. Use the Ground Water simulation model to illustrate aquifers. Assign students to conduct	d. Use the <i>Reflective Writing Rubric on the Differences between Ground Water and Surface</i>

a reflective essay explaining their understanding of the differences between ground water and surface water. CS1, CS2, T3, S2, S3

Water (5.3) to evaluate the reflective writing exercise on student understanding of ground and surface water sources.

Competency 2: Describe important water management practices. NRS 04, AQ1, AQ 2, AQ 3, AQ 4, AQ 6, ES 1, ES 2, ES 3

Suggested Enduring Understandings

1. The amount of water on the earth never changes.
2. Flowing bodies of water have different characteristics than non-flowing bodies of water.
3. Water pollution originates from both known and unknown sources of contamination.
4. Water quality can be monitored by regularly testing the water for certain chemical indicators.
5. Potable water can be consumed by humans.

Suggested Essential Questions

1. How does the water cycle work?
2. What is the difference between flowing and non-flowing bodies of water?
3. What causes water pollution?
4. How do you test for the quality of water?
5. What is potable water?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Diagram and describe the water cycle. (DOK 2)	a. Provide the students a diagram of the water cycle, identify each part, and explain its role in the cycle. S1, S2, S3, CS1, CS2, T3	a. Pencil and paper test
b. Compare natural water bodies of flowing and non-flowing sources. (DOK 2)	b. Define stream, streamflow, and velocity. Determine how they relate to a river, creek, brook, and canal. Explain stream hydrology, stream structure, and stream channel. Identify non-flowing bodies of water (ocean, lake, pond, reservoir, slough, marsh, and estuary). Have students identify water sources in the local county and determine if they are flowing or non-flowing. S1, S2, S3, CS1, CS2, T1, T2, T3, T4, T5, T6	b. Pencil and paper test
c. Identify common causes of water pollution, and distinguish between point and nonpoint sources of pollution. (DOK 1)	c. Identify common kinds of water pollutants (sediment and suspended particles, pathogens, organic wastes, inorganic and organic substances, thermal pollution, urban refuse, agriculture sources, marine debris, oil pollution, etc.). Differentiate between point source and nonpoint source pollution. Have students list pollution on the school campus or in the community. Have them determine the source of	c. Grade student observation chart from the activity manual (Turner, 1997).

the pollution. Have the students complete the <i>Oil Spills and the Environment</i> lab activity from the activity manual (Turner, 1997). Complete a chart of student observations of the oil spill on the habitat. S2, S3, CS1, CS2, T3		
d. Monitor the water quality in a selected body of flowing water. (DOK 2)	d. Use the Ecology Field Kit to monitor the water quality of a selected body of flowing water for a consistent period of time. Consult local Soil Conservation Office about Adopt a Stream projects in area. S1, S2, S3, CS1, CS2, CS4, T2, T3, T4	d. Use the <i>Stream Monitoring Activity Performance Rubric (5.4)</i> to assess student mastery.
e. Describe and analyze the qualities of potable water. (DOK 2)	e. Define potable water. Identify and describe major qualities associated with potable water (odor and taste, color, pH, alkalinity, hardness, dissolved solid materials and turbidity, heavy metal content, chemical and pesticide residue content, and coliform bacterial count). Use the water quality testing kit to test potability of water from local wells and springs. R4, R5, S1, S2, S3, CS1, CS2, CS4, T2, T3, T4	e. Use the <i>Water Quality Testing Laboratory Rubric (5.5)</i> to assess student mastery.

Competency 3: Describe how wastewater is treated to maintain water quality. NRS.05, AQ 3, AQ 4, ES 3

Suggested Enduring Understandings

1. Wastewater is produced by agricultural, industrial, and residential sources.
2. Wastewater can be hazardous to humans, animals, and the environment.
3. There are various methods and treatments for wastewater management that prevents it from being a hazard to the environment.

Suggested Essential Questions

1. Where does wastewater come from?
2. What makes wastewater so hazardous?
3. How is wastewater treated and handled?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify and describe the sources and types of wastewater. (DOK 2)	a. Ask students to list and classify different sources of wastewater (homes and businesses, manufacturing, agricultural, storm runoff). From their list, develop a working definition for wastewater, and classify each source as being spent, domestic, and sewage. S1, S2, S3, CS1, CS2, T3	a. Grade list and student definition of wastewater.
b. Identify and describe hazards that may be present in water. (DOK 2)	b. Identify and describe common hazards associated with waste water to include toxic waste, organic matter, infectious agents, and temperature. S1, S2, S3, CS1, CS2, T3	b. Pencil and paper test

c. Describe methods and processes in wastewater treatment. (DOK 2)	c. Take a field trip to a local waste water treatment plant, and view the processes that occur in the treatment of waste water, or invite a representative from the plant to speak to the class on the process. Have students summarize their findings and record in their electronic journal or blog. W1, W2, W3, W4, W5, S1, S2, S3, CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T5, T6	c. Use the <i>Field Trip to Wastewater Treatment Plant Participation Checklist (5.6)</i> for the field trip or use the <i>Guest Speaker Evaluation Form (5.7)</i> . Evaluate student electronic blog or journal for accuracy and completeness.

Standards

AFNR Industry Standards

- NRS.01. Recognize the important interrelationships between natural resources and humans necessary to conduct management activities in natural environments.
- NRS.02. Apply scientific principles to natural resource management activities.
- NRS.03. Apply knowledge of natural resources industries to production practices and processing procedures.
- NRS.04. Demonstrate techniques used to protect natural resources.

Applied Academic Credit Standards

Aquatic Science

- AQ 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- AQ 2 Develop an understanding of physical and chemical properties of water and aquatic environments.
- AQ 3 Apply an understanding of the diverse organisms found in aquatic environments.
- AQ 4 Draw conclusions about the relationships between human activity and aquatic organisms.

Environmental Science

- ES 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ES 2 Develop an understanding of the relationship of ecological factors that affect an ecosystem.
- ES 3 Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS3 Social & Cross-Cultural Skills
- CS4 Productivity & Accountability
- CS5 Leadership & Responsibility

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T5 Digital Citizenship
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- E1 Topic Development in Terms of Purpose and Focus
- E2 Organization, Unity, and Coherence
- R3 Sequential, Comparative, and Cause–Effect Relationships
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- S1 Interpretation of Data
- S2 Scientific Investigation

S3	Evaluation of Models, Inferences, and Experimental Results
W1	Expressing Judgments
W2	Focusing on the Topic
W3	Developing a Position
W4	Organizing Ideas
W5	Using Language

Suggested References

Adopt-a-Stream Foundation. *Welcome to the adopt-a-stream foundation*. Retrieved June 11, 2010, from <http://streamkeeper.org/>

CEV Video. (n.d.). *CEV pathway: Natural resources & environmental systems pathway* [DVD]. Lubbock, TX: Author.

Mississippi Wildlife Federation. *Adopt a stream*. Retrieved June 11, 2010, from http://www.mswildlife.org/education/adopt_a_stream.html

Parker, R. (1995). *Aquaculture*. Albany, New York: Delmar Publishers.

Porter, L., Lee, J. S., Turner, D. L., & Hillan, M. (2003). *Environmental science and technology* (2nd ed.). Upper Saddle River, NJ: Pearson Education.

Turner, D. L. (1997). *Environmental science and technology activity manual*. Upper Saddle River, NJ: Pearson Education.

For additional references, activities, and web resources, please refer to: Mississippi Agriculture Education B.R.I.D.G.E. Web site: <http://www.rcu.blackboard.com> (Available only to registered users).

Science of Agricultural Environment

Unit 6: The Atmosphere and Environmental Quality

10 Hours

Competency 1: Examine the relationship of the atmosphere to the earth's environment. NRS .01, CH1 4, ES 1, ES 2, ES 3

Suggested Enduring Understandings

1. The atmosphere is a combination of gases, water vapor, and other materials that sustains life on earth.
2. The atmosphere can be divided into distinguishable layers with each layer playing a different function.

Suggested Essential Questions

1. What is the atmosphere made of?
2. What are the various layers of the atmosphere?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Define atmosphere, and describe its contents. (DOK 1)	a. Identify atmosphere, and describe the air, moisture, and particulates in it. M2, M7, S1, CS2, T3	a. Pencil and paper test
b. Diagram and describe the structure of the atmosphere. (DOK 2)	b. Have students draw and label the structure of the atmosphere. Identify the layers and describe their location, characteristics, and special functions. M5, M6, M7, R5, S1, S2, S3, W1, CS1, CS2, CS4, T1, T2, T3, T4	b. Use the <i>Checklist for Evaluating the Diagram of the Atmosphere (6.1)</i> to evaluate the diagram of the atmosphere.

Competency 2: Use weather and climate information in making decisions about the environment. ESS.03, ES 1, ES 2, ES 3

Suggested Enduring Understandings

1. The relationship between the weather and the environment is complex.
2. Climates can be defined using scientific factors such as latitude, longitude, and temperature.
3. The movement of the earth in orbit plays a major role in how weather patterns develop.
4. Weather maps are used to predict and analyze the weather.

Suggested Essential Questions

1. How do the weather and the environment impact each other?
2. How are climates defined?
3. How does the movement of the earth affect weather fronts?
4. What environmental factors are considered when analyzing the weather?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Distinguish between weather and environment. (DOK 2)	a. Compare and contrast weather and the environment. Include where weather forms, and describe the four common weather measurements: temperature, moisture, wind speed and direction, and pressure, including the units used to measure each. CS2, T4, S1, S2, S3	a. Pencil and paper test
b. Explore the relationship of latitude, longitude, and altitude to climate. (DOK 2)	b. Review the use of latitude and longitude measurements. Discuss the effects of latitude and longitude, altitude, moisture, and temperature measurements on climates. Have students use an online mapping site (Google Earth, TerraServer, etc.) or a mapping GPS to locate longitude and latitude of cities and classify them as being in the temperate and tropical regions. (See Attachment 6.2.) CS1, CS2, T3, M1, M2, M3, M4, M5, M6, M7, S1, S2, S3	b. Grade the assignment to locate longitude and latitude.
c. Discuss how the movement of the earth affects weather fronts, clouds, seasons, and storms. (DOK 2)	c. Describe how the rotation of the earth as it orbits the sun affects the weather, climate, and ecology of an area. Identify and describe weather elements such as fronts, clouds, fog, and storms. Invite a weatherperson as a guest speaker. Review weather safety. CS 1, CS2, T3, M1, M2, M3, M4, M5, M6, M7, S1, S2, S3, E1, E2, E3, E4, E5, E6	c. Pencil and paper test
d. Read and interpret weather measurements and maps. (DOK 3)	d. Have students collect 3 days of weather maps from local newspapers and bring in to class. Use Studying the Weather activity in the <i>Environmental Science and Technology Activity Manual</i> to read a weather map, collect and analyze data, and complete a data table. CS 1, CS2, CS5, T3, T5, T6, M1, M2, M3, M4, M5, M6, M7, S1, S2, S3	d. Grade the <i>Studying the Weather</i> activity from the activity manual (Turner, 1997).

Competency 3: Assess air quality and identify sources of air pollution. NRS.01, NRS.02, NRS.03, NRS.04, ES 1, ES 2, ES 3
Suggested Enduring Understandings

1. Air quality is affected by the amount of foreign material in the air.
2. Global pollution occurs through the movement of air.
3. Air pollution comes from many sources.
4. Air pollution can have a negative effect on the environment.
5. Air pollution levels can be detected in the air around you.

Suggested Essential Questions

1. How is air quality defined?
2. How does global pollution occur?
3. What causes air pollution?
4. What are the effects of air pollution on the environment?
5. How can air pollution be detected?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Define air quality, and relate quality to pollution and air quality standards. (DOK 1)	a. Define air quality, air pollution, and air quality standards. Show the relationship between each. CS2, T2, T3, T4, E1, E2	a. Instructors can use the <i>Environmental Science Weather Test (6.5)</i> or another pencil and paper test.
b. Explain the movement of air and global pollution. (DOK 2)	b. Explain the relationship of air movement and pollution globally. Explain how weather fronts play a role in the movement. CS2, T3, S1, S2, S3	b. Instructors can use the <i>Environmental Science Weather Test (6.5)</i> or another pencil and paper test.
c. Describe the major kinds and sources of air pollution. (DOK 2)	c. Describe gases, particulate matter, and metal materials as they relate to air pollution. Assign students to research the major kinds and sources of air pollution and report to the class with a PowerPoint presentation describing one of the major sources of air pollution, how it is created, and the effects on the environment. CS1, CS2, CS3, T3, T2, T5, T6, E1, E2, E3, E4, E5, E6, S1, S2, S3	c. Use the <i>Air Pollution Presentation Rubric (6.3)</i> to assess student mastery.
d. Identify the effects of air pollution on the earth's environment. (DOK 1)	d. Identify the effects of air pollution on human health problems, other animals, plants, and other organisms and climate. Include information from this indicator on the presentation. CS3, T2, T3, S1, S2, S3	d. Use the <i>Detecting Air Pollution Activity Presentation Rubric (6.4)</i> to assess student mastery.

Standards

AFNR Industry Standards

- NRS.01. Recognize the important interrelationships between natural resources and humans necessary to conduct management activities in natural environments.
- NRS.02. Apply scientific principles to natural resource management activities.
- NRS.03. Apply knowledge of natural resources industries to production practices and processing procedures.
- NRS.04. Demonstrate techniques used to protect natural resources.

Applied Academic Credit Standards

Chemistry I

- CHI 4 Analyze the relationship between microscopic and macroscopic models of matter.

Environmental Science

- ES 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ES 2 Develop an understanding of the relationship of ecological factors that affect an ecosystem.
- ES 3 Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS3 Social & Cross-Cultural Skills
- CS4 Productivity & Accountability
- CS5 Leadership & Responsibility

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T5 Digital Citizenship
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- E1 Topic Development in Terms of Purpose and Focus
- E2 Organization, Unity, and Coherence
- E3 Word Choice in Terms of Style, Tone, Clarity, and Economy
- E4 Sentence Structure and Formation
- E5 Conventions of Usage
- E6 Conventions of Punctuation
- M1 Basic Operations and Applications
- M2 Probability, Statistics, and Data Analysis
- M3 Numbers: Concepts and Properties
- M4 Expressions, Equations, and Inequalities
- M5 Graphical Representations
- M6 Properties of Plane Figures
- M7 Measurement
- M8 Functions

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- S1 Interpretation of Data
- S2 Scientific Investigation
- S3 Evaluation of Models, Inferences, and Experimental Results

Suggested References

Arms, K. (2005). *Holt environmental science*. Austin, TX: Holt.

Biondo, R. J., & Lee, J. S. (1997). *Introduction to plant and soil science and technology*. Upper Saddle River, NJ: Pearson.

Burton, D. (2009). *Environmental science, fundamentals, and applications*. Clifton Park, NJ: Delmar

CEV Video. (n.d.). *CEV pathway: Natural resources & environmental systems pathway* [DVD]. Lubbock, TX: Author.

Porter, L., Lee, J. S., Turner, D. L., & Hillan, M. (2003). *Environmental science and technology* (2nd ed.). Danville, Illinois: Interstate Publishers.

Turner, D. L. (1997). *Environmental science and technology activity manual*. Upper Saddle River, NJ: Pearson.

Terraserver . Retrieved on June 14, 2010, from <http://www.terraserver.com>

For additional references, activities, and web resources, please refer to: Mississippi Agriculture Education B.R.I.D.G.E. Web site: <http://www.rcu.blackboard.com> (Available only to registered users).

Science of Agricultural Environment

Unit 7: Forestry and the Environment

10 Hours

Competency 1: Examine basic principles of forest dendrology and mensuration. NRS.01, NRS.02, BIOI 3, BIOI 4, BO1, BO4, ES 1, ES 2, ES 3

Suggested Enduring Understandings

1. typical forest is structured into four layers: the canopy or overstory, the understory (saplings, shade tolerant trees, and tall shrubs, the shrub layer, the herb/fern layer, and the litter layer). Each layer plays a role in the growth and development of the total ecosystem.
2. In Mississippi, the different species of yellow pine as well as oak, hickory, and other hardwoods are economically important furnishing wood and pulp for many different wood products.
3. The number and size of the growth rings in a tree are indicators of the tree's age and annual growth rate.
4. Timber cruising is a process by which a representative sample of trees on a plot is measured and the volume of pulpwood and saw timber is estimated.
5. Young tree seedlings must be planted in a manner that allows them to quickly establish a sound root system and begin to grow into merchantable timber. Important factors in planting young seedling include proper depth of plants, proper placement of the root system, and proper soil compaction.

Suggested Essential Questions

1. How do the layers of a forest function to protect and enhance the ecosystem?
2. What are the most economically important tree species in Mississippi, and how are products from these species used?
3. How can the number and size of the growth rings of a tree be used to determine age and growth rate of the tree?
4. How is an estimate of the volume of pulp and sawlog timber established?
5. What procedures are used in planting young trees for reforestation?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Examine the layered structure of forests and how these layers protect and enhance the ecosystem. (DOK 2)	a. Have students draw a picture of a forest illustrating how the layered structure of the forests and how these layers protect and enhance the ecosystem of the forest. CS1, CS2, CS4, T1, T6, W1, W2, W4	a. Use the <i>Picture Assessment Rubric (7.1)</i> to assess student mastery.
b. Identify locally important tree species by common name, type, physical characteristics, and use. (DOK 1)	b. Have students create a chart identifying major commercial forest trees that will include common names, types (hardwood or softwood), physical characteristics, and uses. Have students bring leaves from a tree near their homes and use the Web site,	b. Evaluate chart for accuracy and completeness.

Mississippi Tree Identification
(http://mdg.ext.msstate.edu/Tom_Tree/tree_id_intro.html), to determine the common name of the tree. Students can use the *Tree Characteristics Chart (7.2)* for this activity.
CS1, CS2, CS4, T1, T6, W1, W2, W4

Examples:

- Pine (slash, loblolly, longleaf, shortleaf)
- Oak (red, pin, white, water)
- Ash (green, white)
- Hickory (bitternut, red, shagbark, mockernut)

c. Analyze the growth rate and age of trees by examining the annual rings and accounting for variations in growth rate due to environmental factors. (DOK 3)	c. Using a cross section of a tree or log, illustrate and discuss the process for analyzing growth rate and age of trees. Provide guidelines for evaluating these factors including the effect of environmental conditions. CS1, CS2, CS4, T1, T6, W1, W2, W4	c. Evaluate student activity sheet for accuracy and completeness.
d. Demonstrate procedures used in timber cruising, including estimation of standing tree volume using a tree scale stick, and measurement of tree height and diameter (DBH). (DOK 3)	d. Have a guest speaker (Forestry or Natural Resource Conservation Officer) discuss and demonstrate procedures for sampling and measuring trees in timber cruising including use of a scale stick to estimate tree diameter and height and use of volume table. Have students estimate volume of standing trees on or near the school campus and record and tabulate their findings. The instructor should use the <i>Volume Estimation Sheet for Sawlogs (7.3)</i> , the <i>Doyle Log Rule (Form Class 80) (7.4)</i> , the <i>Volume Estimation Sheet for Pulpwood (7.5)</i> , and the <i>Volume Estimation Sheet for Pulpwood (7.6)</i> for this activity. CS1, CS2, CS4, T1, T3, T4, M1, M2, M7, S1	d. Use the <i>Volume Estimation Sheet for Sawlogs (7.3)</i> and the <i>Volume Estimation Sheet for Pulpwood (7.5)</i> to evaluate the results of the timber volume estimation activity.
e. Demonstrate proper procedures for planting trees. (DOK 2)	e. Have students read about planting trees based on the information on trees and shrubs found in the text (Burton & Cooper, 2007, pp. 491-492). After demonstrating the procedure, have students apply their knowledge by planting a tree on the school campus. CS2, CS4, T6, R1, R2, R3, R4, R5	e. Use the <i>Tree Planting Checklist (7.7)</i> to assess student mastery.

Competency 2: Discuss the relationship of forestry to environmental quality and economic development.

NRS.03, BIOI 3, BIOII 5, BO 2, BO 5, ES 1, ES 2, ES 3

Suggested Enduring Understandings

1. Wood products and by-products are used in many different ways to create consumer goods including lumber, paper and cardboard, posts and pilings, and foods and medicines.
2. Biodiversity is a term related to the presence of a number of species of plants and animals. Forests encourage biodiversity by providing food and shelter for these species.
3. Prevention of forest fires is preferable to control of fire. Prevention is achieved through a number of methods including prescribed burning and burn bans.
4. Fire can damage standing timber by killing or damaging trees, consuming nutrients from the litter on the forest floor, and increasing the possibility of soil erosion.
5. Reforestation is a major factor in the sustained use of forest land.

Suggested Essential Questions

1. How do forest products affect my life?
2. How do forests promote biodiversity?
3. What are some ways that forest fires can be prevented?
4. How does fire cause damage to the forest and the environment in general?
5. Why is reforestation important, and how is it accomplished?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify consumer goods derived from forest locally. (DOK 1)	a. Invite a representative of the wood products industry to speak to the class regarding the manufacture of wood products from timber. Have students take notes and summarize the major points of the presentation. Follow up with a class discussion to make sure that all major points are covered. Have students record the major points in their electronic notebooks or journals. CS1, CS3, CS4, T1, T6, W2, W4, W5	a. Evaluate using a paper and pencil test.
b. Describe the relationships between biodiversity and forests. (DOK 2)	b. Use a PowerPoint presentation to illustrate and discuss relationships between biodiversity and forests. Have students record the major points from the presentation in their electronic notebooks or journals. CS2, CS4, T2, T6, W2, W4, W5	b. Evaluate using a paper and pencil test.
c. Investigate methods for forest fire prevention. (DOK 3)	c. Invite a representative of the Mississippi Forestry Commission to speak to the class on prevention of forest fires. Have students take notes and summarize the major points of the presentation. Conduct a follow-up discussion to	c. Use the <i>Fire Prevention Poster Rubric (7.8)</i> to assess student

	make sure that all major points have been recorded. Divide the class into teams of two to four students, and have them prepare a poster on forest fire prevention. CS2, CS4, T2, T6, W2, W4, W5	mastery.
d. Discuss the different damages caused by forest fire. (DOK 3)	d. Have students search the Internet and other resources to locate examples of damage caused by forest fire. Hold a class discussion in which students share their findings. List major points on the whiteboard or LCD projector, and have students record them in their electronic journals or notebooks. CS2, CS4, T2, T6, W2, W4, W5	d. Evaluate using a paper and pencil test.
e. Discuss the methods and importance of reforestation. (DOK 2)	e. Use a PowerPoint presentation to illustrate and describe the methods of reforestation. Use oral questioning and discussion to evaluate student understanding. Have students record major points in their electronic notebooks or journals. CS2, CS4, T2, T6, W2, W4, W5	e. Evaluate using a paper and pencil test.

Standards

AFNR Industry Standards

- NRS.01. Explain interrelationships between natural resources and humans necessary to conduct management activities in natural environments.
- NRS.02. Apply scientific principles to natural resource management activities.
- NRS.03. Apply knowledge of natural resources industries to production and processing industries.
- NRS.04. Demonstrate techniques used to protect natural resources.

Applied Academic Credit Standards

Biology I

- BIOI 3 Investigate and evaluate the interaction between living organisms and their environment

Biology II

- BIOII 4 Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.
- BIOII 5 Develop an understanding of organism classification.

Botany

- BO 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- BO 2 Distinguish among the characteristics of botanical organization, structure, and function.
- BO 4 Draw conclusions about the factors that affect the adaptation and survival of plants.
- BO 5 Relate an understanding of plant genetics to its uses in modern living.

Environmental Science

- ES 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ES 2 Develop an understanding of the relationship of ecological factors that affect an ecosystem.
- ES 3 Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS4 Productivity & Accountability

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- M1 Basic Operations and Applications
- M2 Probability, Statistics, and Data Analysis

M7	Measurement
R1	Main Ideas and Author's Approach
R2	Supporting Details
R3	Sequential, Comparative, and Cause–Effect Relationships
R4	Meaning of Words
R5	Generalizations and Conclusions
S1	Interpretation of Data
W1	Expressing Judgments
W2	Focusing on the Topic
W4	Organizing Ideas
W5	Using Language

Suggested References

Biondo, R. J. & Lee, J. S. (2003). *Introduction to plant & soil science & technology*. Lebanon, KY: Pearson.

Biondo, R. J. (2003). *Activity manual for introduction to plant & soil science and technology*. Lebanon, KY: Pearson.

Bioquest Curriculum Consortium. (n.d.). *Bioquest Tree Growth Study Kit*. [Interactive learning kit]. Beloit, WI: Author.

Burton, L. D. (2008). *Introduction to forestry science* (2nd ed.). Clifton Park, NY: Delmar.

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CEV Video. (n.d.). *CEV pathway: Natural resources & environmental systems pathway* [DVD]. Lubbock, TX: Author.

Herren, R. V. (2007). *The science of agriculture: A biological approach* (3rd ed.). Clifton Park, NY: Delmar.

Mississippi State University Extension Service. *Mississippi tree identification*. Retrieved June 14, 2010, from http://mdg.ext.msstate.edu/Tom_Tree/tree_id_intro.html

Reiley, H. E., & Shry, Jr., C. L. (2007). *Introductory Horticulture* (7th ed.). Clifton Park, NY: Delmar.

Rolf, G. L., Edgington, J. M., Holland, I. I., & Fortenberry, G. (2008). *Forests & forestry* (6th ed.). Upper Saddle River, NJ: Pearson.

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Science of Agricultural Environment

Unit 8: Wildlife and the Environment

10 Hours

Competency 1: Examine the relationships of wildlife well-being and environmental quality. NRS.01, NRS.02, NRS.05, AQ 3, AQ 4, BIOI 3, ES 2, ES 3, ZO2, ZO 3

Suggested Enduring Understandings

1. Mississippi is home to a diverse number of aquatic and terrestrial wildlife species.
2. All wildlife species require a habitat that provides food, water, shelter, and space for each species to survive and repopulate.
3. Wildlife species play an important role in human life and in maintaining our environment.
4. Wildlife habitat must be protected, managed, and improved so that this important national resource can be conserved, sustained, and renewed.

Suggested Essential Questions

1. What are the major species of wildlife in my community?
2. What habitat does my community offer to different wildlife species?
3. What are ways in which wildlife benefit humankind and the environment in general?
4. How can habitat for wildlife be managed and improved?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify the wildlife species found in the local area, and classify as terrestrial or aquatic. (DOK 2)	a. Introduce the unit by asking students to compare domesticated animals and wildlife animals. Have students brainstorm as many animals as possible and classify as terrestrial or aquatic wildlife that are found locally. Determine if the animals are vertebrates or invertebrates. Categorize the list of animals by mammals, fish, birds, reptiles, amphibians, insects, mollusks, worms, and arachnids. Have students summarize and incorporate into their electronic notebooks or journals. CS2, CS4, T6	a. Check student notebooks for accuracy and completeness.
b. Assess local wildlife habitat. (DOK 2)	b. Identify and describe habitat components for wildlife including food, water, shelter, and space requirements. Have students research an assigned wildlife animal species and compile a report or poster or make an oral report on the habitat needs of that species. Have students identify areas that provide suitable habitat for the species. CS2, CS4	b. Use the <i>Written Report Rubric (8.1)</i> , the <i>Poster Assessment Rubric (8.2)</i> , and the <i>Oral Report Rubric (8.3)</i> to assess student mastery.
c. Investigate the importance of wildlife to the	c. Explain the benefits of wildlife to the environment and humans through consumptive and non-consumptive uses.	c. Evaluate student performance using a written test.

environment and human well-being. (DOK 2)	Identify animal wildlife products used for food, clothing, ornamentation, medicine, and recreation. Students can make a list of animal and animal products used for each of these categories. ^{CS2, CS4}	
d. Recommend procedures for improving habitat for wildlife. (DOK 3)	d. Assign the class a project to evaluate a given area, and make recommendations on practices and activities that can enhance wildlife habitat. The project should involve on-site visits and result in a visual presentation (PowerPoint) of the findings and recommendations. ^{CS1, CS2, CS4, T1, T2, T3, T4, T6, S2, W2, W4, W5}	d. Use the <i>Group Work Assessment Rubric (8.4)</i> to assess student mastery.

Competency 2: Investigate approaches in protecting and managing wildlife species. ^{NRS.02, NRS.04, ES 3, ZO 3}

Suggested Enduring Understandings

1. Like any renewable natural resource, wildlife must be protected and conserved to maintain sustainability of each species.
2. Because of declining populations, some wildlife species are now protected by being classified as protected, threatened, or endangered.
3. Habitat management and limiting hunting seasons and bag limits are major tools in the conservation and protection of wildlife.

Suggested Essential Questions

1. Why are wildlife conservation and protection policies and programs needed?
2. What wildlife species are now considered to be nuisance, protected, threatened, endangered, or extinct? What is the difference in between these categories?
3. What are the major tools and practices for conserving, protecting, and managing wildlife?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Discuss the need for wildlife protection and conservation policies and how species are lost from the earth. (DOK 2)	a. Ask students why we have hunting seasons and bag limits on most game animals. Explain the difference between nuisance, protected, endangered, and extinct species. Have students research needs for wildlife protection and conservation policies and how animal species are protected from becoming endangered or extinct. Hold a class discussion on these topics. List important points on the whiteboard or LCD projector, and have students transcribe them into their electronic notebooks or journals. ^{CS1, CS4, T2, T6, R5, W2, W4, W5}	a. Use the <i>Group Work Assessment Rubric (8.4)</i> to assess student mastery.
b. Classify wildlife species based on threats to their continued existence.	b. Define the terms nuisance, protected, threatened, endangered, and extinct. From a list of species of Mississippi wildlife, have students research and classify each species. ^{CS1,}	b. Evaluate student performance using a written test.

(DOK 2)			CS4, T2, T6, R5
c. Describe practices in conservation, protection, and management of wildlife. (DOK 2)	c.	Define habitat management, and discuss habitat management practices that directly benefit wildlife. Invite a representative of the Mississippi Game and Fish Commission to speak to the class on state policies and practices that protect, conserve, and manage wildlife populations including game laws, hunting seasons and limits, habitat improvement programs, and so forth. Follow up with a review of major points from the presentation. Have students summarize these points and place in their electronic journals or notebooks.	CS1, CS4, T6, W4, W5
	c.	Evaluate student performance using a written test and/or the <i>Guest Speaker Evaluation and Summary Form (8.5)</i> to assess student mastery.	

Standards

AFNR Industry Standards

- NRS.01. Explain interrelationships between natural resources and humans necessary to conduct management activities in natural environments.
- NRS.02. Apply scientific principles to natural resource management activities.
- NRS.04. Demonstrate techniques used to protect natural resources.
- NRS.05. Use effective methods and venues to communicate natural resource processes to the public.

Applied Academic Credit Standards

Aquatic Science

- AQ 3 Apply an understanding of the diverse organisms found in aquatic environments.
- AQ 4 Draw conclusions about the relationships between human activity and aquatic organisms.

Biology I

- BIOI 3 Investigate and evaluate the interaction between living organisms and their environment.

Environmental Science

- ES 2 Develop an understanding of the relationship of ecological factors that affect an ecosystem.
- ES 3 Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.

Zoology

- ZO 2 Develop an understanding of levels of organization and animal classification.
- ZO 3 Differentiate among animal life cycles, behaviors, adaptations, and relationships.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS4 Productivity & Accountability

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- R5 Generalizations and Conclusions
- S2 Scientific Investigation
- W2 Focusing on the Topic
- W4 Organizing Ideas
- W5 Using Language

Suggested References

Burton, D. (2003). *Fish and wildlife: Principles of zoology and ecology*. Florence, KY: Cengage Learning.

CEV Video. (n.d.). *CEV pathway: Natural resources & environmental systems pathway* [DVD]. Lubbock, TX: Author.

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For additional references, activities, and web resources, please refer to: Mississippi Agriculture Education B.R.I.D.G.E. Web site: <http://www.rcu.blackboard.com> (Available only to registered users).

Science of Agricultural Environment

Unit 9: Environmental Stewardship

20 Hours

Competency 1: Discuss concepts of sustainable agriculture. NRS.02, NRS.03, PS.02, PS.04, ES 2, ES 3, SP 2

Suggested Enduring Understandings

1. Sustainable agriculture is a process for producing agricultural products economically and efficiently while maintaining the quality of the life and the environment and conserving natural resources.
2. Practices that promote sustainable agriculture include reduced tillage, integrated pest management programs, precision agriculture practices, fertilizer management, and protection of the soil.

Suggested Essential Questions

1. What is the difference between traditional agriculture production and sustainable agriculture?
2. What are some key practices associated with sustainable agriculture, and how do they promote sustainability?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe the nature and importance of sustainable agriculture. (DOK 1)	a. Introduce the lesson by a short talk on the concept of sustainability. Have students read the <i>Sustainable Agriculture</i> in the text (Porter et al., 2003). Have students summarize the major points from the chapter and then hold a class discussion to ensure that all major points have been covered. Have students enter these major points into their electronic journals or notebooks. CS1, CS2, CS4, T3, T6, R1, R2, R4, R5, W4, W5	a. Evaluate using a paper and pencil test.
b. Identify and select practices that promote sustainability in agriculture, forestry, and natural resources. (DOK 2)	b. Have students research and prepare a report (either written or oral) on sustainable agriculture practices in the area where you live. In addition to the Internet, have students contact the Cooperative Extension Service, Soil and Water Conservation District, Natural Resource Conservation Service, or other sources for assistance. Identify local producers who use sustainable agriculture, and interview if possible. Take photographs to depict findings. CS1, CS2, CS4, T3, T6, W4, W5	b. Use the <i>Written Report Rubric (9.1)</i> or the <i>Oral Report Rubric (9.2)</i> to assess student mastery.

Competency 2: Explore the services of agencies and organizations that protect and maintain the environment. ESS.02, ES 2

Suggested Enduring Understandings

1. Many local, state, and federal agencies play an important role in protecting and

Suggested Essential Questions

1. What are some roles of governmental agencies and other organizations in

maintaining the environment by providing education and assistance to producers, monitoring production practices, and assisting in environmental cleanup projects. 2. Public laws and policies have been enacted to monitor and protect environmental quality and promote the conservation of natural resources.	protecting the environment and conserving natural resources? 2. How do public laws and governmental policies protect the environment and promote the conservation of natural resources?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify and describe the role of government and other agencies concerned with environmental quality and natural resource conservation. (DOK 1)	a. Have students search the Internet to find at least 10 government agencies or other organizations and briefly describe their functions in protecting the environment and/or conserving natural resources. From this search, lead a discussion to determine common roles shared by several agencies. Have students summarize their findings and record in their electronic journals or notebooks. Students should use the <i>Environmental and Natural Resources Agencies (9.3)</i> worksheet for this activity. CS1, CS2, CS4, T3, T6, R1, R2, R4, R5, W4, W5	a. Evaluate student assignment for accuracy and completeness.
b. Investigate public laws and policies related to environmental quality and natural resource conservation. (DOK 2)	b. Assign each student a section of a public law or policy related to environmental quality or natural resource conservation. (See http://www.nrdc.org/reference/laws.asp for a list of U. S. environmental laws and treaties.) Have students develop a fact sheet from their findings and lead an informative <i>Did You Know</i> session with the class. The findings should be summarized and presented in written or oral reports. CS1, CS2, CS4, T3, T6, R1, R2, R4, R5, W4, W5	b. Use the <i>Written Report Rubric (9.1)</i> or the <i>Oral Report Rubric (9.2)</i> to assess student mastery.

Competency 3: Use appropriate procedures for management and disposal of solid waste. ESS.01, ESS.04, ES 3

Suggested Enduring Understandings

1. Solid wastes come from many different sources and if not properly disposed can cause problems related to pests, public health and safety, and pollution of soil, air, and water.

Suggested Essential Questions

1. What is solid waste, and how does it cause damage?
2. How can solid waste be disposed?
3. What is recycling?
4. What is composting?

2. Solid waste can be disposed by recycling, composting, incineration, or burial in a sanitary landfill.
3. Recycling is the most environmentally friendly way of disposing of solid waste but is not practical for many forms of waste.
4. A recycling program must include methods for collecting, sorting, storing, and disposal/sale of products.
5. Composting is another environmentally friendly disposal method for non-hazardous organic materials (grass clippings, tree limbs, etc.).

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify sources of solid waste. (DOK 1)	a. Have students read the chapter on Solid Waste in the text (Porter et al., 2003). Use a local sanitarian or landfill operator and/or manager as a resource person in class. Have him or her describe the different types of solid waste and explain how each type is disposed of in the local area. Have students summarize the presentation then hold a class discussion to make sure that all major points are discussed using the <i>Guest Speaker Summary Form (9.4)</i> . CS1, CS2, CS4, W4, W5	a. Use the <i>Rubric for Student Electronic Notebook (9.9)</i> to assess student mastery.
b. Identify common hazards associated with improperly managed wastes. (DOK 1)	b. Discuss the three most common hazards associated with solid waste (pests, safety, and pollution of soil, air, and water resources). Have students associate these hazards with the list of solid wastes that was previously compiled. CS1, CS2, CS4	b. Evaluate student understanding using a written test.
c. Explain how solid waste materials should be managed and disposed. (DOK 2)	c. Discuss the most common means of solid waste management and disposal including recycling, incineration, and landfills. Have students develop a list of advantages and disadvantages of each method using the <i>Advantages and Disadvantages of Waste Disposal Methods (9.5)</i> . CS1, CS2, CS4, W4, W5	c. Use the <i>Rubric for Student Electronic Notebook (9.9)</i> to assess student mastery.
d. Develop a plan for recycling. (DOK 4)	d. Have students research and develop a list of items that can be recycled and identify local recycling centers that will accept these products. As a class project, have students develop a recycling program for the school that includes collection, management, and	d. Use the <i>Recycling Program Rubric (9.6)</i> to assess student mastery.

sale/disposal of recycled materials. (See the *School Recycling Guide* at <http://www.waste.ky.gov/NR/rdonlyres/9098AF95-4D8E-41C6-BC49-8D9AD1E562F9/0/sr.pdf>.)

(Example: The National FFA Organization, <http://www.ffa.org>, has a program *FFA Recycles* that will accept inkjet and LaserJet ink cartridges and pay the FFA chapter for those cartridges.) CS1, CS2, CS3, CS4, T6

e. Explain the use of residential, agricultural, and industrial composting. (DOK 3)	e. Define composting and the necessary requirements for developing compost. Organize the class to develop a plan to compost school or local waste including constructing a compost bin, adding materials to it, and taking steps to promote composting in your local area. (See the <i>Connecticut School Composting Manual</i> .) The results of composting can be used in school landscaping projects. CS1, CS2, CS3, CS4, CS5, T6	e. Use the <i>School Composting Plan Rubric (9.7)</i> to assess student mastery.

Competency 4: Select appropriate procedures for managing hazardous waste materials. ESS.03, ESS.04, ES 3

Suggested Enduring Understandings

1. Hazardous waste is any product that has the potential for harming human health or the environment in general.
2. Hazardous waste materials may cause harm by being ignited, reacting with other materials, corroding other materials, or being posing a health hazard to humans and animals.
3. Employers are required to have material safety data sheets available for employees that address the safe handling, storage, and disposal of any hazardous materials. The MSDS also contain information on the nature of the chemical substance, first aid measures, and steps to take in case of a spill.

Suggested Essential Questions

1. What is hazardous waste, and how does it cause harm?
2. Where can I obtain information about hazardous materials?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Explore the meaning of hazardous waste. (DOK 2)	a. Have students recall the different sources of waste (domestic, commercial, medical, municipal, industrial, construction and demolition, transportation, and agricultural)	a. Students will be graded by paper and pencil test.

and identify specific waste products produced by these sources. Invite a local emergency responder or waste management specialist to explain how waste is determined to be hazardous or non-hazardous and how hazardous wastes are now disposed in the local community. Have students recommend improvements in the practices used. Have students summarize and post the information gathered to the Blackboard class site. ^{CS1, CS2, CS4, T1, T4, W4, W5}		
b. Classify hazardous waste materials. (DOK 1)	b. Begin by asking students to describe common hazards that they have encountered. Draw out a definition of hazard from the class. Have students read the chapter on hazardous waste in the text (Porter et al., 2003). Discuss and illustrate the different classes of hazardous materials (ignitibility, reactivity, corrosivity, and toxicity). ^{CS1, CS2, CS4, T4, T6, R1, R4, R5}	b. Evaluate student understanding using a paper and pencil test.
c. Discover information about hazardous materials. (DOK 2)	c. Assign each student a hazardous material commonly found in the home, workplace, and school (ex. motor oil, ammonium nitrate, sulfuric acid, glyphosate [Roundup], antifreeze/coolant, etc.). Have students locate a materials safety data sheet (MSDS) on the Internet and complete an assignment to answer questions in their own words concerning the material. Students should use the <i>Hazardous Materials Discovery Assignment (9.8)</i> for this activity. After reviewing the assignments for accuracy and completeness, post to the class' Blackboard site. ^{CS1, CS2, CS4, T3, T6, R1, R4, R5, W4, W5}	c. Evaluate student assignment for accuracy and completeness.

Standards

AFNR Industry Standards

- ESS.01. Use analytical procedures to plan and evaluate environmental service systems.
- ESS.02. Assess the impact of policies and regulations on environmental service systems.
- ESS.03. Apply scientific principles to environmental service systems.
- ESS.04. Operate environmental service systems to manage a facility environment.
- NRS.02. Apply scientific principles to natural resource management activities.
- NRS.03. Apply knowledge of natural resources industries to production and processing industries.
- PS.02. Prepare and implement a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.
- PS.04. Employ elements of design to enhance an environment.

Applied Academic Credit Standards

Environmental Science

- ES 2 Develop an understanding of the relationship of ecological factors that affect an ecosystem.
- ES 3 Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.

Spatial Information Science

- SP 2 Develop an understanding of geographic information systems.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS3 Social & Cross-Cultural Skills
- CS4 Productivity & Accountability
- CS5 Leadership & Responsibility

National Education Technology Standards for Students (NETS)

- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- W4 Organizing Ideas
- W5 Using Language

Suggested References

Arams, K. (2006). *Holt environmental science*. Austin, TX: Holt, Rinehart, and Winston.

CEV Video. (n.d.). *CEV pathway: Natural resources & environmental systems pathway* [DVD]. Lubbock, TX: Author.

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Porter, L., Lee, J., Turner, D., & Hillman J. (2003). *Environmental science & technology* (2nd ed.). Danville, IL: Interstate.

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For additional references, activities, and web resources, please refer to: Mississippi Agriculture Education B.R.I.D.G.E. Web site: <http://www.rcu.blackboard.com> (Available only to registered users).

Science of Agricultural Environment

Unit 10: Issues in a Global Environment

10 Hours

Competency 1: Analyze issues related to the global environment. ESS.03, BIOI 3, ES 3

Suggested Enduring Understandings

1. Global environmental issues affect the earth as a whole and all human beings. Global issues are not limited to one country or to one specific region.
2. Solutions to global environmental issues require the nations of the world to work together to identify the problem, collect information on its causes, and propose solutions that all nations can accept.

Suggested Essential Questions

1. What is the difference in a local environmental issue and a global environmental issue? Which issues are more of a threat?
2. How do nations work together to identify and address global issues?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Explain how global environmental issues are identified. (DOK 1)	a. Have students read the <i>Global Environment Issues</i> chapter in the text (Porter et al., 2003). Hold a class discussion on the definition of what an issue is to include discussing the difference between local issues (ex. maintaining water supply & quality, maintaining air quality, maintaining soil productivity and preventing soil degradation, etc.) and global issues (war and terrorism, landscape degradation, acid rain deposition, greenhouse gas emissions, global warming, etc.). Summarize important points from the discussion on the LCD projector or Smartboard, and have students record them in their electronic journals or notebooks. CS1, CS2, CS4, T1, T2, T3, T4, T6, R1, R4, R5	a. Students will be assessed using a paper and pencil test.
b. Describe the procedures used in solving environmental problems. (DOK 2)	b. Discuss the five questions used in dealing with solving environmental problems: What is the problem? What information is needed and available about the problem? What are the possible ways of solving the problem? What are the possible outcomes of solving the problem? What is the best solution to the problem? Use a scenario from the local area to pose a problem, and have the class work as a team to analyze it and present possible solutions. CS1, CS2, CS4, T1, T2, T3, T4, T6, S1, S2	b. Have students peer assess the results of their assignment.

Competency 2: Analyze issues that affect the global environment. ESS.01, ESS.03, BIOI 3, CHI1 5, E4, ES 3, PSS

Suggested Enduring Understandings

1. Landscape degradation and defacement detracts from the aesthetic appearance and life-promoting qualities of the landscape.
2. Acid rain results from a number of factors including the burning of fossil fuels and results in damage to plants and animals, buildings and structures, and equipment.
3. The tropical rain forests play an important role in reducing carbon emissions in the atmosphere and lowering the carbon monoxide and carbon dioxide levels of the air.
4. Greenhouse gases such as methane, carbon dioxide, and nitrogen oxides along with an increase in ozone are suspected of causing a greenhouse effect that raises the temperature of the earth.

Suggested Essential Questions

1. How do landscape degradation and defacement affect the environment, and what can be done to avoid or minimize this threat?
2. What is acid rain, and what can be done to minimize its effects?
3. How do the tropical rain forests affect the environment?
4. What are the greenhouse gases, and how do they affect the environment?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Investigate the causes and effects of landscape degradation and defacement on the environment. (DOK 2)	a. Based on the knowledge they obtained by reading the <i>Global Environmental Issues</i> chapter in the text (Porter et al., 2003), have the students take pictures of examples of landscape degradation or defacement in the local area. Have students develop a PowerPoint presentation that identifies the problem, describe how it was caused, and suggest ways in which it can be minimized or avoided in the future. CS1, CS2, CS4, T2, T3, T4, T6, R3, R4, R5, W1, W2, W4, W5	a. Use the <i>Rubric for PowerPoint Presentation on Landscape Degradation and Defacement (10.1)</i> to assess student mastery.
b. Evaluate the causes and effects of acid rain deposition on the environment. (DOK 2)	b. Hold a class discussion on the causes and effects of acid rain. Have students collect rainwater from their homes and analyze it using a pH meter. Have students graph their findings and speculate on why there is a variance. CS1, CS2, CS4, T1, T2, T3, T4, T6, S1, S2, M1, M5, M7	b. Students will be assessed using a paper and pencil test.
c. Evaluate the causes and effects of tropical rain forest destruction on the environment. (DOK 2)	c. Have students research and write a paper describing the causes and effects of the tropical rain forest destruction on the environment. The paper should present recommendations on how future damage to the global environment can be prevented. CS1, CS2, CS4, T1, T2, T3, T4, T6, R1, R2, R4, R5, W1, W2, W4, W5	c. Use the <i>Rubric for Tropical Rain Forest Paper (10.2)</i> to assess student mastery.

d. Evaluate the causes and effects of greenhouse gases on the environment. (DOK 3)	d. Use a PowerPoint presentation on the cause and effects of greenhouse gases on the environment. Divide the class into two groups with one group debating that global warming is a reality and the other group debating that it is a hoax. CS1, CS2, CS4, CS5, T1, T2, T3, T4, T6, S1, S2, S3	d. Students will be graded using a paper and pencil test.

Competency 3: Investigate the design of alternative futures. ESS.01, BIOI 3, ES1, ES2, ES3

Suggested Enduring Understandings

1. By comparing past conditions to current conditions, scientists are able to establish trends that can be used to predict future environmental conditions.
2. Futuring is a process by which we can try to shape the future and have some control over our destiny. Futuring is accomplished through a process that predicts future conditions based on different alternatives.
3. Forecasting is the science of prediction of future events based on trends obtained from past and current data.
4. The local environment can be maintained and improved through careful planning.

Suggested Essential Questions

1. How are trends in environmental quality determined?
2. What is futuring, and how is it accomplished?
3. How is forecasting accomplished?
4. What is the process for developing an environmental improvement plan?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Explain the role of forecasting in the environment. (DOK 2)	a. Have students read Chapter 28 in the text (Porter et al., 2003). Lead a discussion with students regarding environmental planning and forecasting. CS1, CS2, CS4, T2, T3, T4, T6, R1, R2, R4, R5	a. Use the <i>Group Participation Rubric (10.3)</i> to assess student mastery.
b. Discuss how futuring is used to assure a desired environment. (DOK 2)	b. Through classroom discussion, have students develop a definition of futuring as related to environmental protection and enhancement. Have students research recent examples of futuring reports on the environment and include these in the discussion. CS1, CS2, CS4, T1, T2, T3, T4, T6, R1, R2, R4, R5	b. Students will be assessed using a paper and pencil test.
c. Develop a plan for assuring maintaining and improving environmental quality in the local area. (DOK 4)	c. Have students working as a class or in groups develop an environmental improvement plan for your local community or the area near your school that addresses a global issue. Use resource people in the community to help the planning. Be sure to include the following: current conditions, a concise statement of the issue or problem to be addressed, an overall	c. Use the <i>Environmental Plan Rubric (10.3)</i> to assess student mastery.

statement of the direction to go, objectives and goals, ways and means of achieving the objectives and goals, and a means for evaluating progress. Submit the final report to the class in a presentation. [CS1](#), [CS2](#), [CS4](#), [T1](#), [T2](#), [T3](#), [T4](#), [T6](#), [W1](#), [W2](#), [W4](#), [W5](#)

Standards

AFNR Industry Standards

- ESS.01. Use analytical procedures to plan and evaluate environmental service systems.
- ESS.03. Apply scientific principles to environmental service systems.

Applied Academic Credit Standards

Biology I

- BIOI 3 Investigate and evaluate the interaction between living organisms and their environment.

Chemistry I

- CHI 5 Compare factors associated with acid/base and oxidation/reduction reactions.

Earth Science

- E4 Demonstrate an understanding of Earth systems relating to weather and climate.

Environmental Science

- ES 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ES 2 Develop an understanding of the relationship of ecological factors that affect an ecosystem.
- ES 3 Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.

Physical Science

- PS 5 Investigate and apply principles of physical and chemical changes in matter.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS4 Productivity & Accountability

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- M1 Basic Operations and Applications
- M5 Graphical Representations
- M7 Measurement
- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R3 Sequential, Comparative, and Cause–Effect Relationships
- R4 Meaning of Words

R5	Generalizations and Conclusions
S1	Interpretation of Data
S2	Scientific Investigation
S3	Evaluation of Models, Inferences, and Experimental Results
W1	Expressing Judgments
W2	Focusing on the Topic
W4	Organizing Ideas
W5	Using Language

Suggested References

Arams, K. (2006). *Holt environmental science*. Austin, TX: Holt, Rinehart, and Winston.

CEV Video. (n.d.). *CEV pathway: Natural resources & environmental systems pathway* [DVD]. Lubbock, TX: Author.

Energy, greenhouse gases, & farming. Retrieved June 14, 2010, from
<http://www.climateandfarming.org/eghg-f.php>

Porter, L., Lee, J., Turner, D., & Hillman J. (2003). *Environmental science & technology* (2nd ed.). Danville, IL: Interstate.

Powers, L., & McCorley, R. (2000). *Ecological principles for agriculture*. Albany, NY: Delmar.

For additional references, activities, and web resources, please refer to: Mississippi Agriculture Education B.R.I.D.G.E. Web site: <http://www.rcu.blackboard.com> (Available only to registered users).

Student Competency Profile

Student Name: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Introduction to the Science of Agricultural Environment

- _____ 1. Examine the environment and how is it affected by human and agricultural activities.
- _____ 2. Analyze issues affecting the global environment and how these relate to agriculture.
_____ Demonstrate career and leadership skills required for employment in the environmental and natural resources industry.
- _____ 3. resources industry.
- _____ 4. Identify general safety precautions for the laboratory and field.
- _____ 5. Explore career opportunities in environmental and natural resources areas.

Unit 2: Experiential Learning (SAE)

- _____ 1. Plan and implement an experiential learning program.
- _____ 2. Maintain records and documentation of experiential learning activities, projects, and enterprises.

Unit 3: Living Organisms and Ecology

- _____ 1. Investigate the role of living organisms in the environment.
- _____ 2. Examine relationships of living organisms and the environment.
- _____ 3. Discuss the impact of agricultural pests and pest control measures on the environment.
- _____ 4. Examine principles of ecology as related to environment quality.
- _____ 5. Identify ecological diversity in agricultural and wildlife ecosystems.

Unit 4: Land and Soil Management

- _____ 1. Examine the process of planning for urban and rural land use.
- _____ 2. Apply principles of soil and land management and use.
- _____ 3. Assess the impact of agricultural, horticultural, and forestry practices on land and soil.

Unit 5: Water Quality Management

- _____ 1. Explore concepts of water usage and quality.
- _____ 2. Describe important water management practices.
- _____ 3. Describe how wastewater is treated to maintain water quality.

Unit 6: The Atmosphere and Environmental Quality

- _____ 1. Examine the relationship of the atmosphere to the earth's environment.
- _____ 2. Use weather and climate information in making decisions about the environment.
- _____ 3. Assess air quality, and identify sources of air pollution.

Unit 7: Forestry and the Environment

- _____ 1. Examine basic principles of forest dendrology and mensuration.
- _____ 2. Discuss the relationship of forestry to environment quality and economic development.

Unit 8: Wildlife and the Environment

- _____ 1. Examine the relationships of wildlife well-being and environmental quality.
- _____ 2. Investigate approaches in protecting and managing wildlife species.

Unit 9: Environmental Stewardship

- _____ 1. Discuss concepts of sustainable agriculture.
- _____ 2. Explore the services of agencies and organizations that protect and maintain the environment.
- _____ 3. Use appropriate procedures for management and disposal of solid waste.
- _____ 4. Select appropriate procedures for managing hazardous waste materials.

Unit 10: Issues in a Global Environment

- _____ 1. Analyze issues related to the global environment.
- _____ 2. Analyze issues that affect the global environment.
- _____ 3. Investigate the design of alternative futures.

Appendix A: Suggested Rubrics, Checklist, and Activities

Name: _____

Date: _____

Period: _____

Rubric for Student Survey on Environmental Protection and Natural Resources Use (1.1)

On the questions below, indicate your understanding the Environmental Protection and Natural Resource Use by marking a 5 for a great understanding of the issue, a 4 for a good understanding of the issue, a 3 for a basic understanding of the issue, a 2 for a little understanding of the issue, and a 1 for no understanding of the issue.

	Great Understanding	Good Understanding	Basic Understanding	Little Understanding	No Understanding
1. The natural resources in our area are in need of protection.	5	4	3	2	1
2. The natural resources in our area are obviously used by people.	5	4	3	2	1
3. The natural resources in our area add beauty and quality of life to our community.	5	4	3	2	1
4. There is a great need for protection of our local natural resources.	5	4	3	2	1
5. I can contribute to protecting our local environment.	5	4	3	2	1
6. Our nation's natural resources are in jeopardy of being destroyed.	5	4	3	2	1
7. The availability of our nation's natural resources is affecting the price of fuel.	5	4	3	2	1
8. Our government works to protect our natural resources.	5	4	3	2	1
9. I can contribute to protecting our nation's natural resources.	5	4	3	2	1
10. Environmental protection laws are essential to preserving our nation's natural resources.	5	4	3	2	1

Name: _____

Date: _____

Period: _____

Lecture Notes for Unit 1 (1.2)

Vocabulary Words: Use the Environmental Science and Technology Text Book to define the terms for the week.

Air
Development
Domesticate
Environment
Fossil fuel
Inorganic substance
Landscape
Mineral
Natural resource
Non renewable
Renewable
Wildlife

In a group discussion, have students identify and describe the kinds of natural resources that exist:

Air – Mixture of gases surrounding the earth
Water – A colorless, transparent, natural compound found in oceans, lakes, icebergs, and vaporized in the air
Soil – Top layer of the earth's crust
Wildlife – Includes non-domesticated animals and plants and trees
Fossil Fuels – Energy-producing material made of dead and decaying plant material
Petroleum – Liquid form
Natural gas – Gaseous form
Coal – Solid form
Minerals – Inorganic substances, such as iron, gold, limestone, etc.
People

Discuss the differences between a resource being *renewable* or *nonrenewable*, exhaustible and non-exhaustible, and the importance of preserving, conserving, and protecting those resources.

Natural resources interaction:

Sustainability – All natural resources affect one another in both positive and negative ways, but they also **DEPEND** on one another for survival.

Name: _____

Date: _____

Period: _____

Construct a Food Web Activity (1.3)

1. Begin building a giant food web out of yarn or string and colored index cards. Create the center of the web using index cards of the same and putting each nonliving natural resource on a card and connecting them together.
2. Have students brainstorm a list of common wildlife animals that can be found in their county. Divide the list among student groups, and assign them the task of researching the animals on their list to find their eating habits and see whether they are omnivore (meat and plant eaters), carnivore (meat eater), or herbivore (plant eater) and to create a food chain on each animal.
3. When the groups have finished researching their assigned animals, instruct students to put the plant names each on a green card and build the level of the web around the nonliving natural resources. The next circle should be the herbivores identified on a yellow card, then the carnivores on a red card, and then the omnivores on a blue card. Instruct the students to connect the cards to one another using the yarn, thus creating a giant food web.
4. Display the web on a wall or bulletin board for future reference in class discussion.

Name: _____

Date: _____

Period: _____

Rubric for Group Activity to Construct a Food Web (1.4)

CATEGORY	4-Exceptional	3-Admirable	2-Acceptable	1-Amateur	SCORE
Content of Activity	Students exhibited exceptionally accurate detail including nonliving resources, plants, and animals and correctly assigned all species to appropriate categories.	Students included the most common nonliving resources, plants, and animals and correctly assigned all species to appropriate categories.	Students included 1–3 of the common nonliving resources, plants, and animals and correctly assigned all species to appropriate categories.	Students assigned only one common nonliving resource, plant, and animal to the web.	
Group Participation	All students participated in the activity.	3/4 of the students participated in the activity.	1/2 of the students participated in the activity.	Only one or two students actively participated.	
Shared Responsibility	Responsibility for task is shared evenly by all members of the group.	Responsibility is shared by most group members.	Responsibility is shared by 1/2 the group members.	One or two members bore the majority of the responsibility for accomplishing the task.	
Quality of Interaction	All members exhibited excellent listening and leadership skills.	Most students exhibited excellent listening skills.	The group demonstrated some ability to listen, interact, and discuss.	There was very little interaction or discussion. Some students were disinterested or distracted.	
Roles Within Group	Each student was assigned a clearly defined role; group members perform roles effectively.	Each student was assigned a role, but roles were not clearly defined or consistently adhered to.	Students were assigned roles, but roles were not consistently adhered to.	No effort was made to assign roles to group members.	
Total Score					

Name: _____

Date: _____

Period: _____

Rubric for Position Paper on Conservation and Responsible Use of Natural Resources (1.5)

CATEGORY	4-Exceptional	3-Admirable	2-Acceptable	1-Amateur	SCORE
Technical Content	The paper clearly stated more than five programs or activities in which the selected agricultural enterprise directly promoted the conservation and responsible use of natural resources.	The paper clearly stated more than four to five programs or activities in which the selected agricultural enterprise directly promoted the conservation and responsible use of natural resources.	The paper clearly stated more than three programs or activities in which the selected agricultural enterprise directly promoted the conservation and responsible use of natural resources.	The paper clearly stated two or fewer programs or activities in which the selected agricultural enterprise directly promoted the conservation and responsible use of natural resources.	
Organization	Content is extremely well organized in a logical format that is easy to follow and flows smoothly from one idea to another enhancing the effectiveness of the project.	Content is presented in a thoughtful, organized manner, and most transitions were easy to follow. Only a few ideas were unclear.	While content was somewhat organized, ideas were not presented coherently, and transitions were not always smooth.	The content was choppy and confusing. It was difficult to follow; transitions were abrupt and seriously distracted from theme and purpose.	
Content Accuracy	All content was completely accurate; all facts were precise and explicit.	Content was mostly accurate with only a few inconsistencies or errors in information.	Content was somewhat accurate, but there were more than a few inconsistencies or errors in information.	Content was grossly inaccurate to the point that the facts in this project were misleading to the audience.	
Research	Research on the project went above and beyond expectations. The student solicited material in addition to what was provided, brought in personal ideas and information to enhance project, and utilized more than six types of resources to make project effective.	The student did a very good job of researching, using materials provided to his or her full potential; the student used more than four types of research to enhance project (at least one source from information outside of the school).	The student used at least three references provided by the school in an acceptable manner but did not consult any additional resources.	The student did not use provided resources effectively and did little or no fact gathering on the topic.	
Creativity	The report demonstrated exceptional creativity and originality on the part of the student.	The report was cleverly presented in a thoughtful and interesting manner.	The student did add a few creative touches to enhance the report but mostly reported the information as provided.	The report showed little creativity or originality.	

Name: _____

Date: _____

Period: _____

Sample Test Questions (1.6)

Multiple Choice

1. Naturally occurring resources that are found in nature are called:
 - a. natural resources.
 - b. renewable resources.
 - c. nonrenewable resources.
 - d. sustainable resources.
2. Resources that can be replaced when they are used are called:
 - a. natural resources.
 - b. renewable resources.
 - c. nonrenewable resources.
 - d. sustainable resources.
3. Resources that cannot be replaced when used are called:
 - a. natural resources.
 - b. renewable resources.
 - c. nonrenewable resources.
 - d. sustainable resources.
4. Materials used to provide energy, created by the decomposition of dead plants and animals, are called:
 - a. air.
 - b. fossil fuels.
 - c. soil.
 - d. wildlife.
5. There are three types of fossil fuels. The liquid form used to make gasoline and plastics is called:
 - a. coal.
 - b. natural gas.
 - c. peat.
 - d. petroleum.
6. The solid form of fossil fuels that is used in factories and electricity generating plants is called:
 - a. coal.
 - b. natural gas.
 - c. oil.
 - d. petroleum.
7. The gaseous fossil fuel used for heating and cooking food is called:
 - a. coal.
 - b. natural gas.
 - c. crude oil.
 - d. petroleum.

8. The energy in fossil fuels was put there when plants converted energy from the sun in to food. This process is called:
 - a. respiration.
 - b. chlorophyll.
 - c. photosynthesis.
 - d. transpiration.
9. The type of consumer that eats only meat is called a/an:
 - a. carnivore.
 - b. herbivore.
 - c. omnivore.
 - d. predator.
10. The type of consumer that eats only plants is called a/an:
 - a. carnivore.
 - b. herbivore.
 - c. omnivore.
 - d. predator.
11. The type of consumer that eats both plants and animals is called a/an:
 - a. carnivore.
 - b. herbivore.
 - c. omnivore.
 - d. predator.
12. This part of the food chain feeds on producers. It cannot make its own food. Most of these organisms eat only living tissue, but some eat both alive and dead tissue, such as the horse that eats grass and hay. This is called a:
 - a. producer.
 - b. consumer.
 - c. decomposer.
 - d. transformer.
13. This organism takes nutrients and energy from nonliving sources and makes them into its food. It is also called an autotroph. It does not depend on other organisms for food. What is it?
 - a. Producer
 - b. Consumer
 - c. Decomposer
 - d. Transformer
14. This organism breaks down the bodies of dead plants and animals. They normally only feed on dead tissue and break it down into inorganic substances. Some examples are bacteria and mushrooms. These organisms are called:
 - a. producers.
 - b. consumers.
 - c. decomposers.
 - d. transformers.
15. Wetlands are important in the environment to keep ground water supplies clean and available and provide a habitat for many species of wildlife. When laws are passed to help protect wetlands, this is called:
 - a. sustainable agriculture.
 - b. sustainable development.
 - c. sustainable resource use.

- d. sustainability.
16. When an area of farmland is taken out of production and cleared to build a subdivision of houses for people, environmental considerations must be taken in manufacturing and construction. This is called:
- a. sustainable agriculture.
 - b. sustainable development.
 - c. sustainable resource use.
 - d. sustainability.
17. If a housing development is being built in a forested area and consideration is given to cut down as few trees as possible and to keep the lake that exists in place by building around lake, this kind of relationship is called:
- a. design for the environment.
 - b. symbiotic relationship.
 - c. aesthetic relationship.
 - d. conservation relationship.
18. One of the requirements of an environment to remain healthy for the wildlife in that area is for there to be enough room for the animal to find food, find a mate, and establish a territory. This is called:
- a. food.
 - b. water.
 - c. space.
 - d. shelter.
19. All the parts of a particular environment are called:
- a. habitat.
 - b. ecosystem.
 - c. community.
 - d. territory.
20. The area an animal uses and protects as its own is called:
- a. habitat.
 - b. ecosystem.
 - c. community.
 - d. territory.

Name: _____

Date: _____

Period: _____

Rubric for Student Electronic Notebook (1.7)

Scoring Criteria				
<i>The student did the following:</i>	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Captured the main ideas from the presentation or lecture in handwritten form				
Accurately transcribed the main ideas into the proper electronic format				
Checked spelling and grammar				
Demonstrated comprehension of the writing process				
Summarized the important points and added personal reflections				

Name: _____

Date: _____

Period: _____

Rubric for Written Report on Environmental Agencies (1.8)

Date: _____

	Scoring Criteria			
<i>The student did the following:</i>	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Presented the mission and purpose of the agency in preserving land and environment and provided examples of projects designed to prevent landscape degradation				
Included all required parts from introduction to conclusion in smooth transition				
Provided interesting, supportive, and complete statements				
Demonstrated comprehension of the writing process				
Used correct spelling, grammar, punctuation, and sentence structure				
Prepared paragraphs that emphasize appropriate points				
Documented sources and references clearly and accurately				

Name: _____

Date: _____

Period: _____

21st Century Life and Career Skills (1.9)

Today's life and work environments require far more than thinking skills and content knowledge. The ability to navigate the complex life and work environments in the globally competitive information age requires students to pay rigorous attention to developing adequate life and career skills.

CS1 Global Awareness

1. Using 21st century skills to understand and address global issues
2. Learning from and working collaboratively with individuals representing diverse cultures, religions, and lifestyles in a spirit of mutual respect and open dialogue in personal, work, and community contexts
3. Understanding other nations and cultures, including the use of non-English languages

CS2 Financial, Economic, Business and Entrepreneurial Literacy

1. Knowing how to make appropriate personal economic choices
2. Understanding the role of the economy in society
3. Using entrepreneurial skills to enhance workplace productivity and career options

CS3 Civic Literacy

1. Participating effectively in civic life through knowing how to stay informed and understanding governmental processes
2. Exercising the rights and obligations of citizenship at local, state, national, and global levels
3. Understanding the local and global implications of civic decisions

CS4 Health Literacy

1. Obtaining, interpreting, and understanding basic health information and services and using such information and services in ways that enhance health
2. Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance, and stress reduction
3. Using available information to make appropriate health-related decisions
4. Establishing and monitoring personal and family health goals
5. Understanding national and international public health and safety issues

CS5 Environmental Literacy

1. Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water, and ecosystems
2. Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.)
3. Investigate and analyze environmental issues, and make accurate conclusions about effective solutions
4. Take individual and collective action towards addressing environmental challenges (e.g., participating in global actions, designing solutions that inspire action on environmental issues)

CSS2-Learning and Innovation Skills

CS6 Creativity and Innovation

1. Think Creatively
2. Work Creatively with Others
3. Implement Innovations

CS7 Critical Thinking and Problem Solving

1. Reason Effectively
2. Use Systems Thinking
3. Make Judgments and Decisions
4. Solve Problems

CS8 Communication and Collaboration

1. Communicate Clearly
2. Collaborate with Others

CSS3-Information, Media and Technology Skills

CS9 Information Literacy

1. Access and Evaluate Information
2. Use and Manage Information

CS10 Media Literacy

1. Analyze Media
2. Create Media Products

CS11 ICT Literacy

1. Apply Technology Effectively

CSS4-Life and Career Skills

CS12 Flexibility and Adaptability

1. Adapt to change
2. Be Flexible

CS13 Initiative and Self-Direction

1. Manage Goals and Time
2. Work Independently
3. Be Self-directed Learners

CS14 Social and Cross-Cultural Skills

1. Interact Effectively with others
2. Work Effectively in Diverse Teams

CS15 Productivity and Accountability

1. Manage Projects
2. Produce Results

CS16 Leadership and Responsibility

1. Guide and Lead Others
2. Be Responsible to Others

Name: _____

Date: _____

Period: _____

21st Century Life and Career Skills Assessment Rubric (1.10)

The following scale can be used to assess application of each of the Life and Career Skills of students.

Superior	(18–20 points) The student consistently demonstrates all aspects of this skill in classroom and laboratory activities.
Exceptional	(15–17 points) The student consistently demonstrates most of the aspects of this skills in classroom and laboratory activities but lapses at times on one to two of the indicators.
Adequate	(12–14 points) The student demonstrates knowledge of the skill during classroom and laboratory activities but lapses on three or more indicators from time to time.
Improving	(9–11 points) The student is vaguely aware of the skill but shows only marginal evidence of being able to apply it in the classroom or laboratory.
Minimal	(0–8 points) The student consistently fails to demonstrate knowledge or application of the skill.

Skill	Comments	Score
Flexibility and Adaptability		
Initiative & Self-Direction		
Social & Cross-Cultural Skills		
Productivity & Accountability		
Leadership & Responsibility		
		TOTAL SCORE

Name: _____

Date: _____

Period: _____

Rubric for Personal Plans (1.11)

Scoring Criteria				
<i>The student did the following:</i>	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Identified areas where he or she felt a need to improve leadership and human relations skills				
Identified activities in FFA and other organizations that would aid in the development of these skills				
Kept records and documentation of leadership and human relations activities and incorporated these into the electronic portfolio				

Need to Know and How to Guide Report Rubric (1.12)

Criteria	Superior 5 Points	Exceptional 4 Points	Adequate 3 points	Marginal 2 points	Minimal 1 Point	Score
Written report addressed the topic	Provided specific details on the topic	Provided general details on the topic	Provided details on the topic	Provided minimal details on the topic	Provided limited information on the topic	
Presentation addressed the topic	Provided specific details on the topic	Provided general details on the topic	Provided details on the topic	Provided some details on the topic	Provided limited information on the topic	
Quality of the visual aid	Shows relevance to the topic by creatively displaying specific details related to the topic	Shows relevance to the topic by creatively displaying general details related to the topic	Shows relevance to the topic by displaying details related to the topic	Shows some relevance to the topic by displaying limited details related to the topic	Shows very little relevance to the topic	
Quality of written report	No errors in grammar, syntax, spelling, etc.	One to two minor errors in grammar, syntax, spelling, etc.	Two to four minor errors in grammar, syntax, spelling, etc.	More than four minor errors in grammar, syntax, spelling, etc.	Major errors in grammar, syntax, spelling, etc.	
TOTAL SCORE:						

Natural Resources Careers Research Rubric (1.13)

Criteria	Superior 5 Points	Exceptional 4 Points	Adequate 3 points	Marginal 2 points	Minimal 1 Point	Score
Table addressed the topic	Provided specific details on the topic	Provided general details on the topic	Provided details on the topic	Provided minimal details on the topic	Provided limited information on the topic	
Written Justification addressed the topic	Provided specific points supporting the job choice	Provided general points supporting the job choice	Provided points supporting the job choice	Provided some points supporting the job choice	Provided limited points supporting the job choice	
Quality of the visual aid	Shows relevance to the topic by creatively displaying specific details related to the topic	Shows relevance to the topic by creatively displaying general details related to the topic	Shows relevance to the topic by displaying details related to the topic	Shows some relevance to the topic by displaying limited details related to the topic	Shows very little relevance to the topic	
Quality of written report	No errors in grammar, syntax, spelling, etc.	One to two minor errors in grammar, syntax, spelling, etc.	Two to four minor errors in grammar, syntax, spelling, etc.	More than four minor errors in grammar, syntax, spelling, etc.	Major errors in grammar, syntax, spelling, etc.	
TOTAL SCORE:						

Name: _____

Date: _____

Period: _____

Rubric for Experiential Learning Planning and Record Keeping (2.1)

Scoring Criteria				
	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Long-range and short-term goals reflect the educational and career goals of the student.				
The SAE plan/training agreement reflects growth in student skill and proficiency.				
Records accurately reflect all SAE accomplishments of the student over the year.				
Records are maintained on a timely basis.				
Journals or calendars are maintained on a timely basis and serve as the source for record keeping.				
Hours and earnings are recorded based on activities.				
A summary of all activities is provided at the end of each grading period.				
Financial records are maintained accurately.				
Financial records are summarized at the end of the year.				

Microbe Collection and Wet Mount Slide Performance Rubric (3.1)

	Possible Points	Points Awarded
Safety - Personal safety (glasses, gloves, clothing, etc.) - Safe use of tools - Safely performs the task	25	
Performance of the Task - Follows the instructions on preparing a Wet Mount Slide - Successfully finds image of specimen in microscope - Records data and information accurately - Identifies specimen classification	50	
Lab Maintenance - Properly handled the microscope - Understood the mechanics of the microscope - Area cleanup (clean and tidy) - Area organization (before, during, and after the task)	25	
Total	100	

Comments for deductions:

Life Span Visual Performance Rubric (3.2)

Criteria	Superior 5 Points	Exceptional 4 Points	Adequate 3 points	Marginal 2 points	Minimal 1 Point	Score
Selection of animal and depiction of life span	Selected an animal and included a depiction of the animal at each of the five stages of life	Selected an animal and included a depiction of the animal at four of the five stages of life	Selected an animal and included a depiction of the animal at three of the five stages of life	Selected an animal and included a depiction of the animal at two of the five stages of life	Selected an animal and included a depiction of the animal at one of the five stages of life	
Description of each life stage to include name and picture	Provided specific details on each of the life stages	Provided general details on each of the life stages	Provided details on at least four of the life stages	Provided some details on at least three of the life stages	Provided limited information on at least one of the life stages	
Content of visual aid	At least five pictures or graphics are detailing each life stage.	At least four pictures or graphics are detailing each life stage.	At least three pictures or graphics are detailing each life stage.	At least two pictures or graphics are detailing each life stage.	At least one picture or graphic is detailing each life stage.	
Quality of visual aid	No errors in grammar, syntax, spelling, etc.	One to two minor errors in grammar, syntax, spelling, etc.	Two to four minor errors in grammar, syntax, spelling, etc.	More than four minor errors in grammar, syntax, spelling, etc.	Major errors in grammar, syntax, spelling, etc.	
TOTAL SCORE						

Comments:

Rubric for Life Process Poster (3.3)

Criteria	Superior 5 Points	Exceptional 4 Points	Adequate 3 points	Marginal 2 points	Minimal 1 Point	Score
Description of life process	Description includes at least five characteristics of the life process.	Description includes at least four characteristics of the life process.	Description includes at least three characteristics of the life process.	Description includes at least two characteristics of the life process.	Description includes at least one characteristic of the life process.	
Association of life process to animal anatomy and physiology	Associates chosen life process to specific details of at least three different animals' anatomy and physiology	Associates chosen life process to general details of at least three different animals' anatomy and physiology	Associates chosen life process to details of at least two different animals' anatomy and physiology	Associates chosen life process to minimal details of at least two different animals' anatomy and physiology	Associates chosen life process to a few details of at least one animal's anatomy and physiology	
Content of visual aid	At least five pictures or graphics are detailing the life process in each animal.	At least four pictures or graphics are detailing the life process in each animal.	At least three pictures or graphics are detailing the life process in each animal.	At least two pictures or graphics are detailing the life process in each animal.	At least one picture or graphic is detailing the life process in each animal.	
Quality of visual aid	No errors in grammar, syntax, spelling, etc.	One to two minor errors in grammar, syntax, spelling, etc.	Two to four minor errors in grammar, syntax, spelling, etc.	More than four minor errors in grammar, syntax, spelling, etc.	Major errors in grammar, syntax, spelling, etc.	
TOTAL SCORE						

Grading Checklist for Collection of Specimens and/or Photographs that Illustrate Biodiversity (3.4)

- _____ 1. Collection of specimen and/or picture to represent each of the five kingdoms
- _____ 2. Picture of two or more organisms sharing a resource
- _____ 3. Photos of five different vertebrate animals
- _____ 4. Photos of five different invertebrate animals
- _____ 5. Photos of five different plants
- _____ 6. Photo depicting ecological diversity
- _____ 7. Photo depicting genetic diversity
- _____ 8. Photo depicting species diversity

Rubric for Pest Pamphlet (3.5)

Criteria	Superior 5 Points	Exceptional 4 Points	Adequate 3 points	Marginal 2 points	Minimal 1 Point	Score
Pamphlet contains information on an environmental pest	Pamphlet includes specific details on the environmental pest.	Pamphlet includes general details on the environmental pest.	Pamphlet includes details on the environmental pest.	Pamphlet includes minimal details on the environmental pest.	Pamphlet includes few details on the environmental pest.	
Content includes in pamphlet	Includes all the required information	Includes at least four of the required components	Includes at least three of the required components	Includes at least two of the required components	Includes at least one of the required components	
Quality of pamphlet layout	Pamphlet is in color and includes at least five graphics, artwork, or pictures. Layout is easy to follow and organized.	Pamphlet is in color and includes at least three graphics, artwork, or pictures. Layout is easy to follow and organized.	Pamphlet is in color and includes at least one graphic, artwork, or picture. Layout is organized.	Pamphlet is not in color but includes at least three graphics, artwork, or pictures. Layout is somewhat organized.	Pamphlet is not in color and does not include any graphics/artwork or pictures. Layout is difficult to follow.	
Quality of brochure presentation	No errors in grammar, syntax, spelling, etc.	One to two minor errors in grammar, syntax, spelling, etc.	Two to four minor errors in grammar, syntax, spelling, etc.	More than four minor errors in grammar, syntax, spelling, etc.	Major errors in grammar, syntax, spelling, etc.	
TOTAL SCORE						

Grading Checklist for the Wiki on Ecology (3.6)

An effective wiki shows the following:

- ____ 1. **A collaborative effort** (as seen in the history)
Several students in the assigned group contributed to the Wiki.
- ____ 2. **Visual appeal**
Graphics are effectively used.
- ____ 3. **Organization**
A table of contents, headings, and/or other visual organizers are used.
- ____ 4. **Hyperlinks to sources**
Wiki contains several hyperlinks to sources of information. These hyperlinks have been checked to make sure they work.
- ____ 5. **Original, intelligent wording**
Words used in the Wiki are original, not cut and pasted into the Wiki. Any text present is original, not copied.
Optional wiki traits
- ____ 6. **Multisensory tools are used.**
Multimedia information is presented in the Wiki. This strengthens the influence of the Wiki.
- ____ 7. **RSS Feeds and Cutting edge tools are used.**
Web 2.0 technology is also used, such as podcasts.

Grading Rubric for the Owl Pellet Dissection (3.7)

	Possible Points	Points Awarded
Safety - Personal safety (glasses, gloves, clothing, etc.) - Safe use of tools - Safely performs the task	25	
Performance of the Task - Follows the instructions on dissecting owl pellets - Successfully dissects the pellet - Records data and information accurately - Identifies specimen classification	50	
Lab Maintenance - Properly handled the tools - Proper disposal of waste - Area cleanup (clean and tidy) - Area organization (before, during, and after the task)	25	
Total	100	

Comments for deductions:

Grading Rubric for Stream Monitoring (3.8)

	Possible Points	Points Awarded
Safety - Personal safety (glasses, clothing, etc.) - Safe use of tools - Safely performs the task - Safely works in outdoor stream environment	25	
Performance of the Task - Follows the task instructions - Performs the task efficiently - Performs the task satisfactorily - Records data and information accurately	50	
Outdoor Safety - Area cleanup (clean and tidy) - Maintained operation of tools and monitoring equipment - Equipment organization (before, during, and after the task)	25	
Total	100	

Comments for deductions:

Guest Speaker Evaluation Form (4.1)

1. List five main ideas expressed in the presentation.

1. _____
2. _____
3. _____
4. _____
5. _____

2. Write a brief summary relating the topics of the presentation to your life.

Land Measurement Checklist (4.2)

- _____ 1. Student demonstrated measuring horizontal distance.
- _____ 2. Student demonstrated land chaining.
- _____ 3. Student demonstrated direction measurements using a compass.
- _____ 4. Student demonstrated making elevation measurements using a level.
- _____ 5. Student accurately measured horizontal distance using the appropriate tools.
- _____ 6. Student accurately measured a horizontal distance using the chaining method.
- _____ 7. Student accurately measured direction using a compass.
- _____ 8. Student accurately measured slope using a level.

Part 2

Provide a boundary survey of a given tract of land.

- _____ 1. Student was able to identify markers using a GPS.
- _____ 2. Student was able to identify markers using compass and land description.
- _____ 3. Student was able to visually identify boundary lines.
- _____ 4. Student was able to identify boundary lines using GPS technology and compasses.
- _____ 5. Student demonstrated ability to pace distance along a boundary.

Reflective Writing Rubric (4.3)

CATEGORY	4	3	2	1
Writing Structure	Sentences and paragraphs are complete, well-constructed, and of varied structure.	All sentences are complete and well-constructed (no fragments, no run-ons). Paragraphing is generally done well.	Most sentences are complete and well-constructed. Paragraphing needs some work.	Many sentence fragments or run-on sentences OR paragraphing needs lots of work.
Content	The writing contains a description of all steps taken during the "feel" test of the soil.	The writing contains a description of three steps taken during the "feel" test of the soil.	The writing contains a description of two steps taken during the "feel" test of the soil.	The writing contains a description of one step taken during the "feel" test of the soil.
Content Accuracy	The writing contains at least three accurate descriptions of the soil texture.	The writing contains at least two accurate examples of the soil texture.	The writing contains at least one accurate example of the soil texture.	The writing contains no examples of the soil texture.
Content Understanding	Ideas were expressed in a clear and organized fashion. It was easy to tell that the students grasped the "feel" test concept of texture.	Ideas were expressed in a pretty clear manner, but the organization could have been better.	Ideas were somewhat organized but were not very clear. It took more than one reading to figure out what the student was describing.	The writing seemed to be a collection of unrelated sentences. It was very obvious the student could not communicate about the experience.

Mechanical Analysis of Soil Rubric (4.4)

	Possible Points	Points Awarded
Safety • Personal safety (glasses, clothing, etc.) • Safe use of tools and materials • Safely performs the task	25	
Performance of the Task • Follows the task instructions • Performs the task efficiently • Performs the task satisfactorily • Records data and information accurately	50	
Lab Maintenance and Reporting • Kept accurate records of all steps taken • Completed the laboratory report • Area cleanup (clean and tidy) • Area organization (before, during, and after the task)	25	
Total	100	

Comments for deductions:

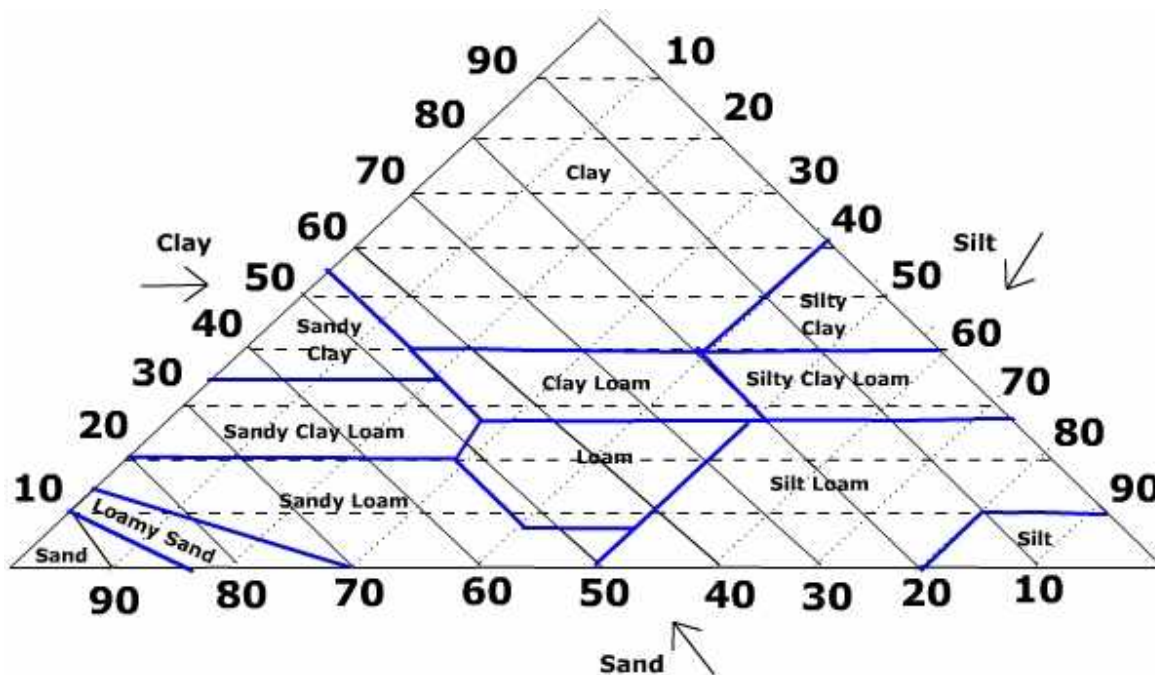
Soil Texture Classification Assignment (4.5)

Use the chart below to determine the texture of soils with the following sand, silt, and clay content.

1. _____ 50% sand, 40% silt, 10%
clay _____
2. _____ 34% Sand, 35% silt, 31%
clay _____
3. _____ 0% sand, 50% silt, 50%
clay _____
4. _____ 20% sand, 65% silt, 15%
clay _____
5. _____ 10% sand, 10% silt, 80%
clay _____
6. _____ 85 % sand, 15% clay

7. _____ 67% sand, 10% silt, 23%
clay _____
8. _____ 0% sand, 20% silt, 80%
clay _____
9. _____ 90% silt, 10% clay

10. _____ 45% sand, 45% silt, 10%
clay _____



Rubric for Evaluating Oral Report on Soil Conservation and Degradation (4.6)

Criteria	Superior 5 Points	Exceptional 4 Points	Adequate 3 points	Marginal 2 points	Minimal 1 Point	Score
Written report addressed the topic on soil erosion and degradation	Provided specific details on erosion and degradation	Provided general details on erosion and degradation	Provided details on erosion and degradation	Provided minimal details on erosion and degradation	Provided limited information on erosion and degradation	
Presentation addressed the topic	Provided specific details on the topic	Provided general details on the topic	Provided details on the topic	Provided some details on the topic	Provided limited information on the topic	
Quality of the visual aid	Shows relevance to the topic by creatively displaying specific details related to the topic	Shows relevance to the topic by creatively displaying general details related to the topic	Shows relevance to the topic by displaying details related to the topic	Shows some relevance to the topic by displaying limited details related to the topic	Shows very little relevance to the topic	
Quality of written report	No errors in grammar, syntax, spelling, etc.	One to two minor errors in grammar, syntax, spelling, etc.	Two to four minor errors in grammar, syntax, spelling, etc.	More than four minor errors in grammar, syntax, spelling, etc.	Major errors in grammar, syntax, spelling, etc.	
TOTAL SCORE:						

Fish Research Group Project Rubric (5.1)

CATEGORY	4-Exceptional	3-Admirable	2-Acceptable	1-Amateur	SCORE
Group Participation	All students participated in the activity.	3/4 of the students participated in the activity.	1/2 of the students participated in the activity.	Only one or two students actively participated.	
Shared Responsibility	Responsibility for task is shared evenly by all members of the group.	Responsibility is shared by most group members.	Responsibility is shared by 1/2 the group members.	One or two members bore the majority of the responsibility for accomplishing the task.	
Quality of Interaction	All members exhibited excellent listening and leadership skills.	Most students exhibited excellent listening skills.	The group demonstrated some ability to listen, interact, and discuss.	There was very little interaction or discussion. Some students were disinterested or distracted.	
Roles Within Group	Each student was assigned a clearly defined role; group members perform roles effectively.	Each student was assigned a role, but roles were not clearly defined or consistently adhered to.	Students were assigned roles, but roles were not consistently adhered to.	No effort was made to assign roles to group members.	
Completing the Assignment	The group effectively responded to the assignment and presented information on three fish species and gave thorough descriptions.	The group responded to the assignment and presented information on three fish species and gave weak descriptions.	The group somewhat responded to the assignment and presented information on less than three fish species and gave poor descriptions.	The group did not respond to the assignment and presented information on less than three fish species and gave no descriptions.	
Content	Information provided was very detailed and technically accurate. Illustrations were provided.	Information provided was very detailed and technically accurate.	Information was general in nature but technically accurate.	Limited information was provided, or there were major inaccuracies in the report.	
Total Score:					

Student Water Use Diary (5.2)

[illegible]

Identify five ways in which you could conserve water.

1. _____
2. _____
3. _____
4. _____
5. _____

Reflective Writing Rubric on the Differences between Ground Water and Surface Water (5.3)

CATEGORY	4	3	2	1
Writing Structure	Sentences and paragraphs are complete, well-constructed, and of varied structure.	All sentences are complete and well-constructed (no fragments, no run-ons). Paragraphing is generally done well.	Most sentences are complete and well-constructed. Paragraphing needs some work.	Many sentence fragments or run-on sentences OR paragraphing needs lots of work.
Content	The writing contains a detailed description of both surface and ground water.	The writing contains a general description of the characteristics of ground water and surface water.	The writing contains a limited description of the characteristics of ground water and surface water.	The writing contains a very weak description or inaccurate description of the characteristics of ground water and surface water.
Content Accuracy	The writing contains at least three accurate descriptions of ground water and surface water.	The writing contains at least two accurate descriptions of ground water and surface water.	The writing contains at least one accurate example descriptions of ground water and surface water.	The writing contains no examples of descriptions of ground water and surface water.
Content Understanding	Ideas were expressed in a clear and organized fashion. It was easy to figure out that the student understands the difference between surface and ground water.	Ideas were expressed in a clear manner, but the organization could have been better.	Ideas were somewhat organized but were not very clear. It took more than one reading to figure out whether the student understood the difference between surface and ground water.	The writing seemed to be a collection of unrelated sentences. The student did not grasp the concept of the difference between surface and ground water.

Name: _____

Date: _____

Period: _____

Stream Monitoring Activity Performance Rubric (5.4)

	Possible Points	Points Awarded
Safety • Personal safety (glasses, gloves, clothing, etc.) • Safe use of tools and equipment • Safely performs the task	25	
Performance of the Task • Follows the instructions on conducting stream monitoring practices • Successfully collects information for assessment • Records data and information accurately • Summarizes data correctly	50	
Lab Maintenance • Properly handled the Ecology Kit tools and equipment • Understood the mechanics of water quality measuring devices • Area cleanup (clean and tidy) • Area organization (before, during, and after the task)	25	
Total	100	

Comments for deductions:

Name: _____

Date: _____

Period: _____

Water Quality Testing Laboratory Rubric (5.5)

Scoring Criteria				
<i>The student/team does the following:</i>	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Explains the skill				
Explains the skill as performed				
Summarizes conclusions				
Participates as a team				
Presents effective explanation				
Subtotal of explanation				
Performs the skill				
Prepares (sets up supplies and equipment for demonstration)				
Performs the water quality test				
Cleans the demonstration area (removes supplies and equipment and cleans the area)				
Demonstrates satisfactory participation by all team members				
<i>Subtotal for skill performance</i>				
Demonstrates overall effectiveness				
Completes laboratory report				
Observes all safety practices				
Maintains appropriate dress				
Maintains personal grooming				
<i>Subtotal for overall effectiveness</i>				
Summative Total				

Field Trip to Wastewater Treatment Plant Participation Checklist (5.6)

- ___ 1. The student arrived at the designated meeting place on time with all materials and supplies required for the field trip.
- ___ 2. The student observed all safety rules and policies while traveling to and participating in the field trip.
- ___ 3. The student demonstrated interest in the content of the field trip by paying attention to the exhibits and speakers, asking pertinent questions, and taking notes.
- ___ 4. The student exhibited a positive attitude toward the events and activities of the field trip.
- ___ 5. The student remained on task throughout the field trip.
- ___ 6. The student exhibited cooperative workplace skills with other students throughout the field trip.

Guest Speaker Evaluation Form (5.7)

1. List five main ideas expressed in the presentation.

1. _____
2. _____
3. _____
4. _____
5. _____

2. Write a brief summary relating the topics of the presentation to your life.

[illegible]

Checklist for Evaluating the Diagram of the Atmosphere (6.1)

- _____ 1. The diagram included the five layers of the atmosphere and a description of their characteristics and functions.
- _____ 2. The diagram was properly labeled with detail.
- _____ 3. The diagram was in color.
- _____ 4. The diagram was easy to understand.
- _____ 5. The diagram was drawn on an 8 ½-in. x 11-in. sheet of paper.

Grade _____ %

Locating Latitude and Longitude on Maps (6.2)

Identify the latitude and longitude of each of the following cities, and classify them as being in either the temperate or tropical zone.

CITY	LATITUDE	LONGITUDE	ZONE
San Diego, California			
Albany, New York			
London, England			
Sydney, Australia			
New Delhi, India			
Rome, Italy			
Denver, Colorado			

San Francisco, California, lies at a latitude of 37° 48' N. Paris, France, lies at a latitude of 49° 50' N. Which city would you expect to have a colder climate based on its latitude?

Puerto San Julian, Argentina, lies at a latitude of 49° 17'S. St Louis, Missouri, lies at a latitude of 38° 35' N. Which city would you expect to have a warmer climate based on latitude?

Denver, Colorado, lies at a latitude of 39° 46'N and an altitude of 5,240 ft. Baltimore, Maryland, lies at a latitude of 39° 16'N and an altitude of 30 ft. Based on the latitude and altitude, how would you compare the climate of the two cities? (Warmer, cooler, or the same)

Air Pollution Presentation Rubric (6.3)

	Possible Points	Points Earned
1. Information was accurate and complete.	30	
2. Presentation included appropriate information on the topic of air pollution.	30	
3. Correct grammar, spelling, and punctuation were used.	20	
4. Proper design elements were used.	10	
5. Student worked well with team members.	5	
6. Student contributed to the finished product.	5	
TOTAL SCORE	100	

Detecting Air Pollution Activity Performance Rubric (6.4)

	Possible Points	Points Awarded
Safety - Personal safety (glasses, clothing, etc.) - Safe use of tools, equipment, and supplies - Safely performs the task	25	
Performance of the Task - Follows the task instructions - Performs the task efficiently - Performs the task satisfactorily - Records data and information accurately	50	
Lab Maintenance - Area cleanup (clean and tidy) - Area organization (before, during, and after the task)	25	
Total	100	

Comments for deductions:

Environmental Science Weather Test (6.5)

Select from the following terms to answer the remaining questions.

dew point	precipitation	temperature	humidity
atmospheric pressure	wind	clouds	warm front
cirrus	cumulus	stratus	cold front
weather front	high	low	

1. Clouds that appear in large layers or sheets are called _____.
2. Any form of moisture that falls to the earth is _____.
3. The measure of the amount of heat in something is _____.
4. Moving air is called _____.
5. The amount of water vapor in the air is described as relative or absolute _____.
6. The temperature of the air when dew begins to form is called _____.
7. The pressure exerted by the air is called _____.
8. Large, dense, billowy clouds that have flat bases and a towering, dome-like appearance are called _____.
9. When a warm air mass and a cold air mass meet, it is called a _____.
10. Clouds that are high, white, and thin are _____.

11. Small droplets or ice crystals in the atmosphere that form together are called

_____.

12. This symbol () on a weather map indicates a _____.

13. This symbol () on a weather map indicates a _____.

14. Colder air is often indicated by an area of _____ pressure.

15. Warmer air is often indicated by an area of _____ pressure.

Multiple Choice

1. How often does the earth revolve around the sun?
 - a. Every 12 hr
 - b. Every 24 hr
 - c. Every 7 days
 - d. Every 365 days
2. How often does the earth rotate?
 - a. Every 12 hr
 - b. Every 24 hr
 - c. Every 7 days
 - d. Every 365 days
3. The time when the earth's axis tilts at the greatest angle toward or away from the sun is called the:
 - a. orbit.
 - b. equinox.
 - c. revolution.
 - d. solstice.
4. The time when the sun is directly over the equator is called the:
 - a. orbit.
 - b. equinox.
 - c. revolution.
 - d. solstice.
5. In which direction does the earth's axis point?
 - a. North/South
 - b. East/West

- c. Northeast/Southeast
 - d. Northwest/Southwest
6. The air that surrounds the earth is called the:
- a. atmosphere.
 - b. hemisphere.
 - c. climate.
 - d. weather.
7. The weather that generally prevails is called the:
- a. atmosphere .
 - b. hemisphere.
 - c. climate.
 - d. weather.
8. The current condition of the atmosphere is called:
- a. atmosphere.
 - b. hemisphere.
 - c. climate.
 - d. weather.
9. The part of the atmosphere closest to the earth is the:
- a. mesosphere.
 - b. stratosphere.
 - c. thermosphere.
 - d. troposphere.
10. The uppermost layer of the atmosphere that is very HOT is called the:
- a. mesosphere.
 - b. stratosphere.
 - c. thermosphere.
 - d. troposphere.
11. The area that extends about 30 miles above the earth and is used by airplanes is the:
- a. mesosphere.
 - b. stratosphere.
 - c. thermosphere.
 - d. troposphere.
12. The area that extends about 50 miles above the earth and is very COLD is the:
- a. mesosphere.
 - b. stratosphere.

- c. thermosphere.
- d. troposphere.

13. The distance between any location on the earth and the Prime Meridian is called the:

- a. atmosphere.
- b. altitude.
- c. longitude.
- d. latitude.

14. The distance North and South of the equator measured in degrees is the:

- a. atmosphere.
- b. altitude.
- c. longitude.
- d. latitude.

15. The distance a point is above sea level is called the:

- a. atmosphere.
- b. altitude.
- c. longitude.
- d. latitude.

Short Answer. Answer the following in complete sentences or by showing your math calculations.

1. What are four characteristics of a tornado?

2. What is the rating scale for tornadoes called? What is the worst rating?

3. What is time based upon?

4. What four factors are used to determine the weather?

5. What direction do weather fronts tend to move in North America?

Use the following formula to solve questions 6 and 7. Show the mathematical equations that you used to arrive at the answer.

$$C = \frac{5}{9} (F - 32)$$

$$F = \frac{9}{5} (C + 32)$$

6. Convert 36 degrees Fahrenheit to Celsius.

7. Convert 105 degrees Celsius to Fahrenheit.

Name: _____

Date: _____

Period: _____

Picture Assessment Rubric (7.1)

	Exemplary 4 points	Accomplished 3 points	Developing 2 points	Beginning 1 point	Score
Required Content	The picture includes all required content elements as well as additional information.	All required content elements are included on the picture.	All but one of the required content elements are included on the picture.	Several required content elements were missing.	
Labels	All items of importance on the picture are clearly labeled with labels that are easy to read.	Almost all items of importance on the picture are clearly labeled with labels that are easy to read.	Many items of importance on the picture are clearly labeled with labels that are easy to read.	Labels are too small to read, or no important items were labeled.	
Attractiveness	The picture is exceptionally attractive in terms of design, layout, and neatness.	The picture is attractive in terms of design, layout, and neatness.	The picture is acceptably attractive though it may be a bit messy.	The picture is distractingly messy or very poorly designed.	
Grammar	There are no grammatical or mechanical mistakes on the picture.	There are one to two grammatical or mechanical mistakes on the picture.	There are three to four grammatical or mechanical mistakes on the picture.	There are more than four grammatical or mechanical mistakes on the picture.	
					Total Score

Comments:

Name: _____

Date: _____

Period: _____

Tree Characteristics Chart (7.2)

Students will create a chart identifying major commercial forest trees (oaks, hickories, pines, ash, etc.) that will include common names, types (hardwood or softwood), physical characteristics, and uses. Students may use the Internet, classroom books, or encyclopedias as resource information to complete this project.

Common Name	Type (Hardwood or Softwood)	Physical Characteristics	Uses

Name: _____

Date: _____

Period: _____

Volume Estimation Sheet for Sawlogs (7.3)

Tree Number	D.B.H.	No. 16 ft Logs	Board Feet	Score
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

TOTAL BOARD FEET IN ONE ACRE _____

Scoring:

4 points for each correct DBH and number of logs

20 points for correct Total Board Feet

2 points to be deducted for each 5% plus or minus from the correct measured volume

Maximum score (10 logs) = 100 points

Name: _____

Date: _____

Period: _____

Doyle Log Rule (Form Class 80) (7.4)

Volume (Board Feet) by Number of 16 Foot Logs

D.B.H.	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5
10	16	20	23	24	26	29	32	35	38
11	24	30	35	38	42	45	48	51	55
12	31	39	47	52	57	60	62	65	59
13	42	53	64	72	80	84	88	91	95
14	52	67	82	93	104	109	114	117	121
15	64	84	104	118	132	141	150	157	165
16	77	101	125	143	161	174	186	196	207
17	92	122	152	175	198	214	230	244	258
18	108	144	179	206	234	254	273	290	308
19	126	168	210	244	278	301	324	345	367
20	144	193	242	282	321	348	374	396	417
21	164	221	278	324	370	403	436	462	489
22	185	250	315	368	420	458	497	529	561
23	208	282	356	417	478	521	564	604	643
24	231	314	397	466	536	583	630	678	725
25	256	350	443	522	600	655	710	764	818
26	282	386	489	576	663	727	791	852	912
27	310	425	540	638	735	806	877	946	1015
28	339	466	592	700	807	885	963	1040	1118
29	370	509	648	766	884	970	1056	1144	1232
30	400	552	703	832	961	1055	1149	1248	1346

Name:	
Date:	
Period:	

Volume Estimation Sheet for Pulpwood (7.5)

Tree Number	D.B.H.	Height	Cords	Score
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

TOTAL CORDAGE IN ONE ACRE

Scoring:

4 points for each correct DBH and height

20 points for correct Total Cordage

2 points to be deducted for each 5% plus or minus from the correct measured volume

Maximum score (10 logs) = 100 points

Name: _____

Date: _____

Period: _____

Volume Estimation Sheet for Pulpwood (7.6)

DBH (Inches)	Height (Feet)								
	8	16	24	32	40	48	54	64	72
	Cords								
6	0.01	0.02							
8	0.02	0.03	0.04	0.05					
10		0.07	0.10	0.12	0.15	0.18	0.21	0.24	
12			0.14	0.18	0.22	0.26	0.30	0.35	
14			0.19	0.24	0.29	0.35	0.41	0.47	
16			0.25	0.31	0.38	0.46	0.54	0.62	0.69
18			0.31	0.40	0.49	0.58	0.69	0.78	0.88
20			0.35	0.43	0.53	0.63	0.75	0.85	0.95
22				0.59	0.73	0.87	1.02	1.16	1.31
24				0.70	0.87	1.03	1.22	1.38	1.56
26				0.83	1.02	1.21	1.43	1.62	1.83

Name: _____

Date: _____

Period: _____

Tree Planting Checklist (7.7)

Place a check by each step or practice that the student performed correctly.

- _____ 1. The student protected the seedlings to be planted from drying out from sun or wind damage.
- _____ 2. The student followed all safety practices in working in the field.
- _____ 3. The student selected the proper spacing for planting the seedling.
- _____ 4. The student used the dibble or shovel to make a planting hole of the correct size and depth.
- _____ 5. The student planted the seedling to the correct depth and checked to make sure that the tap root was pointing straight down (not J-rooted or L-rooted).
- _____ 6. The student used the dibble to close both the bottom and top of the planting hole eliminating any air pockets around the root.
- _____ 7. The student finished closing the hole with his or her shoe heel to create a small indentation at the seedling to collect and hold water.
- _____ 8. The student correctly stored all tools and remaining seedlings after completing the planting task.

Comments:

Name: _____

Date: _____

Period: _____

Fire Prevention Poster Rubric (7.8)

	Exemplary 4 points	Accomplished 3 points	Developing 2 points	Beginning 1 point	Score
Required Content	The poster includes all required content elements as well as additional information.	All required content elements are included on the poster.	All but one of the required content elements are included on the poster.	Several required content elements were missing.	
Labels	All items of importance on the poster are clearly labeled with labels that are easy to read.	Almost all items of importance on the poster are clearly labeled with labels that are easy to read.	Many items of importance on the poster are clearly labeled with labels that are easy to read.	Labels are too small to read, or no important items were labeled.	
Attractiveness	The poster is exceptionally attractive in terms of design, layout, and neatness.	The poster is attractive in terms of design, layout, and neatness.	The poster is acceptably attractive though it may be a bit messy.	The poster is distractingly messy or very poorly designed.	
Grammar	There are no grammatical or mechanical mistakes on the poster.	There are one to two grammatical or mechanical mistakes on the poster.	There are three to four grammatical or mechanical mistakes on the poster.	There are more than four grammatical or mechanical mistakes on the poster.	
Total Score:					

Comments:

Name: _____
 Date: _____
 Period: _____

Written Report Rubric (8.1)

	Exemplary 4 Points	Accomplished 3 Points	Developing 2 Points	Beginning 1 Point	Score
Content	Clear thesis and focus that remain apparent	Thesis and focus that remain apparent	Addresses subject matter with minimal support	Does not focus on topic	
Grammar	Correct and effective use of grammar and mechanics	Occasional errors in use of grammar and mechanics	Problems in use of grammar and mechanics	Repeated errors in use of grammar and mechanics	
Content	Clear thesis and focus that remain apparent	Thesis and focus that remain apparent	Addresses subject matter with minimal support	Does not focus on topic	
Organization	Ideas flow smoothly and logically with clarity and coherence	Logical order and appropriate sequencing of ideas with adequate transition	Some evidence of an organizational plan or strategy	Lacks organization	
TOTAL					

Name: _____

Date: _____

Period: _____

Poster Assessment Rubric (8.2)

	Exemplary 4 Points	Accomplished 3 Points	Developing 2 Points	Beginning 1 Point	Score
Required Content	The poster includes all required content elements as well as additional information.	All required content elements are included on the poster.	All but one of the required content elements are included on the poster.	Several required content elements were missing.	
Labels	All items of importance on the poster are clearly labeled with labels that are easy to read.	Almost all items of importance on the poster are clearly labeled with labels that are easy to read.	Many items of importance on the poster are clearly labeled with labels that are easy to read.	Labels are too small to read, or no important items were labeled.	
Attractiveness	The poster is exceptionally attractive in terms of design, layout, and neatness.	The poster is attractive in terms of design, layout, and neatness.	The poster is acceptably attractive though it may be a bit messy.	The poster is distractingly messy or very poorly designed.	
Grammar	There are no grammatical or mechanical mistakes on the poster.	There are one to two grammatical or mechanical mistakes on the poster.	There are three to four grammatical or mechanical mistakes on the poster.	There are more than four grammatical or mechanical mistakes on the poster.	
TOTAL					

Comments:

Name: _____

Date: _____

Period: _____

Oral Report Rubric (8.3)

Scoring Criteria				
<i>The student does the following:</i>	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Communicates the main idea or theme				
Organizes the content				
Uses appropriate emphasis to express main points				
Expresses ideas clearly				
Maintains eye contact with the audience				
Maintains poise and body posture				
Displays self-confidence				
Maintains ease before the audience				
Conveys thought and meaning				
Uses appropriate visual aids (if applicable) that are meaningful				
Accomplishes purpose and/or objectives				
Responds to questions with carefully planned answers				

Notes:

Name: _____

Date: _____

Period: _____

Group Work Assessment Rubric (8.4)

	Highly Successful 3 points	Meeting Success 2 points	Experiencing Difficulty 1 point	Score
Sharing	Shared ideas with others	Occasionally shared ideas with others	Seldom shared ideas with others	
Listening	Always listened to peers	Occasionally listened to peers	Ignored ideas of peers	
Respecting	Interacted with, encouraged, and supported ideas of others	Occasionally encouraged and supported others	Seldom encouraged and supported others	
Participating	Shared task equally with group members	Did most of the task	Did very little of the task	
TOTAL				

Comments:

Name: _____

Date: _____

Period: _____

Guest Speaker Evaluation and Summary Form (8.5)

1. List five main ideas expressed in the presentation.

1. _____
2. _____
3. _____
4. _____
5. _____

2. Write a brief summary relating the topics of the presentation to your life.

Name: _____

Date: _____

Period: _____

Written Report Rubric (9.1)

	Exemplary 4 Points	Accomplished 3 Points	Developing 2 Points	Beginning 1 Point	Score
Content	Clear thesis and focus that remain apparent	Thesis and focus that remain apparent	Addresses subject matter with minimal support	Does not focus on topic	
Grammar	Correct and effective use of grammar and mechanics	Occasional errors in use of grammar and mechanics	Problems in use of grammar and mechanics	Repeated errors in use of grammar and mechanics	
Content	Clear thesis and focus that remain apparent	Thesis and focus that remain apparent	Addresses subject matter with minimal support	Does not focus on topic	
Organization	Ideas flow smoothly and logically with clarity and coherence	Logical order and appropriate sequencing of ideas with adequate transition	Some evidence of an organizational plan or strategy	Lacks organization	
TOTAL					

Name: _____

Date: _____

Period: _____

Oral Report Rubric (9.2)

Scoring Criteria				
<i>The student does the following:</i>	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Communicates the main idea or theme				
Organizes the content				
Uses appropriate emphasis to express main points				
Expresses ideas clearly				
Maintains eye contact with the audience				
Maintains poise and body posture				
Displays self-confidence				
Maintains ease before the audience				
Conveys thought and meaning				
Uses appropriate visual aids (if applicable) that are meaningful				
Accomplishes purpose and/or objectives				
Responds to questions with carefully planned answers				

Notes:

Name: _____

Date: _____

Period: _____

Environmental and Natural Resources Agencies (9.3)

Name of agency/organization	Major purpose or role
U.S Environmental Protection Agency	
U.S. Occupational Safety and Health Administration	
U.S. Forest Service	
U.S. Natural Resources and Conservation Service	
Mississippi Department of Environmental Quality	
Mississippi Department of Wildlife, Fisheries, and Parks	
Mississippi Forestry Commission	
Nature Conservatory	
Sierra Club	
Mississippi Department of Agriculture and Commerce	
National Wildlife Federation	

Name: _____

Date: _____

Period: _____

Guest Speaker Summary Form (9.4)

1. List five main ideas expressed in the presentation.

2. _____

3. _____

4. _____

5. _____

2. Write a brief summary relating the topics of the presentation to your life.

[illegible]

Name: _____

Date: _____

Period: _____

Advantages and Disadvantages of Waste Disposal Methods (9.5)

The three most common means of solid waste disposal are listed below. For each method, list the major advantage and the major disadvantage. Also, how can the disadvantage be overcome?

1. LANDFILLS

Advantage:

Disadvantage:

Ways to Overcome:

2. INCINERATION

Advantage:

Disadvantage:

Ways to Overcome:

3. RECYCLING

Advantage:

Disadvantage:

Ways to Overcome:

Name: _____

Date: _____

Period: _____

Recycling Program Rubric (9.6)

Rate the effectiveness of the students' recycling program plan using the following indicators.

Scale:

5 – Very Effective

4 – Effective

3 – Adequate

2 – Minimal

1 – Needs improvement

- _____ 1. The students organized themselves into a team with defined roles and responsibilities for all members.
- _____ 2. The students conducted a recycling audit to determine the types and volume of solid waste being generated at the school.
- _____ 3. The students identified markets for recycled products, taking transportation costs into effect.
- _____ 4. Based on the information found in steps 2 and 3, the students determined which waste products should be collected for recycling.
- _____ 5. The students established a system for collecting, sorting, and storing different types of waste products.
- _____ 6. The students implemented an education program for staff and other students to inform them of the program.
- _____ 7. The students established a reward system to encourage participation in the recycling program.

Comments:

Name: _____

Date: _____

Period: _____

School Composting Plan Rubric (9.7)

Rate the effectiveness of the students' recycling program plan using the following indicators.

Scale:

5 – Very Effective

4 – Effective

3 – Adequate

2 – Minimal

1 – Needs improvement

- _____ 1. The students organized themselves into a team with defined roles and responsibilities for all members.
- _____ 2. The students conducted a composting audit to determine the sources, kinds, and amounts of material to be composted and determined where composted materials could be used.
- _____ 3. The students designed and constructed a composting facility.
- _____ 4. The student established a schedule for collecting materials.
- _____ 5. The students informed staff and other students of the composting program.
- _____ 6. The students established a schedule for turning the compost.
- _____ 7. The students established a reward program for participation in the project.

Comments:

Name: _____

Date: _____

Period: _____

Hazardous Materials Discovery Assignment (9.8)

Your instructor will assign you a common material found in agricultural enterprises that can pose a hazard to your health or the environment. Using the Internet, search for information to answer the following questions.

1. What is the common name of this material?
2. How hazardous is this material to your health?
3. If you accidentally drank or ate some of this material, what should you do?
4. If you accidentally spilled some of this material, what should you do?
5. How should you store this material?
6. If you no longer need this material, how should you dispose of it?

Name: _____

Date: _____

Period: _____

Rubric for Student Electronic Notebook (9.9)

Scoring Criteria				
<i>The student did the following:</i>	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Captured the main ideas from the presentation or lecture in handwritten form				
Accurately transcribed the main ideas into the proper electronic format				
Checked spelling and grammar				
Demonstrated comprehension of the writing process				
Summarized the important points and added personal reflections				

Name: _____

Date: _____

Period: _____

Rubric for PowerPoint Presentation on Landscape Degradation and Defacement (10.1)

CATEGORY	4-Exceptional	3-Admirable	2-Acceptable	1-Amateur	SCORE
Technical Content	Clearly illustrated a local issue related to landscape degradation/defacement and provided specific details related to its causes and possible solutions	Clearly illustrated the local issue and provided general information related to cause and solution	Vaguely illustrated a local issue and provided limited information on cause and solution	Vaguely illustrated a local issue and provided very little or no information on cause or solution	
Organization	Extremely well organized in a logical format that is easy to follow and flows smoothly from one idea to another enhancing the effectiveness of the project	Presented in a thoughtful, organized manner, and most transitions were easy to follow. Only a few ideas were unclear.	Somewhat organized, ideas were not presented coherently, and transitions were not always smooth.	Choppy and confusing; difficult to follow; transitions were abrupt and seriously distracted from theme and purpose.	
Content Accuracy	All content was completely accurate; all facts were precise and explicit.	Content was mostly accurate with only a few inconsistencies or errors in information.	Content was somewhat accurate, but there were more than a few inconsistencies or errors in information.	Content was grossly inaccurate to the point that the facts in this project were misleading to the audience.	
Research	Research on the project went above and beyond expectations. The student solicited material in addition to what was provided and brought in personal ideas and information to enhance project.	The student did a very good job of researching, using materials provided to his or her full potential, and at least one source came from information outside of the school.	The student used at least three references provided by the school in an acceptable manner but did not consult any additional resources.	The student did not use provided resources effectively and did little or no fact gathering on the topic.	
Creativity	The report demonstrated exceptional creativity and originality on the part of the student.	The report was cleverly presented in a thoughtful and interesting manner.	The student did add a few creative touches to enhance the report but mostly reported the information as provided.	The report showed little creativity or originality.	

Name: _____

Date: _____

Period: _____

Rubric for Tropical Rain Forest Paper (10.2)

	Exemplary (4 points)	Accomplished (3 points)	Developing (2 points)	Beginning (1 point)	Score
Content	Thesis and focus provide specific details on the causes and remedies for rainforest destruction.	Thesis and focus provide general details on the causes and remedies for rainforest destruction.	Thesis and focus provide limited details on the causes and remedies for rainforest destruction.	Does not focus on topic	
Grammar	Correct and effective use of grammar and mechanics	Occasional errors in use of grammar and mechanics	Problems in use of grammar and mechanics	Repeated errors in use of grammar and mechanics	
Organization	Ideas flow smoothly and logically with clarity and coherence.	Logical order and appropriate sequencing of ideas with adequate transition	Some evidence of an organizational plan or strategy	Lacks organization	
Total Score:					

Name: _____

Date: _____

Period: _____

Group Participation Rubric (10.3)

	Beginning	Developing	Accomplished	Exemplary	Score
	1 point	2 points	3 points	4 points	
Group Discussions	Rarely contributed to discussions of the group	Contributed good effort to discussions of the group	Contributed great effort to discussions of the group	Contributed exceptional effort to discussions of the group	
On-task Behavior	Exhibited on-task behavior inconsistently	Exhibited on-task behavior some of the time	Exhibited on-task behavior most of the time	Exhibited on-task behavior consistently	
Helping Others	Did not assist other group members	Seldom assisted other group members	Occasionally assisted other group members	Assisted other group members	
Listening	Ignored ideas of group members	Seldom listened to ideas of group members	Occasionally listened to ideas of group members	Always listened to ideas of group members	
Total Score:					

Name: _____

Date: _____

Period: _____

Environmental Plan Rubric (10.4)

	Exemplary 4 Points	Accomplished 3 Points	Developing 2 Points	Beginning 1 Point	Score
Current Conditions	The plan provides specific and detailed data related to local conditions.	The plan provides a general description of local conditions.	The plan provides a limited description of local conditions.	A description is provided but contains errors.	
Problem Statement	The problem statement is stated concisely and accurately reflects the problem.	The problem statement is stated concisely and generally reflects the problem.	The problem statement is wordy and marginally reflects the problem.	The problem statement is poorly written and marginally reflects the problem.	
Goals and Objectives	Stated goals and objectives are specific and measureable.	Stated goals and objectives are general but measurable.	Stated goals are general and vague.	Stated goals and objectives are poorly written and cannot be measured.	
Evaluation	The evaluation statement provides specific details on how the success of the program will be measured.	The evaluation statement provides general details on how the success of the program will be measured.	The evaluation statement provides very limited details on how the success of the program will be measured.	The evaluation statement provides few if any details on how the success of the program will be measured.	
TOTAL					

Appendix B: 21st Century Skills Standards¹

Today's life and work environments require far more than thinking skills and content knowledge. The ability to navigate the complex life and work environments in the globally competitive information age requires students to pay rigorous attention to developing adequate life and career skills.

CSS1-21st Century Themes

CS1 Global Awareness

1. Using 21st century skills to understand and address global issues
2. Learning from and working collaboratively with individuals representing diverse cultures, religions, and lifestyles in a spirit of mutual respect and open dialogue in personal, work, and community contexts
3. Understanding other nations and cultures, including the use of non-English languages

CS2 Financial, Economic, Business and Entrepreneurial Literacy

1. Knowing how to make appropriate personal economic choices
2. Understanding the role of the economy in society
3. Using entrepreneurial skills to enhance workplace productivity and career options

CS3 Civic Literacy

1. Participating effectively in civic life through knowing how to stay informed and understanding governmental processes
2. Exercising the rights and obligations of citizenship at local, state, national, and global levels
3. Understanding the local and global implications of civic decisions

CS4 Health Literacy

1. Obtaining, interpreting, and understanding basic health information and services and using such information and services in ways that enhance health
2. Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance, and stress reduction
3. Using available information to make appropriate health-related decisions
4. Establishing and monitoring personal and family health goals
5. Understanding national and international public health and safety issues

CS5 Environmental Literacy

1. Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water, and ecosystems
2. Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.)
3. Investigate and analyze environmental issues, and make accurate conclusions about effective solutions
4. Take individual and collective action towards addressing environmental challenges (e.g., participating in global actions, designing solutions that inspire action on environmental issues)

CSS2-Learning and Innovation Skills

CS6 Creativity and Innovation

1. Think Creatively
2. Work Creatively with Others
3. Implement Innovations

CS7 Critical Thinking and Problem Solving

1. Reason Effectively
2. Use Systems Thinking
3. Make Judgments and Decisions
4. Solve Problems

¹ *21st century skills*. (n.d.). Washington, DC: Partnership for 21st Century Skills.

CS8 Communication and Collaboration

1. Communicate Clearly
2. Collaborate with Others

CSS3-Information, Media and Technology Skills

CS9 Information Literacy

1. Access and Evaluate Information
2. Use and Manage Information

CS10 Media Literacy

1. Analyze Media
2. Create Media Products

CS11 ICT Literacy

1. Apply Technology Effectively

CSS4-Life and Career Skills

CS12 Flexibility and Adaptability

1. Adapt to change
2. Be Flexible

CS13 Initiative and Self-Direction

1. Manage Goals and Time
2. Work Independently
3. Be Self-directed Learners

CS14 Social and Cross-Cultural Skills

1. Interact Effectively with others
2. Work Effectively in Diverse Teams

CS15 Productivity and Accountability

1. Manage Projects
2. Produce Results

CS16 Leadership and Responsibility

1. Guide and Lead Others
2. Be Responsible to Others

Appendix C: MS Academic Standards

MISSISSIPPI SCIENCE FRAMEWORK 2010

Marine and Aquatic Science

- AQ 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- AQ 2 Develop an understanding of physical and chemical properties of water and aquatic environments.
- AQ 3 Apply an understanding of the diverse organisms found in aquatic environments.
- AQ 4 Draw conclusions about the relationships between human activity and aquatic organisms.
1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
 - a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
 - b. Formulate questions that can be answered through research and experimental design. (DOK 3)
 - c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
 - d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
 - e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
 - g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
 2. **Develop an understanding of physical and chemical properties of water and aquatic environments.**
 - a. Analyze the physical and chemical properties of water, and justify why it is essential to living organisms. (DOK 1)
 - b. Explain the causes and characteristics of tides. (DOK 1)
 - c. Research, create diagrams, and summarize principles related to waves and current characteristics and formation. (DOK 2)
 - d. Compare and contrast the physical and chemical parameters of dissolved O₂, pH, temperature, salinity, and results obtained through analysis of different water column depths/zones. (DOK 2)
 - e. Investigate the causes and effects of erosion and discuss conclusions. (DOK 2)
 - f. Describe and differentiate among the major geologic features of specific aquatic environments. (DOK 1)
 - Plate tectonics
 - Rise, slope, elevation, and depth
 - Formation of dunes, reefs, barrier/volcanic islands, and coastal/flood plains
 - Watershed formation as it relates to bodies of freshwater
 - g. Compare and contrast the unique abiotic and biotic characteristics of selected aquatic ecosystems. (DOK 2)
 - Barrier island, coral reef, tidal pool, and ocean
 - River, stream, lake, pond, and swamp
 - Bay, sound, estuary, and marsh
 3. **Apply an understanding of the diverse organisms found in aquatic environments.**
 - a. Analyze and explain the diversity and interactions among aquatic life. (DOK 3)
 - Adaptations of representative organisms for their aquatic environments

- Relationship of organisms in food chains/webs within aquatic environments
- b. Research, calculate, and interpret population data. (DOK 2)
- c. Research and compare reproductive processes in aquatic organisms. (DOK 2)
- d. Differentiate among characteristics of planktonic, nektonic, and benthic organisms. (DOK 1)
- e. Explore the taxonomy of aquatic organisms, and use dichotomous keys to differentiate among the organisms. (DOK 2)
- f. Research and explain the symbiotic relationships in aquatic ecosystems. (DOK 3)
- 4. **Draw conclusions about the relationships between human activity and aquatic organisms.**
 - a. Describe the impact of natural and human activity on aquatic ecosystems, and evaluate the effectiveness of various solutions to environmental problems. (DOK 3)
 - Sources of pollution in aquatic environments and methods to reduce the effects of the pollution
 - Effectiveness of a variety of methods of environmental management and stewardship
 - Effects of urbanization on aquatic ecosystems and the effects of continued expansion
 - b. Research and cite evidence of the effects of natural phenomena such as hurricanes, floods, or drought on aquatic habitats and organisms. (DOK 3)
 - c. Discuss the advantages and disadvantages involved in applications of modern technology in aquatic science. (DOK 2)
 - Careers related to aquatic science
 - Modern technology within aquatic science (e.g., mariculture and aquaculture)
 - Contributions of aquatic technology to industry and government

Biology I

BI0I 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BI0I 2	Describe the biochemical basis of life, and explain how energy flows within and between the living systems.
BI0I 3	Investigate and evaluate the interaction between living organisms and their environment.
BI0I 4	Analyze and explain the structures and function of the levels of biological organization.
BI0I 5	Demonstrate an understanding of the molecular basis of heredity.
BI0I 6	Demonstrate an understanding of principles that explain the diversity of life and biological evolution.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
 - a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
 - d. Formulate questions that can be answered through research and experimental design. (DOK 3)
 - e. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 2)
 - f. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
 - g. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - h. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
 - i. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
2. **Describe the biochemical basis of life, and explain how energy flows within and between the living systems.**
 - a. Explain and compare with the use of examples the types of bond formation (e.g., covalent, ionic, hydrogen, etc.) between or among atoms. (DOK 2)
 - Subatomic particles and arrangement in atoms

- Importance of ions in biological processes
 - b. Develop a logical argument defending water as an essential component of living systems (e.g., unique bonding and properties including polarity, high specific heat, surface tension, hydrogen bonding, adhesion, cohesion, and expansion upon freezing). (DOK 2)
 - c. Classify solutions as acidic, basic, or neutral, and relate the significance of the pH scale to an organism's survival (e.g., consequences of having different concentrations of hydrogen and hydroxide ions). (DOK 2)
 - d. Compare and contrast the structure, properties, and principle functions of carbohydrates, lipids, proteins, and nucleic acids in living organisms. (DOK 2)
 - Basic chemical composition of each group
 - Building components of each group (e.g., amino acids, monosaccharides, nucleotides, etc.)
 - Basic functions (e.g., energy, storage, cellular, heredity) of each group
 - e. Examine the life processes to conclude the role enzymes play in regulating biochemical reactions. (DOK 2)
 - Enzyme structure
 - Enzyme function, including enzyme-substrate specificity and factors that affect enzyme function (pH and temperature)
 - f. Describe the role of adenosine triphosphate (ATP) in making energy available to cells. (DOK 1)
 - ATP structure
 - ATP function
 - g. Analyze and explain the biochemical process of photosynthesis and cellular respiration, and draw conclusions about the roles of the reactant and products in each. (DOK 3)
 - Photosynthesis and respiration (reactants and products)
 - Light-dependent reactions and light independent reactions in photosynthesis, including requirements and products of each
 - Aerobic and anaerobic processes in cellular respiration, including products each and energy differences
3. **Investigate and evaluate the interaction between living organisms and their environment.**
- a. Compare and contrast the characteristics of the world's major biomes (e.g., deserts, tundra, taiga, grassland, temperate forest, tropical rainforest). (DOK 2)
 - Plant and animal species
 - Climate (temperature and rainfall)
 - Adaptations of organisms
 - b. Provide examples to justify the interdependence among environmental elements. (DOK 2)
 - Biotic and abiotic factors in an ecosystem (e.g., water, carbon, oxygen, mold, leaves)
 - Energy flow in ecosystems (e.g., energy pyramids and photosynthetic organisms to herbivores, carnivores, and decomposers)
 - Roles of beneficial bacteria
 - Interrelationships of organisms (e.g., cooperation, predation, parasitism, commensalism, symbiosis, and mutualism)
 - c. Examine and evaluate the significance of natural events and human activities on major ecosystems (e.g., succession, population growth, technology, loss of genetic diversity, consumption of resources). (DOK 2)
4. **Analyze and explain the structures and function of the levels of biological organization.**
- a. Differentiate among plant and animal cells and eukaryotic and prokaryotic cells. (DOK 2)
 - Functions of all major cell organelles and structures (e.g., nucleus, mitochondrion, rough ER, smooth ER, ribosomes, Golgi bodies, vesicles, lysosomes, vacuoles, microtubules, microfilaments, chloroplast, cytoskeleton, centrioles, nucleolus, chromosomes, nuclear membrane, cell wall, cell membrane [active and passive transport], cytosol)
 - Components of mobility (e.g., cilia, flagella, pseudopodia)
 - b. Differentiate between types of cellular reproduction. (DOK 1)

- Main events in the cell cycle and cell mitosis (including differences in plant and animal cell divisions)
 - Binary fission (e.g., budding, vegetative propagation, etc.)
 - Significance of meiosis in sexual reproduction
 - Significance of crossing over
 - c. Describe and differentiate among the organizational levels of organisms (e.g., cells, tissues, organs, systems, types of tissues). (DOK 1)
 - d. Explain and describe how plant structures (vascular and nonvascular) and cellular functions are related to the survival of plants (e.g., movement of materials, plant reproduction). (DOK 1)
5. **Demonstrate an understanding of the molecular basis of heredity.**
- a. Analyze and explain the molecular basis of heredity and the inheritance of traits to successive generations by using the Central Dogma of Molecular Biology. (DOK 3)
 - Structures of DNA and RNA
 - Processes of replication, transcription, and translation
 - Messenger RNA codon charts
 - b. Utilize Mendel's laws to evaluate the results of monohybrid Punnett squares involving complete dominance, incomplete dominance, codominance, sex linked, and multiple alleles (including outcome percentage of both genotypes and phenotypes). (DOK 2)
 - c. Examine inheritance patterns using current technology (e.g., pedigrees, karyotypes, gel electrophoresis). (DOK 2)
 - d. Discuss the characteristics and implications of both chromosomal and gene mutations. (DOK 2)
 - Significance of nondisjunction, deletion, substitutions, translocation, frame shift mutation in animals
 - Occurrence and significance of genetic disorders such as sickle cell anemia, Tay-Sachs disorder, cystic fibrosis, hemophilia, Down syndrome, color blindness
6. **Demonstrate an understanding of principles that explain the diversity of life and biological evolution.**
- a. Draw conclusions about how organisms are classified into a hierarchy of groups and subgroups based on similarities that reflect their evolutionary relationships. (DOK 2)
 - Characteristics of the six kingdoms
 - Major levels in the hierarchy of taxa (e.g., kingdom, phylum/division, class, order, family, genus, and species)
 - Body plans (symmetry)
 - Methods of sexual reproduction (e.g., conjugation, fertilization, pollination)
 - Methods of asexual reproduction (e.g., budding, binary fission, regeneration, spore formation)
 - b. Critique data (e.g., comparative anatomy, Biogeography, molecular biology, fossil record, etc.) used by scientists (e.g., Redi, Needham, Spallanzani, Pasteur) to develop an understanding of evolutionary processes and patterns. (DOK 3)
 - c. Research and summarize the contributions of scientists (including Darwin, Malthus, Wallace, Lamarck, and Lyell) whose work led to the development of the theory of evolution. (DOK 2)
 - d. Analyze and explain the roles of natural selection, including the mechanisms of speciation (e.g., mutations, adaptations, geographic isolation) and applications of speciation (e.g., pesticide and antibiotic resistance). (DOK 3)
 - e. Differentiate among chemical evolution, organic evolution, and the evolutionary steps along the way to aerobic heterotrophs and photosynthetic autotrophs. (DOK 2)

Biology II

BIOII 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BIOII 2	Describe and contrast the structures, functions, and chemical processes of the cell.
BIOII 3	Investigate and discuss the molecular basis of heredity.
BIOII 4	Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.

BIOII 5 Develop an understanding of organism classification.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Use current technologies such as CD-ROM, DVD, Internet, and on-line data search to explore current research related to a specific topic. (DOK 3)
- b. Clarify research questions and design laboratory investigations. (DOK 3)
- c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
- e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. Describe and contrast the structures, functions, and chemical processes of the cell.

- a. Relate the structure and function of a selectively permeable membrane to its role in diffusion and osmosis. (DOK 2)
- b. Summarize how cell regulation controls and coordinates cell growth and division. (DOK 2)
- c. Analyze and describe the function of enzymes in biochemical reactions. (DOK 2)
 - The impact of enzymatic reactions on biochemical processes
 - Factors that affect enzyme function (e.g., pH, concentration, temperature, etc.)
- d. Differentiate between photosynthesis and cellular respiration. (DOK 2)
 - Cellular sites and major pathways of anaerobic and aerobic respiration (with reactants, products, and ATP per monosaccharide)
 - Cellular respiration with respect to the sites at which they take place, the reactions involved, and the energy input and output in each stage (e.g., glycolysis, Krebs cycle, electron transport chain)
 - Pigments, absorption, reflection of light, and light-dependent and light-independent reactions of photosynthesis
 - Oxidation and reduction reactions

3. Investigate and discuss the molecular basis of heredity.

- a. Explain how the process of meiosis clarifies the mechanism underlying Mendel's conclusions about segregation and independent assortment on a molecular level. (DOK 1)
- b. Research and explain how major discoveries led to the determination of DNA structure. (DOK 2)
- c. Relate gene expression (e.g., replication, transcription, translation) to protein structure and function. (DOK 2)
 - Translation of a messenger RNA strand into a protein
 - Processing by organelles so that the protein is appropriately packaged, labeled, and eventually exported by the cell
 - Messenger RNA codon charts to determine the effects of different types of mutations on amino acid sequence and protein structure (e.g., sickle cell anemia resulting from base substitution mutation)
 - Gene expression regulated in organisms so that specific proteins are synthesized only when they are needed by the cell (e.g., allowing cell specialization)
- d. Assess the potential implications of DNA technology with respect to its impact on society. (DOK 3)
 - Modern DNA technologies (e.g., polymerase chain reaction (PCR), gene splicing, gel electrophoresis, transformation, recombinant DNA) in agriculture, medicine, and forensics
- e. Develop a logical argument defending or refuting bioethical issues arising from applications of genetic technology (e.g., the human genome project, cloning, gene therapy, stem cell research). (DOK 3)

4. Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.

- a. Explain the history of life on earth, and infer how geological changes provide opportunities and constraints for biological evolution. (DOK 2)
 - Main periods of the geologic timetable of earth's history
 - Roles of catastrophic and gradualistic processes in shaping planet Earth
- b. Provide support for the argument based upon evidence from anatomy, embryology, biochemistry, and paleontology that organisms descended with modification from common ancestry. (DOK 2)
- c. Identify and provide supporting evidence for the evolutionary relationships among various organisms using phylogenetic trees and cladograms. (DOK 2)
- d. Formulate a scientific explanation based on fossil records of ancient life-forms, and describe how new species could originate as a result of geological isolation and reproductive isolation. (DOK 2)
- e. Compare and contrast the basic types of selection (e.g., disruptive, stabilizing, directional, etc.). (DOK 2)
- f. Cite examples to justify behaviors that have evolved through natural selection (e.g., migration, parental care, use of tools, etc.). (DOK 1)
- g. Research and explain the contributions of 19th century scientists (e.g., Malthus, Wallace, Lyell, and Darwin) on the formulation of ideas about evolution. (DOK 2)
- h. Develop a logical argument describing ways in which the influences of 20th century science have impacted the development of ideas about evolution (e.g., synthetic theory of evolution, molecular biology). (DOK 3)
- i. Analyze changes in an ecosystem resulting from natural causes (succession), changes in climate, human activity (pollution and recycling), or introduction of nonnative species. (DOK 2)

5. Develop an understanding of organism classification.

- a. Classify organisms according to traditional Linnaean classification characteristics (e.g., cell structure, biochemistry, anatomy, fossil record, methods of reproduction) and the cladistic approach. (DOK 2)
- b. Categorize organisms according to the characteristics that distinguish them as Bacteria, Archaea, or Eucarya. (DOK 1)
 - Bacteria, fungi, and protists
 - Characteristics of invertebrates (e.g., habitat, reproduction, body plan, locomotion) as related to phyla (e.g., Porifera, Cnidarians, Nematoda, Annelida, Platyhelminthes, and Arthropoda) and classes (e.g., Insecta, Crustacea, Arachnida, Mollusca, Echinodermata)
 - Characteristics of vertebrates (e.g., habitat, reproduction, body plan, locomotion) as related to classes (e.g., Agnatha, Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, Mammalia)
 - Nomenclature of various types of plants (e.g., Bryophyta, Tracheophyta, Gymnospermae, Angiospermae, Monocotyledonae, Dicotyledonae, vascular plants, nonvascular plants)

Botany

BO 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BO 2	Distinguish among the characteristics of botanical organization, structure, and function.
BO 3	Demonstrate an understanding of plant reproduction.
BO 4	Draw conclusions about the factors that affect the adaptation and survival of plants.
BO 5	Relate an understanding of plant genetics to its uses in modern living.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Formulate questions that can be answered through research and experimental design. (DOK 3)

- c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
 - d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
 - e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
 - g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
2. **Distinguish among the characteristics of botanical organization, structure, and function.**
- a. Relate plant cell structures to their functions (e.g., major organelles, cell wall components, photosynthetic chemical reactions, plant pigments, plant tissues, roots, stems, leaves, flowers). (DOK 1)
 - b. Differentiate the characteristics found in various plant divisions. (DOK 2)
 - Differences and similarities of nonvascular plants
 - Characteristics of seed-bearing and non-seed bearing vascular plants relative to taxonomy
 - Major vegetative structures and their modifications in angiosperms and gymnosperms
 - c. Compare and contrast leaf modifications of gymnosperms and angiosperms (e.g., needles, overlapping scales, simple leaves, compound leaves, evergreen trees, and deciduous trees). (DOK 2)
 - d. Apply the modern classification scheme utilized in naming plants to identify plant specimens. (DOK 2)
 - Classification scheme used in botany
 - Classification of native Mississippi plants
 - e. Use inquiry to investigate and discuss the physical and chemical processes of plants. (DOK 3)
 - Relationships among photosynthesis, cellular respiration, and translocation
 - Importance of soil type and soil profiles to plant survival
 - Mechanism of water movement in plants
 - Effects of environmental conditions for plant survival
 - Tropic responses of a plant organ to a given stimulus
3. **Demonstrate an understanding of plant reproduction.**
- a. Compare and contrast reproductive structures (e.g., cones, flowers). (DOK 2)
 - b. Differentiate among the vegetative organs of monocots, herbaceous dicots, and woody dicots. (DOK 1)
 - c. Differentiate between the structures and processes of sexual and asexual reproduction in plants. (DOK 1)
 - Reproductive structures, their modifications, and the mechanisms involved in plant reproduction
 - Functions of flower parts, seeds, cones
 - Spore production in bryophytes and ferns
 - d. Explain and provide examples of the concept of alternation of generations and its examples. (DOK 2)
 - e. Categorize types of fruits and methods of seed distribution in plants. (DOK 1)
 - f. Research and compare various methods of plant propagation. (DOK 2)
4. **Draw conclusions about the factors that affect the adaptation and survival of plants.**
- a. List and assess several adaptations of plants to survive in a given biome. (DOK 2)
 - b. Design and conduct an experiment to determine the effects of environmental factors on photosynthesis. (DOK 3)
 - c. Explain how natural selection and the evolutionary consequences (e.g., adaptation or extinction) support scientific explanations for similarities of ancient life-forms in the fossil record and molecular similarities present in living organisms. (DOK 2)
 - d. Research factors that might influence or alter plant stability, and propose actions that may reduce the negative impacts of human activity. (DOK 2)
5. **Relate an understanding of plant genetics to its uses in modern living.**
- a. Research, prepare, and present a position relating to issues surrounding the current botanical trends involving biotechnology. (DOK 3)
 - b. Apply an understanding of the principles of plant genetics to analyze monohybrid and dihybrid crosses, and predict the potential effects the crosses might have on agronomy and agriculture. (DOK 3)
 - c. Discuss the effects of genetic engineering of plants on society. (DOK 2)

- d. Describe the chemical compounds extracted from plants, their economical importance, and the impact on humans. (DOK 3)
 - Plant extracts, their function, and origin
 - Impact of the timber industry on local and national economy

Chemistry I

- CHI 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- CHI 2 Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.
- CHI 3 Develop an understanding of the periodic table.
- CHI 4. Analyze the relationship between microscopic and macroscopic models of matter.
- CHI 5 Compare factors associated with acid/base and oxidation/reduction reactions.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
- b. Clarify research questions and design laboratory investigations. (DOK 3)
- c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
- e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.

- a. Describe and classify matter based on physical and chemical properties and interactions between molecules or atoms. (DOK 1)
 - Physical properties (e.g., melting points, densities, boiling points) of a variety of substances
 - Substances and mixtures
 - Three states of matter in terms of internal energy, molecular motion, and the phase transitions between them
- b. Research and explain crucial contributions and critical experiments of Dalton, Thomson, Rutherford, Bohr, de Broglie, and Schrödinger, and describe how each discovery contributed to the current model of atomic and nuclear structure. (DOK 2)
- c. Develop a model of atomic and nuclear structure based on theory and knowledge of fundamental particles. (DOK 2)
 - Properties and interactions of the three fundamental particles of the atom
 - Laws of conservation of mass, constant composition, definite proportions, and multiple proportions
- d. Write appropriate equations for nuclear decay reactions, describe how the nucleus changes during these reactions, and compare the resulting radiation with regard to penetrating ability. (DOK 1)
 - Three major types of radioactive decay (e.g., alpha, beta, gamma) and the properties of the emissions (e.g., composition, mass, charge, penetrating power)
 - The concept of half-life for a radioactive isotope (e.g., carbon-14 dating) based on the principle that the decay of any individual atom is a random process
- e. Compare the properties of compounds according to their type of bonding. (DOK 1)
 - Covalent, ionic, and metallic bonding
 - Polar and nonpolar covalent bonding

- Valence electrons and bonding atoms
- f. Compare different types of intermolecular forces, and explain the relationship between intermolecular forces, boiling points, and vapor pressure when comparing differences in properties of pure substances. (DOK 1)
- g. Develop a three-dimensional model of molecular structure. (DOK 2)
 - Lewis dot structures for simple molecules and ionic compounds
 - Valence shell electron pair repulsion theory (VSEPR)
- 3. **Develop an understanding of the periodic table.**
 - a. Calculate the number of protons, neutrons, and electrons in individual isotopes using atomic numbers and mass numbers, write electron configurations of elements and ions following the Aufbau principle, and balance equations representing nuclear reactions. (DOK 1)
 - b. Analyze patterns and trends in the organization of elements in the periodic table, and compare their relationship to position in the periodic table. (DOK 2)
 - Atomic number, atomic mass, mass number, and number of protons, electrons, and neutrons in isotopes of elements
 - Average atomic mass calculations
 - Chemical characteristics of each region
 - Periodic properties (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius)
 - c. Classify chemical reactions by type. (DOK 2)
 - Single displacement, double displacement, synthesis (combination), decomposition, disproportionation, combustion, or precipitation
 - Products (given reactants) or reactants (given products) for each reaction type
 - Solubility rules for precipitation reactions and the activity series for single and double displacement reactions
 - d. Use stoichiometry to calculate the amount of reactants consumed and products formed. (DOK 3)
 - Difference between chemical reactions and chemical equations
 - Formulas and calculations of the molecular (molar) masses
 - Empirical formula given the percent composition of elements
 - Molecular formula given the empirical formula and molar mass
- 4. **Analyze the relationship between microscopic and macroscopic models of matter.**
 - a. Calculate the number of protons, neutrons, and electrons in individual isotopes using atomic numbers and mass numbers, write electron configurations of elements and ions following the Aufbau principle, and balance equations representing nuclear reactions. (DOK 1)
 - b. Analyze patterns and trends in the organization of elements in the periodic table, and compare their relationship to position in the periodic table. (DOK 2)
 - Atomic number, atomic mass, mass number, and number of protons, electrons, and neutrons in isotopes of elements
 - Average atomic mass calculations
 - Chemical characteristics of each region
 - Periodic properties (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius)
 - c. Classify chemical reactions by type. (DOK 2)
 - Single displacement, double displacement, synthesis (combination), decomposition, disproportionation, combustion, or precipitation
 - Products (given reactants) or reactants (given products) for each reaction type
 - Solubility rules for precipitation reactions and the activity series for single and double displacement reactions
 - d. Use stoichiometry to calculate the amount of reactants consumed and products formed. (DOK 3)
 - Difference between chemical reactions and chemical equations
 - Formulas and calculations of the molecular (molar) masses
 - Empirical formula given the percent composition of elements

- Molecular formula given the empirical formula and molar mass

5. **Compare factors associated with acid/base and oxidation/reduction reactions.**

- a. Analyze and explain acid/base reactions. (DOK 2)
 - Properties of acids and bases, including how they affect indicators and the relative pH of the solution
 - Formation of acidic and basic solutions
 - Definition of pH in terms of the hydronium ion concentration and the hydroxide ion concentration
 - The pH or pOH from the hydrogen ion or hydroxide ion concentrations of solution
 - How a buffer works and examples of buffer solutions
- b. Classify species in aqueous solutions according to the Arrhenius and Bronsted-Lowry definitions respectively, and predict products for aqueous neutralization reactions. (DOK 2)
- c. Analyze a reduction/oxidation reaction (REDOX) to assign oxidation numbers (states) to reaction species, and identify the species oxidized and reduced, the oxidizing agent, and reducing agent. (DOK 2)

Organic Chemistry

- ORGC 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ORGC 2 Demonstrate an understanding of the properties, structure, and function of organic compounds.
- ORGC 3 Discuss the versatility of polymers and the diverse application of organic chemicals.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Formulate questions that can be answered through research and experimental design. (DOK 3)
- c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
- e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
- f. Recognize and analyze alternative explanations for experimental results, and make predictions based on observations and prior knowledge. (DOK 3)
- g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. **Demonstrate an understanding of the properties, structure, and function of organic compounds.**

- a. Apply International Union of Pure and Applied Chemistry (IUPAC) nomenclature, and differentiate the structure of aliphatic, aromatic, and cyclic hydrocarbon compounds. (DOK 1)
 - Structures of hydrocarbon compounds
 - Isomerism in hydrocarbon compounds
- b. Relate structure to physical and chemical properties of hydrocarbon. (DOK 1)
- c. Apply principles of geometry and hybridization to organic molecules. (DOK 2)
 - Lewis structures for organic molecules
 - Bond angles
 - Hybridization (as it applies to organic molecules)
- d. Write, complete, and classify common reactions for aliphatic, aromatic, and cyclic hydrocarbons. (DOK 1)
- e. Construct, solve, and explain equations representing combustion reactions, substitution reactions, dehydrogenation reactions, and addition reactions. (DOK 2)
- f. Classify functional groups (e.g., alcohols, ethers, aldehydes, ketones, carboxylic acids, esters, amines, amides, and nitriles) by their structure and properties. (DOK 2)
 - Structural formulas from functional group names and vice versa
 - Chemical and physical properties of compounds containing functional groups

- Equations representing the transformation of one functional group into another
- 3. **Discuss the versatility of polymers and the diverse application of organic chemicals.**
 - a. Describe and classify the synthesis, properties, and uses of polymers. (DOK 2)
 - Common polymers
 - Synthesis of polymers from monomers by addition or condensation
 - Condensations of plastics according to their commercial types
 - Elasticity and other polymer properties
 - b. Develop a logical argument supporting the use of organic chemicals and their application in industry, drug manufacture, and biological chemistry. (DOK 1)
 - Common uses of polymers and organic compounds in medicine, drugs, and personal care products
 - Compounds that have the property to dye materials
 - Petrochemical production
 - Biologically active compounds in terms of functional group substrate interaction
 - c. Research and summarize the diversity, applications, and economics of industrial chemicals (solvents, coatings, surfactants, etc.). (DOK 3)

Earth and Space Science

E1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
E2	Develop an understanding of the history and evolution of the universe and earth.
E3	Discuss factors that are used to explain the geological history of earth.
E4	Demonstrate an understanding of earth systems relating to weather and climate.
E5	Apply an understanding of ecological factors to explain relationships between earth systems.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
 - a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers.
 - b. Formulate questions that can be answered through research and experimental design. (DOK 3)
 - c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
 - d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
 - e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
 - g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
2. **Develop an understanding of the history and evolution of the universe and earth.**
 - a. Summarize the origin and evolution of the universe. (DOK 2)
 - Big bang theory
 - Microwave background radiation
 - The Hubble constant
 - Evidence of the existence of dark matter and dark energy in the universe and the history of the universe
 - b. Differentiate methods used to measure space distances, including astronomical unit, light-year, stellar parallax, Cepheid variables, and the red shift. (DOK 1)

- c. Interpret how gravitational attraction played a role in the formation of the planetary bodies and how the fusion of hydrogen and other processes in “ordinary” stars and supernovae lead to the formation of all other elements. (DOK 2)
 - d. Summarize the early evolution of the earth, including the formation of Earth’s solid layers (e.g., core, mantle, and crust), the distribution of major elements, the origin of internal heat sources, and the initiation of plate tectonics. (DOK 2)
 - How the decay of radioactive isotopes is used to determine the age of rocks, earth, and the solar system
 - How Earth acquired its initial oceans and atmosphere
- 3. Discuss factors which are used to explain the geological history of earth.**
- a. Develop an understanding of how plate tectonics create certain geological features, materials, and hazards. (DOK 1)
 - Plate tectonic boundaries (e.g., divergent, convergent, and transform)
 - Modern and ancient geological features to each kind of plate tectonic boundary
 - Production of particular groups of igneous and metamorphic rocks and mineral resources
 - Sedimentary basins created and destroyed through time
 - b. Compare and contrast types of mineral deposits/groups (e.g., oxides, carbonates, halides, sulfides, sulfates, silicates, phosphates). (DOK 2)
 - c. Categorize minerals and rocks by determining their physical and/or chemical characteristics. (DOK 2)
 - d. Justify the causes of certain geological hazards (e.g., earthquakes, volcanoes, tsunamis) to their effects on specific plate tectonic locations. (DOK 2)
 - e. Interpret and explain how rock relationships and fossils are used to reconstruct the geologic history of the earth. (DOK 2)
 - f. Apply principles of relative age (e.g., superposition, original horizontality, crosscutting relations, and original lateral continuity) to support an opinion related to earth’s geological history. (DOK 3)
 - Types of unconformity (e.g., disconformity, angular unconformity, nonconformity)
 - Geological timetable
 - g. Apply the principle of uniformitarianism to relate sedimentary rock associations and their fossils to the environments in which the rocks were deposited. (DOK 2)
 - h. Compare and contrast the relative and absolute dating methods (e.g., the principle of fossil succession, radiometric dating, and paleomagnetism) for determining the age of the earth. (DOK 1)
- 4. Demonstrate an understanding of earth systems relating to weather and climate.**
- a. Explain the interaction of earth systems that affect weather and climate. (DOK 1)
 - Latitudinal variations in solar heating
 - The effects of Coriolis forces on ocean currents, cyclones, anticyclones, ocean currents, topography, and air masses (e.g., warm fronts, cold fronts, stationary fronts, and occluded fronts).
 - b. Interpret the patterns in temperature and precipitation that produce the climate regions on earth, and relate them to the hazards associated with extreme weather events and climate change (e.g., hurricanes, tornadoes, El Niño/La Niña, global warming). (DOK 2)
 - c. Justify how changes in global climate and variation in earth/sun relationships contribute to natural and anthropogenic (human-caused) modification of atmospheric composition. (DOK 2)
 - d. Summarize how past and present actions of ice, wind, and water contributed to the types and distributions of erosional and depositional features in landscapes. (DOK 1)
 - e. Research and explain how external forces affect earth’s topography. (DOK 2)
 - How surface water and groundwater act as the major agents of physical and chemical weathering
 - How soil results from weathering and biological processes
 - Processes and hazards associated with both sudden and gradual mass wasting
- 5. Apply an understanding of ecological factors to explain relationships between earth systems.**
- a. Draw conclusions about how life on earth shapes earth systems and responds to the interaction of earth systems (lithosphere, hydrosphere, atmosphere, and biosphere). (DOK 3)
 - Nature and distribution of life on earth, including humans, to the chemistry and availability of water
 - Distribution of biomes (e.g., terrestrial, freshwater, and marine) to climate regions through time

- Geochemical and ecological processes (e.g., rock, hydrologic, carbon, nitrogen) that interact through time to cycle matter and energy and how human activity alters the rates of these processes (e.g., fossil fuel formation and combustion, damming and channeling of rivers)
- b. Interpret the record of shared ancestry (fossils), evolution, and extinction as related to natural selection. (DOK 2)
- c. Identify the cause and effect relationships of the evolutionary innovations that most profoundly shaped earth systems. (DOK 1)
 - Photosynthesis and the atmosphere
 - Multicellular animals and marine environments
 - Land plants and terrestrial environments
- d. Cite evidence about how dramatic changes in earth's atmosphere influenced the evolution of life. (DOK 1)

Environmental Science

- ES 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ES 2 Develop an understanding of the relationship of ecological factors that affect an ecosystem.
- ES 3 Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Formulate questions that can be answered through research and experimental design. (DOK 3)
- c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
- f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
- g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK3)

2. Develop an understanding of the relationship of ecological factors that affect an ecosystem.

- a. Compare ways in which the three layers of the biosphere change over time and their influence on an ecosystem's ability to support life. (DOK 2)
- b. Explain the flow of matter and energy in ecosystems. (DOK 2)
 - Interactions between biotic and abiotic factors
 - Indigenous plants and animals and their roles in various ecosystems
 - Biogeochemical cycles within the environment
- c. Predict the impact of the introduction, removal, and reintroduction of an organism on an ecosystem. (DOK 3)
- d. Develop a logical argument explaining the relationships and changes within an ecosystem. (DOK 2)
 - How a species adapts to its niche
 - Process of primary and secondary succession and its effects on a population
 - How changes in the environment might affect organisms
- e. Explain the causes and effects of changes in population dynamics (e.g., natural selection, exponential growth, predator/prey relationships) to carrying capacity and limiting factors. (DOK 2)
- f. Research and explain how habitat destruction leads to the loss of biodiversity. (DOK 2)

- g. Compare and contrast the major biomes of the world's ecosystems, including location, climate, adaptations and diversity. (DOK 1)

3. Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.

- a. Summarize the effects of human activities on resources in the local environments. (DOK 2)
 - Sources, uses, quality, and conservation of water
 - Renewable and nonrenewable resources
 - Effects of pollution (e.g., water, noise, air, etc.) on the ecosystem
- b. Research and evaluate the impacts of human activity and technology on the lithosphere, hydrosphere, and atmosphere, and develop a logical argument to support how communities restore ecosystems. (DOK 3)
- c. Research and evaluate the use of renewable and nonrenewable resources, and critique efforts to conserve natural resources and reduce global warming in the United States including (but not limited) to Mississippi. (DOK 3)

Genetics

- G 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- G 2 Analyze the structure and function of the cell and cellular organelles.
- G 3 Apply the principles of heredity to demonstrate genetic understandings.

1. Use critical thinking and scientific problem solving in designing and performing biological research and experimentation. (L, P, E)

- a. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
- b. Clarify research questions and design laboratory investigations. (DOK 3)
- c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for pie, bar, and line graphs) to draw conclusions and make inferences. (DOK 3)
- e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. Review the structure and function of the cell as it applies to genetics. (L)

- a. Cite evidence to illustrate how the structure and function of cells are involved in the maintenance of life. (DOK 2)
- b. Describe how organic components are integral to biochemical processes. (DOK 2)
- c. Differentiate among the processes by which plants and animals reproduce. (DOK 1)
 - Cell cycle and mitosis
 - Meiosis, spermatogenesis, and oogenesis
- d. Explain the significance of the discovery of nucleic acids. (DOK 1)
- e. Analyze and explain the structure and function of DNA and RNA in replication, transcription, translation and DNA repair. (DOK 2)
- f. Cite examples to compare the consequences of the different types of mutations. (DOK 1)
- g. Draw conclusions about the importance and potential impacts of the process of gene transfer used in biotechnology. (DOK 3)

3. Analyze the structure and function of DNA and RNA molecules. (L, P)

- a. Cite evidence that supports the significance of Mendel's concept of "particulate inheritance" to explain the understanding of heredity. (DOK 1)
- b. Apply classical genetics principles to solve basic genetic problems. (DOK 2)

- Genes and alleles, dominance, recessiveness, the laws of segregation, and independent assortment
- Inheritance of autosomal and sex-linked traits
- Inheritance of traits influenced by multiple alleles and traits with polygenetic inheritance
- Chromosomal theory of inheritance
- c. Apply population genetic concepts to summarize variability of multicellular organisms. (DOK 2)
 - Genetic variability
 - Hardy-Weinberg formula
 - Migration and genetic drift
 - Natural selection in humans
- d. Distinguish and explain the applications of various tools and techniques used in DNA manipulation. (DOK 1)
 - Steps in genetic engineering experiments
 - Use of restriction enzymes
 - Role of vectors in genetic research
 - Use of transformation techniques
- e. Research and present a justifiable explanation the practical uses of biotechnology (e.g., chromosome mapping, karyotyping, and pedigrees). (DOK 2)
- f. Develop and present a scientifically-based logical argument for or against moral and ethical issues related to genetic engineering. (DOK 3)
- g. Research genomics (human and other organisms), and predict benefits and medical advances that may result from the use of genome projects. (DOK 2)

Geology

GE1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
GE2	Develop an understanding of plate tectonics and geochemical and ecological processes that affect earth.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Formulate questions that can be answered through research and experimental design. (DOK 3)
- c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
- f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
- g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. Develop an understanding of plate tectonics and geochemical and ecological processes that affect earth.

- a. Differentiate the components of the earth's atmosphere and lithosphere. (DOK 1)
- b. Research and summarize explanations of how earth acquired its initial atmosphere and oceans. (DOK 2)
- c. Compare the causes and effects of internal and external components that shape earth's topography. (DOK 2)
 - Physical weathering (e.g., atmospheric, glacial, etc.)
 - Chemical weathering agents (e.g., acid precipitation, carbon dioxide, oxygen, water, etc.)

- d. Develop an understanding of how plate tectonics create certain geologic features, materials, and hazards. (DOK 2)
 - Types of crustal movements and the resulting landforms (e.g., seafloor spreading, paleomagnetic measurements, and orogenesis)
 - Processes that create earthquakes and volcanoes
 - Asthenosphere
- e. Summarize the theories of plate development and continental drift, and describe the causes and effects involved in each. (DOK 2)
- f. Develop a logical argument to explain how geochemical and ecological processes (e.g., rock, hydrologic, carbon, nitrogen) interact through time to cycle matter and energy and how human activity alters the rates of these processes (e.g., fossil fuel formation and combustion, damming, and channeling of rivers). (DOK 2)
- g. Interpret how the earth's geological time scale relates to geological history, landforms, and life-forms. (DOK 2)
- h. Research and describe different techniques for determining relative and absolute age of the earth (e.g., index of fossil layers, superposition, radiometric dating, etc.). (DOK 1)
- i. Summarize the geological activity of the New Madrid fault line, and compare and contrast it to geological activity in other parts of the world. (DOK 2)
- j. Identify and differentiate the major geological features in Mississippi (e.g., Delta, Coastal Areas, etc.). (DOK 1)
- k. Evaluate an emergency preparedness plan for natural disasters associated with crustal movement. (DOK 3)

Physical Science

PS 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
PS 2	Describe and explain how forces affect motion.
PS 3	Demonstrate an understanding of general properties and characteristics of waves.
PS 4	Develop an understanding of the atom.
PS 5	Investigate and apply principles of physical and chemical changes in matter.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Use appropriate laboratory safety symbols and procedures to design and conduct a scientific investigation. (DOK 2)
 - Safety symbols and safety rules in all laboratory activities
 - Proper use and care of the compound light microscope
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Identify questions that can be answered through scientific investigations. (DOK 3)
- c. Identify and apply components of scientific methods in classroom investigations. (DOK 3)
 - Predicting, gathering data, drawing conclusions
 - Recording outcomes and organizing data from a variety of sources (e.g., scientific articles, magazines, student experiments, etc.)
 - Critically analyzing current investigations/problems using periodicals and scientific scenarios
- d. Interpret and generate graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures and data to draw conclusions about the validity of research. (DOK 3)
- f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- g. Communicate effectively to present and explain scientific results, using appropriate terminology and graphics. (DOK 3)

2. Describe and explain how forces affect motion.

- a. Demonstrate and explain the basic principles of Newton's three laws of motion including calculations of acceleration, force, and momentum. (DOK 2)

- Inertia and distance-time graphs to determine average speed
 - Net force (accounting for gravity, friction, and air resistance) and the resulting motion of objects
 - Effects of the gravitational force on objects on Earth and effects on planetary and lunar motion
 - Simple harmonic motion (oscillation)
 - b. Explain the connection between force, work, and energy. (DOK 2)
 - Force exerted over a distance (results in work done)
 - Force-distance graph (to determine work)
 - Network on an object that contributes to change in kinetic energy (work-to-energy theorem)
 - c. Describe (with supporting details and diagrams) how the kinetic energy of an object can be converted into potential energy (the energy of position) and how energy is transferred or transformed (conservation of energy). (DOK 2)
 - d. Draw and assess conclusions about charges and electric current. (DOK 2)
 - Static/current electricity and direct current/alternating current
 - Elements in an electric circuit that are in series or parallel
 - Conductors and insulators
 - Relationship between current flowing through a resistor and voltage flowing across a resistor
 - e. Cite evidence and explain the application of electric currents and magnetic fields as they relate to their use in everyday living (e.g., the application of fields in motors and generators and the concept of electric current using Ohm's law). (DOK 2)
- 3. Demonstrate an understanding of general properties and characteristics of waves.**
- a. Differentiate among transverse, longitudinal, and surface waves as they propagate through a medium (e.g., string, air, water, steel beam). (DOK 1)
 - b. Compare properties of waves (e.g., superposition, interference, refraction, reflection, diffraction, Doppler effect), and explain the connection among the quantities (e.g., wavelength, frequency, period, amplitude, and velocity). (DOK 2)
 - c. Classify the electromagnetic spectrum's regions according to frequency and/or wavelength, and draw conclusions about their impact on life. (DOK 2)
 - The emission of light by electrons when moving from higher to lower levels
 - Energy (photons as quanta of light)
 - Additive and subtractive properties of colors
 - Relationship of visible light to the color spectrum
 - d. Explain how sound intensity is measured and its relationship to the decibel scale. (DOK 1)
- 4. Develop an understanding of the atom.**
- a. Cite evidence to summarize the atomic theory. (DOK 1)
 - Models for atoms
 - Hund's rule and Aufbau process to specify the electron configuration of elements
 - Building blocks of matter (e.g., proton, neutron, and electron) and elementary particles (e.g., positron, mesons, neutrinos, etc.)
 - Atomic orbitals (s, p, d, f) and their basic shapes
 - b. Explain the difference between chemical and physical changes, and demonstrate how these changes can be used to separate mixtures and compounds into their components. (DOK 2)
 - c. Research the history of the periodic table of the elements, and summarize the contributions that led to the atomic theory. (DOK 2)
 - Contributions of scientists (e.g., John Dalton, J.J. Thomson, Ernest Rutherford, Newton, Einstein, Neils, Bohr, Louis de Broglie, Erwin Schrödinger, etc.)
 - Technology (e.g., X-rays, cathode-ray tubes, spectroscopes)
 - Experiments (e.g., gold-foil, cathode-ray, etc.)
 - d. Utilize the periodic table to predict and explain patterns and draw conclusions about the structure, properties, and organization of matter. (DOK 2)
 - Atomic composition and valence electron configuration (e.g., atomic number, mass number of protons, neutrons, electrons, isotopes, and ions)
 - Periodic trends using the periodic table (e.g., valence, reactivity, atomic radius)

- Average atomic mass from isotopic abundance
- Solids, liquids, and gases
- Periodic properties of elements (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius) and how they relate to position in the periodic table

5. Investigate and apply principles of physical and chemical changes in matter.

- Write chemical formulas for compounds comprising monatomic and polyatomic ions. (DOK 1)
- Balance chemical equations. (DOK 2)
- Classify types of chemical reactions (e, g., composition, decomposition, single displacement, double displacement, combustion, acid/base reactions). (DOK 2)

Physics I

PHYI 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
PHYI 2	Develop an understanding of concepts related to forces and motion.
PHYI 3	Develop an understanding of concepts related to work and energy.
PHYI 4	Discuss the characteristics and properties of light and sound.
PHYI 5	Apply an understanding of magnetism, electric fields, and electricity.
PHYI 6	Analyze and explain concepts of nuclear physics.

1. Investigate and apply principles of physical and chemical changes in matter.

- Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
- Clarify research questions, and design laboratory investigations. (DOK 3)
- Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
- Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. Develop an understanding of concepts related to forces and motion.

- Use inquiry to investigate and develop an understanding of the kinematics and dynamics of physical bodies. (DOK 3)
 - Vector and scalar quantities
 - Vector problems (solved mathematically and graphically)
 - Vector techniques and free-body diagrams to determine the net force on a body when several forces are acting on it
 - Relations among mass, inertia, and weight
- Analyze, describe, and solve problems by creating and utilizing graphs of one-dimensional motion (e.g., position, distance, displacement, time, speed, velocity, acceleration, the special case of freefall). (DOK 3)
- Analyze real-world applications to draw conclusions about Newton's three laws of motion. (DOK 2)
- Apply the effects of the universal gravitation law to graph and interpret the force between two masses, acceleration due to gravity, and planetary motion. (DOK 2)
 - Situations where g is constant (falling bodies)
 - Concept of centripetal acceleration undergoing uniform circular motion
 - Kepler's third law
 - Oscillatory motion and the mechanics of waves

3. Develop an understanding of concepts related to work and energy.

- Explain and apply the conservation of energy and momentum. (DOK 2)

- Concept of work and applications
 - Concept of kinetic energy, using the elementary work-energy theorem
 - Concept of conservation of energy with simple examples
 - Concepts of energy, work, and power (qualitatively and quantitatively)
 - Principles of impulse in inelastic and elastic collisions
- b. Analyze real-world applications to draw conclusions about mechanical potential energy (the energy of configuration). (DOK 3)
- c. Apply the principles of impulse, and compare conservation of momentum and conservation of kinetic energy in perfectly inelastic and elastic collisions. (DOK 1)
- d. Investigate and summarize the principles of thermodynamics. (DOK 2)
- How heat energy is transferred from higher temperature to lower temperature until equilibrium is reached
 - Temperature and thermal energy as related to molecular motion and states of matter
 - Problems involving specific heat and heat capacity
 - First and second laws of thermodynamics as related to heat engines, refrigerators, and thermal efficiency
- e. Develop the kinetic theory of ideal gases and explain the concept of Carnot efficiency. (DOK 2)
- 4. Discuss the characteristics and properties of light and sound.**
- a. Describe and model the characteristics and properties of mechanical waves. (DOK 2)
- Simple harmonic motion
 - Relationships among wave characteristics such as velocity, period, frequency, amplitude, phase, and wavelength
 - Energy of a wave in terms of amplitude and frequency.
 - Standing waves and waves in specific media (e.g., stretched string, water surface, air, etc.)
- b. Differentiate and explain the Doppler effect as it relates to a moving source and to a moving observer. (DOK 1)
- c. Explain the laws of reflection and refraction, and apply Snell's law to describe the relationship between the angles of incidence and refraction. (DOK 2)
- d. Use ray tracing and the thin lens equation to solve real-world problems involving object distance from lenses. (DOK 2)
- e. Investigate and draw conclusions about the characteristics and properties of electromagnetic waves. (DOK 2)
- 5. Apply an understanding of magnetism, electric fields, and electricity.**
- a. Analyze and explain the relationship between electricity and magnetism. (DOK 2)
- Characteristics of static charge and how a static charge is generated
 - Electric field, electric potential, current, voltage, and resistance as related to Ohm's law
 - Magnetic poles, magnetic flux and field, Ampère's law and Faraday's law
 - Coulomb's law
- b. Use schematic diagrams to analyze the current flow in series and parallel electric circuits, given the component resistances and the imposed electric potential. (DOK 2)
- c. Analyze and explain the relationship between magnetic fields and electrical current by induction, generators, and electric motors. (DOK 2)
- 6. Analyze and explain concepts of nuclear physics.**
- a. Analyze and explain the principles of nuclear physics. (DOK 1)
- The mass number and atomic number of the nucleus of an isotope of a given chemical element
 - The conservation of mass and the conservation of charge
 - Nuclear decay
- b. Defend the wave-particle duality model of light, using observational evidence. (DOK 3)
- Quantum energy and emission spectra
 - Photoelectric and Compton effects

Spatial Information Science

- SP 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
SP 2 Develop an understanding of geographic information systems.

1. Demonstrate the basic concepts of global positioning systems (GPS). (E)

- a. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
- b. Clarify research questions, and design laboratory investigations. (DOK 3)
- c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, and theory development). (DOK 3)
- d. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences). (DOK 3)
- e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. Demonstrate the basic concepts of remote sensing. (E, P)

- a. Describe the characteristics of the electromagnetic spectrum.
- b. Using images and graphs, interpret the absorption/reflection spectrum.
- c. Distinguish between passive vs. active sensor systems.
- d. Analyze the effects of changes in spatial, temporal, and spectral resolution.
- e. Analyze the effects on images due to changes in scale.
- f. Identify the types of sensor platforms.

Zoology

- ZO 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
ZO 2 Develop an understanding of levels of organization and animal classification.
ZO 3 Differentiate among animal life cycles, behaviors, adaptations, and relationships.
ZO 4 Demonstrate an understanding of the principles of animal genetic diversity and evolution.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Formulate questions that can be answered through research and experimental design. (DOK 3)
- c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
- f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
- g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. Develop an understanding of levels of organization and animal classification.

- a. Explain how organisms are classified, and identify characteristics of major groups. (DOK 1)
 - Levels of organization of structures in animals (e.g., cells, tissues, organs, and systems)

- Characteristics used to classify organisms (e.g., cell structure, biochemistry, anatomy, fossil record, and methods of reproduction)
 - b. Identify and describe characteristics of the major phyla. (DOK 1)
 - Symmetry and body plan
 - Germ layers and embryonic development
 - Organ systems (e.g., digestive, circulatory, excretory, and reproductive)
 - Locomotion and coordination
 - c. Distinguish viruses from bacteria and protists, and give examples. (DOK 1)
 - d. Differentiate among the characteristics of bacteria, archaea, and eucarya. (DOK 1)
 - Phylogenic sequencing of the major phyla
 - Invertebrate characteristics (e.g., habitat, reproduction, body plan, locomotion) of the following phyla: Porifera, Cnidarians, Nematoda, Annelida, Platyhelminthes, Arthropoda, Insecta, Crustacea, Arachnida, Mollusca [Bivalvia and Gastropoda], and Echinodermata
 - Vertebrate characteristics (e.g., habitat, reproduction, body plan, locomotion) of the following classes: Agnatha, Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, and Mammalia
3. **Differentiate among animal life cycles, behaviors, adaptations, and relationships.**
- a. Describe life cycles, alternation of generations, and metamorphosis of various animals, and evaluate the advantages and disadvantages of asexual and sexual reproduction. (DOK 1)
 - b. Describe and explain concepts of animal behavior, and differentiate between learned and innate behavior. (DOK 1)
 - Division of labor within a group of animals
 - Communication within animals groups
 - Degree of parental care given in animal groups
 - c. Evaluate the unique protective adaptations of animals as they relate to survival. (DOK 2)
 - d. Compare and contrast ecological relationships, and make predictions about the survival of populations under given circumstances. (DOK 3)
 - Terrestrial and aquatic ecosystems
 - Herbivores, carnivores, omnivores, decomposers and other feeding relationships
 - Symbiotic relationships such as mutualism, commensalisms, and parasitism
 - e. Contrast food chains and food webs. (DOK 2)
4. **Demonstrate an understanding of the principles of animal genetic diversity and evolution.**
- a. Categorize and explain sources of genetic variation on the cellular level (e.g., mutations, crossing over, and nondisjunction) and the population level (e.g., nonrandom mating, migration, etc.). (DOK 2)
 - Relationship between natural selection and evolution
 - Mutations, crossing over, non-disjunction
 - Nonrandom mating, migration, etc.
 - Effects of genetic drift on evolution
 - b. Develop a logical argument defending or refuting issues related to genetic engineering of animals. (DOK 3)

Appendix D: ACT College Readiness Standards

English

E1 Topic Development in Terms of Purpose and Focus

- Identify the basic purpose or role of a specified phrase or sentence.
- Delete a clause or sentence because it is obviously irrelevant to the essay.
- Identify the central idea or main topic of a straightforward piece of writing.
- Determine relevancy when presented with a variety of sentence-level details.
- Identify the focus of a simple essay, applying that knowledge to add a sentence that sharpens that focus or to determine if an essay has met a specified goal.
- Delete material primarily because it disturbs the flow and development of the paragraph.
- Add a sentence to accomplish a fairly straightforward purpose such as illustrating a given statement.
- Apply an awareness of the focus and purpose of a fairly involved essay to determine the rhetorical effect and suitability of an existing phrase or sentence or to determine the need to delete plausible but irrelevant material.
- Add a sentence to accomplish a subtle rhetorical purpose such as to emphasize, to add supporting detail, or to express meaning through connotation.
- Determine whether a complex essay has accomplished a specific purpose.
- Add a phrase or sentence to accomplish a complex purpose, often expressed in terms of the main focus of the essay.

E2 Organization, Unity, and Coherence

- Use conjunctive adverbs or phrases to show time relationship in simple narrative essays (e.g., *then, this time, etc.*).
- Select the most logical place to add a sentence in a paragraph.
- Use conjunctive adverbs or phrases to express straightforward logical relationships (e.g., *first, afterward, in response*).
- Decide the most logical place to add a sentence in an essay.
- Add a sentence that introduces a simple paragraph.
- Determine the need for conjunctive adverbs or phrases to create subtle logical connections between sentences (e.g., *therefore, however, in addition*).
- Rearrange the sentences in a fairly uncomplicated paragraph for the sake of logic.
- Add a sentence to introduce or conclude the essay or to provide a transition between paragraphs when the essay is fairly straightforward.
- Make sophisticated distinctions concerning the logical use of conjunctive adverbs or phrases, particularly when signaling a shift between paragraphs.
- Rearrange sentences to improve the logic and coherence of a complex paragraph.
- Add a sentence to introduce or conclude a fairly complex paragraph.
- Consider the need for introductory sentences or transitions, basing decisions on a thorough understanding of both the logic and rhetorical effect of the paragraph and essay.

E3 Word Choice in Terms of Style, Tone, Clarity, and Economy

- Revise sentences to correct awkward and confusing arrangements of sentence elements.
- Revise vague nouns and pronouns that create obvious logic problems.
- Delete obviously synonymous and wordy material in a sentence.
- Revise expressions that deviate from the style of an essay.
- Delete redundant material when information is repeated in different parts of speech (e.g., *alarmingly startled*).
- Use the word or phrase most consistent with the style and tone of a fairly straightforward essay.
- Determine the clearest and most logical conjunction to link clauses.
- Revise a phrase that is redundant in terms of the meaning and logic of the entire sentence.
- Identify and correct ambiguous pronoun references.
- Use the word or phrase most appropriate in terms of the content of the sentence and tone of the essay.
- Correct redundant material that involves sophisticated vocabulary and sounds acceptable as conversational English (e.g., *an aesthetic viewpoint* versus *the outlook of an aesthetic viewpoint*).
- Correct vague and wordy or clumsy and confusing writing containing sophisticated language.
- Delete redundant material that involves subtle concepts or that is redundant in terms of the paragraph as a whole.

E4 Sentence Structure and Formation

- Use conjunctions or punctuation to join simple clauses.
- Revise shifts in verb tense between simple clauses in a sentence or between simple adjoining sentences.
- Determine the need for punctuation and conjunctions to avoid awkward sounding sentence fragments and fused sentences.
- Decide the appropriate verb tense and voice by considering the meaning of the entire sentence.
- Recognize and correct marked disturbances of sentence flow and structure (e.g., participial phrase fragments, missing or incorrect relative pronouns, dangling or misplaced modifiers).
- Revise to avoid faulty placement of phrases and faulty coordination and subordination of clauses in sentences with subtle structural problems.
- Maintain consistent verb tense and pronoun person on the basis of the preceding clause or sentence.
- Use sentence-combining techniques, effectively avoiding problematic comma splices, run-on sentences, and sentence fragments, especially in sentences containing compound subjects or verbs.
- Maintain a consistent and logical use of verb tense and pronoun person on the basis of information in the paragraph or essay as a whole.
- Work comfortably with long sentences and complex clausal relationships within sentences, avoiding weak conjunctions between independent clauses and maintaining parallel structure between clauses.

E5 Conventions of Usage

- Solve such basic grammatical problems as how to form the past and past participle of irregular but commonly used verbs and how to form comparative and superlative adjectives.
- Solve such grammatical problems as whether to use an adverb or adjective form, how to ensure straightforward subject–verb and pronoun–antecedent agreement, and which preposition to use in simple contexts.
- Recognize and use the appropriate word in frequently confused pairs such as *there* and *their*, *past* and *passed*, and *led* and *lead*.
- Use idiomatically appropriate prepositions, especially in combination with verbs (e.g., *long for*, *appeal to*).
- Ensure that a verb agrees with its subject when there is some text between the two.
- Ensure that a pronoun agrees with its antecedent when the two occur in separate clauses or sentences.
- Identify the correct past and past participle forms of irregular and infrequently used verbs, and form present–perfect verbs by using *have* rather than *of*.
- Correctly use reflexive pronouns, the possessive pronouns *its* and *your*, and the relative pronouns *who* and *whom*.

- Ensure that a verb agrees with its subject in unusual situations (e.g., when the subject–verb order is inverted or when the subject is an indefinite pronoun).
- Provide idiomatically and contextually appropriate prepositions following verbs in situations involving sophisticated language or ideas.
- Ensure that a verb agrees with its subject when a phrase or clause between the two suggests a different number for the verb.

E6 Conventions of Punctuation

- Delete commas that create basic sense problems (e.g., between verb and direct object).
- Provide appropriate punctuation in straightforward situations (e.g., items in a series).
- Delete commas that disturb the sentence flow (e.g., between modifier and modified element).
- Use commas to set off simple parenthetical phrases.
- Delete unnecessary commas when an incorrect reading of the sentence suggests a pause that should be punctuated (e.g., between verb and direct object clause).
- Use punctuation to set off complex parenthetical phrases.
- Recognize and delete unnecessary commas based on a careful reading of a complicated sentence (e.g., between the elements of a compound subject or compound verb joined by *and*).
- Use apostrophes to indicate simple possessive nouns.
- Recognize inappropriate uses of colons and semicolons.
- Use commas to set off a nonessential/nonrestrictive appositive or clause.
- Deal with multiple punctuation problems (e.g., compound sentences containing unnecessary commas and phrases that may or may not be parenthetical).
- Use an apostrophe to show possession, especially with irregular plural nouns.
- Use a semicolon to indicate a relationship between closely related independent clauses.
- Use a colon to introduce an example or an elaboration.

Math

M1 Basic Operations and Applications

- Perform one-operation computation with whole numbers and decimals.
- Solve problems in one or two steps using whole numbers.
- Perform common conversions (e.g., inches to feet or hours to minutes).
- Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent.
- Solve some routine two-step arithmetic problems.
- Solve routine two-step or three-step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and computing with a given average.
- Solve multistep arithmetic problems that involve planning or converting units of measure (e.g., feet per second to miles per hour).
- Solve word problems containing several rates, proportions, or percentages.
- Solve complex arithmetic problems involving percent of increase or decrease and problems requiring integration of several concepts from pre-algebra and/or pre-geometry (e.g., comparing percentages or averages, using several ratios, and finding ratios in geometry settings).

M2 Probability, Statistics, and Data Analysis

- Calculate the average of a list of positive whole numbers.
- Perform a single computation using information from a table or chart.
- Calculate the average of a list of numbers.
- Calculate the average, given the number of data values and the sum of the data values.
- Read tables and graphs.
- Perform computations on data from tables and graphs.

- Use the relationship between the probability of an event and the probability of its complement.
- Calculate the missing data value, given the average and all data values but one.
- Translate from one representation of data to another (e.g., a bar graph to a circle graph).
- Determine the probability of a simple event.
- Exhibit knowledge of simple counting techniques.*
- Calculate the average, given the frequency counts of all the data values.
- Manipulate data from tables and graphs.
- Compute straightforward probabilities for common situations.
- Use Venn diagrams in counting.*
- Calculate or use a weighted average.
- Interpret and use information from figures, tables, and graphs.
- Apply counting techniques.
- Compute a probability when the event and/or sample space is not given or obvious.
- Distinguish between mean, median, and mode for a list of numbers.
- Analyze and draw conclusions based on information from figures, tables, and graphs.
- Exhibit knowledge of conditional and joint probability.

M3 Numbers: Concepts and Properties

- Recognize equivalent fractions and fractions in lowest terms.
- Recognize one-digit factors of a number.
- Identify a digit's place value.
- Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor.
- Find and use the least common multiple.
- Order fractions.
- Work with numerical factors.
- Work with scientific notation.
- Work with squares and square roots of numbers.
- Work problems involving positive integer exponents.*
- Work with cubes and cube roots of numbers.*
- Determine when an expression is undefined.*
- Exhibit some knowledge of the complex numbers.†
- Apply number properties involving prime factorization.
- Apply number properties involving even and odd numbers and factors and multiples.
- Apply number properties involving positive and negative numbers.
- Apply rules of exponents.
- Multiply two complex numbers.†
- Draw conclusions based on number concepts, algebraic properties, and/or relationships between expressions and numbers.
- Exhibit knowledge of logarithms and geometric sequences.
- Apply properties of complex numbers.

M4 Expressions, Equations, and Inequalities

- Exhibit knowledge of basic expressions (e.g., identify an expression for a total as $b + g$).
- Solve equations in the form $x + a = b$, where a and b are whole numbers or decimals.
- Substitute whole numbers for unknown quantities to evaluate expressions.
- Solve one-step equations having integer or decimal answers.
- Combine like terms (e.g., $2x + 5x$).
- Evaluate algebraic expressions by substituting integers for unknown quantities.
- Add and subtract simple algebraic expressions.
- Solve routine first-degree equations.

- Perform straightforward word-to-symbol translations.
- Multiply two binomials.*
- Solve real-world problems using first-degree equations.
- Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions).
- Identify solutions to simple quadratic equations.
- Add, subtract, and multiply polynomials.*
- Factor simple quadratics (e.g., the difference of squares and perfect square trinomials).*
- Solve first-degree inequalities that do not require reversing the inequality sign.*
- Manipulate expressions and equations.
- Write expressions, equations, and inequalities for common algebra settings.
- Solve linear inequalities that require reversing the inequality sign.
- Solve absolute value equations.
- Solve quadratic equations.
- Find solutions to systems of linear equations.
- Write expressions that require planning and/or manipulating to accurately model a situation.
- Write equations and inequalities that require planning, manipulating, and/or solving.
- Solve simple absolute value inequalities.

M5 Graphical Representations

- Identify the location of a point with a positive coordinate on the number line.
- Locate points on the number line and in the first quadrant.
- Locate points in the coordinate plane.
- Comprehend the concept of length on the number line.*
- Exhibit knowledge of slope.*
- Identify the graph of a linear inequality on the number line.*
- Determine the slope of a line from points or equations.*
- Match linear graphs with their equations.*
- Find the midpoint of a line segment.*
- Interpret and use information from graphs in the coordinate plane.
- Match number line graphs with solution sets of linear inequalities.
- Use the distance formula.
- Use properties of parallel and perpendicular lines to determine an equation of a line or coordinates of a point.
- Recognize special characteristics of parabolas and circles (e.g., the vertex of a parabola and the center or radius of a circle).†
- Match number line graphs with solution sets of simple quadratic inequalities.
- Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$.
- Solve problems integrating multiple algebraic and/or geometric concepts.
- Analyze and draw conclusions based on information from graphs in the coordinate plane.

M6 Properties of Plane Figures

- Exhibit some knowledge of the angles associated with parallel lines.
- Find the measure of an angle using properties of parallel lines.
- Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90° , 180° , and 360°).
- Use several angle properties to find an unknown angle measure.
- Recognize Pythagorean triples.*
- Use properties of isosceles triangles.*
- Apply properties of 30° - 60° - 90° , 45° - 45° - 90° , similar, and congruent triangles.
- Use the Pythagorean theorem.
- Draw conclusions based on a set of conditions.

- Solve multistep geometry problems that involve integrating concepts, planning, visualization, and/or making connections with other content areas.
- Use relationships among angles, arcs, and distances in a circle.

M7 Measurement

- Estimate or calculate the length of a line segment based on other lengths given on a geometric figure.
- Compute the perimeter of polygons when all side lengths are given.
- Compute the area of rectangles when whole number dimensions are given.
- Compute the area and perimeter of triangles and rectangles in simple problems.
- Use geometric formulas when all necessary information is given.
- Compute the area of triangles and rectangles when one or more additional simple steps are required.
- Compute the area and circumference of circles after identifying necessary information.
- Compute the perimeter of simple composite geometric figures with unknown side lengths.*
- Use relationships involving area, perimeter, and volume of geometric figures to compute another measure.
- Use scale factors to determine the magnitude of a size change.
- Compute the area of composite geometric figures when planning or visualization is required.

M8 Functions

- Evaluate quadratic functions, expressed in function notation, at integer values.
- Evaluate polynomial functions, expressed in function notation, at integer values.†
- Express the sine, cosine, and tangent of an angle in a right triangle as a ratio of given side lengths.†
- Evaluate composite functions at integer values.†
- Apply basic trigonometric ratios to solve right-triangle problems.†
- Write an expression for the composite of two simple functions.†
- Use trigonometric concepts and basic identities to solve problems.†
- Exhibit knowledge of unit circle trigonometry.†
- Match graphs of basic trigonometric functions with their equations.

Notes

- Students who score in the 1–12 range are most likely beginning to develop the knowledge and skills assessed in the other ranges.
- Standards followed by an asterisk (*) apply to the PLAN and ACT Mathematics tests only.
- Standards followed by a dagger (†) apply to the ACT Mathematics test only.

Reading

R1 Main Ideas and Author's Approach

- Recognize a clear intent of an author or narrator in uncomplicated literary narratives.
- Identify a clear main idea or purpose of straightforward paragraphs in uncomplicated literary narratives.
- Infer the main idea or purpose of straightforward paragraphs in uncomplicated literary narratives.
- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in uncomplicated passages.
- Identify a clear main idea or purpose of any paragraph or paragraphs in uncomplicated passages.
- Infer the main idea or purpose of straightforward paragraphs in more challenging passages.
- Summarize basic events and ideas in more challenging passages.
- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in more challenging passages.
- Infer the main idea or purpose of more challenging passages or their paragraphs.
- Summarize events and ideas in virtually any passage.

- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in virtually any passage.
- Identify clear main ideas or purposes of complex passages or their paragraphs.

R2 Supporting Details

- Locate basic facts (e.g., names, dates, events) clearly stated in a passage.
- Locate simple details at the sentence and paragraph level in uncomplicated passages.
- Recognize a clear function of a part of an uncomplicated passage.
- Locate important details in uncomplicated passages.
- Make simple inferences about how details are used in passages.
- Locate important details in more challenging passages.
- Locate and interpret minor or subtly stated details in uncomplicated passages.
- Discern which details, though they may appear in different sections throughout a passage, support important points in more challenging passages.
- Locate and interpret minor or subtly stated details in more challenging passages.
- Use details from different sections of some complex informational passages to support a specific point or argument.
- Locate and interpret details in complex passages.
- Understand the function of a part of a passage when the function is subtle or complex.

R3 Sequential, Comparative, and Cause—Effect Relationships

- Determine when (e.g., first, last, before, after) or if an event occurred in uncomplicated passages.
- Recognize clear cause—effect relationships described within a single sentence in a passage.
- Identify relationships between main characters in uncomplicated literary narratives.
- Recognize clear cause—effect relationships within a single paragraph in uncomplicated literary narratives.
- Order simple sequences of events in uncomplicated literary narratives.
- Identify clear relationships between people, ideas, and so forth in uncomplicated passages.
- Identify clear cause—effect relationships in uncomplicated passages.
- Order sequences of events in uncomplicated passages.
- Understand relationships between people, ideas, and so forth in uncomplicated passages.
- Identify clear relationships between characters, ideas, and so forth in more challenging literary narratives.
- Understand implied or subtly stated cause—effect relationships in uncomplicated passages.
- Identify clear cause—effect relationships in more challenging passages.
- Order sequences of events in more challenging passages.
- Understand the dynamics between people, ideas, and so forth in more challenging passages.
- Understand implied or subtly stated cause—effect relationships in more challenging passages.
- Order sequences of events in complex passages.
- Understand the subtleties in relationships between people, ideas, and so forth in virtually any passage.
- Understand implied, subtle, or complex cause—effect relationships in virtually any passage.

R4 Meaning of Words

- Understand the implication of a familiar word or phrase and of simple descriptive language.
- Use context to understand basic figurative language.
- Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in uncomplicated passages.
- Use context to determine the appropriate meaning of virtually any word, phrase, or statement in uncomplicated passages.
- Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in more challenging passages.

- Determine the appropriate meaning of words, phrases, or statements from figurative or somewhat technical contexts.
- Determine, even when the language is richly figurative and the vocabulary is difficult, the appropriate meaning of context-dependent words, phrases, or statements in virtually any passage.

R5 Generalizations and Conclusions

- Draw simple generalizations and conclusions about the main characters in uncomplicated literary narratives.
- Draw simple generalizations and conclusions about people, ideas, and so forth in uncomplicated passages.
- Draw generalizations and conclusions about people, ideas, and so forth in uncomplicated passages.
- Draw simple generalizations and conclusions using details that support the main points of more challenging passages.
- Draw subtle generalizations and conclusions about characters, ideas, and so forth in uncomplicated literary narratives.
- Draw generalizations and conclusions about people, ideas, and so forth in more challenging passages.
- Use information from one or more sections of a more challenging passage to draw generalizations and conclusions about people, ideas, and so forth.
- Draw complex or subtle generalizations and conclusions about people, ideas, and so forth, often by synthesizing information from different portions of the passage.
- Understand and generalize about portions of a complex literary narrative.

Science

S1 Interpretation of Data

- Select a single piece of data (numerical or non-numerical) from a simple data presentation (e.g., a table or graph with two or three variables, a food web diagram).
- Identify basic features of a table, graph, or diagram (e.g., headings, units of measurement, axis labels).
- Select two or more pieces of data from a simple data presentation.
- Understand basic scientific terminology.
- Find basic information in a brief body of text.
- Determine how the value of one variable changes as the value of another variable changes in a simple data presentation.
- Select data from a complex data presentation (e.g., a table or graph with more than three variables, a phase diagram).
- Compare or combine data from a simple data presentation (e.g., order or sum data from a table).
- Translate information into a table, graph, or diagram.
- Compare or combine data from two or more simple data presentations (e.g., categorize data from a table using a scale from another table).
- Compare or combine data from a complex data presentation.
- Interpolate between data points in a table or graph.
- Determine how the value of one variable changes as the value of another variable changes in a complex data presentation.
- Identify and/or use a simple (e.g., linear) mathematical relationship between data.
- Analyze given information when presented with new, simple information.
- Compare or combine data from a simple data presentation with data from a complex data presentation.
- Identify and/or use a complex (e.g., nonlinear) mathematical relationship between data.
- Extrapolate from data points in a table or graph.
- Compare or combine data from two or more complex data presentations.
- Analyze given information when presented with new, complex information.

S2 Scientific Investigation

- Understand the methods and tools used in a simple experiment.
- Understand the methods and tools used in a moderately complex experiment.
- Understand a simple experimental design.
- Identify a control in an experiment.
- Identify similarities and differences between experiments.
- Understand the methods and tools used in a complex experiment.
- Understand a complex experimental design.
- Predict the results of an additional trial or measurement in an experiment.
- Determine the experimental conditions that would produce specified results.
- Determine the hypothesis for an experiment.
- Identify an alternate method for testing a hypothesis.
- Understand precision and accuracy issues.
- Predict how modifying the design or methods of an experiment will affect results.
- Identify an additional trial or experiment that could be performed to enhance or evaluate experimental results.

S3 Evaluation of Models, Inferences, and Experimental Results

- Select a simple hypothesis, prediction, or conclusion that is supported by a data presentation or a model.
- Identify key issues or assumptions in a model.
- Select a simple hypothesis, prediction, or conclusion that is supported by two or more data presentations or models.
- Determine whether given information supports or contradicts a simple hypothesis or conclusion and why.
- Identify strengths and weaknesses in one or more models.
- Identify similarities and differences between models.
- Determine which model(s) is/are supported or weakened by new information.
- Select a data presentation or a model that supports or contradicts a hypothesis, prediction, or conclusion.
- Select a complex hypothesis, prediction, or conclusion that is supported by a data presentation or model.
- Determine whether new information supports or weakens a model and why.
- Use new information to make a prediction based on a model.
- Select a complex hypothesis, prediction, or conclusion that is supported by two or more data presentations or models.
- Determine whether given information supports or contradicts a complex hypothesis or conclusion and why.

Writing

W1 Expressing Judgments

- Show a little understanding of the persuasive purpose of the task, but neglect to take or to maintain a position on the issue in the prompt.
- Show limited recognition of the complexity of the issue in the prompt.
- Show a basic understanding of the persuasive purpose of the task by taking a position on the issue in the prompt but may not maintain that position.
- Show a little recognition of the complexity of the issue in the prompt by acknowledging, but only briefly describing, a counterargument to the writer's position.
- Show understanding of the persuasive purpose of the task by taking a position on the issue in the prompt.
- Show some recognition of the complexity of the issue in the prompt by doing the following:
 - Acknowledging counterarguments to the writer's position
 - Providing some response to counterarguments to the writer's position
- Show clear understanding of the persuasive purpose of the task by taking a position on the specific issue in the prompt and offering a broad context for discussion.

- Show recognition of the complexity of the issue in the prompt by doing the following:
 - Partially evaluating implications and/or complications of the issue
 - Posing and partially responding to counterarguments to the writer's position
- Show clear understanding of the persuasive purpose of the task by taking a position on the specific issue in the prompt and offering a critical context for discussion.
- Show understanding of the complexity of the issue in the prompt by doing the following:
 - Examining different perspectives
 - Evaluating implications or complications of the issue
 - Posing and fully discussing counterarguments to the writer's position

W2 Focusing on the Topic

- Maintain a focus on the general topic in the prompt through most of the essay.
- Maintain a focus on the general topic in the prompt throughout the essay.
- Maintain a focus on the general topic in the prompt throughout the essay, and attempt a focus on the specific issue in the prompt.
- Present a thesis that establishes focus on the topic.
- Maintain a focus on discussion of the specific topic and issue in the prompt throughout the essay.
- Present a thesis that establishes a focus on the writer's position on the issue.
- Maintain a clear focus on discussion of the specific topic and issue in the prompt throughout the essay.
- Present a critical thesis that clearly establishes the focus on the writer's position on the issue.

W3 Developing a Position

- Offer a little development, with one or two ideas; if examples are given, they are general and may not be clearly relevant; resort often to merely repeating ideas.
- Show little or no movement between general and specific ideas and examples.
- Offer limited development of ideas using a few general examples; resort sometimes to merely repeating ideas.
- Show little movement between general and specific ideas and examples.
- Develop ideas by using some specific reasons, details, and examples.
- Show some movement between general and specific ideas and examples.
- Develop most ideas fully, using some specific and relevant reasons, details, and examples.
- Show clear movement between general and specific ideas and examples.
- Develop several ideas fully, using specific and relevant reasons, details, and examples.
- Show effective movement between general and specific ideas and examples.

W4 Organizing Ideas

- Provide a discernible organization with some logical grouping of ideas in parts of the essay.
- Use a few simple and obvious transitions.
- Present a discernible, though minimally developed, introduction and conclusion.
- Provide a simple organization with logical grouping of ideas in parts of the essay.
- Use some simple and obvious transitional words, though they may at times be inappropriate or misleading.
- Present a discernible, though underdeveloped, introduction and conclusion.
- Provide an adequate but simple organization with logical grouping of ideas in parts of the essay but with little evidence of logical progression of ideas.
- Use some simple and obvious, but appropriate, transitional words and phrases.
- Present a discernible introduction and conclusion with a little development.
- Provide unity and coherence throughout the essay, sometimes with a logical progression of ideas.
- Use relevant, though at times simple and obvious, transitional words and phrases to convey logical relationships between ideas.
- Present a somewhat developed introduction and conclusion.

- Provide unity and coherence throughout the essay, often with a logical progression of ideas.
- Use relevant transitional words, phrases, and sentences to convey logical relationships between ideas.
- Present a well-developed introduction and conclusion.

W5 Using Language

- Show limited control of language by doing the following:
 - Correctly employing some of the conventions of standard English grammar, usage, and mechanics but with distracting errors that sometimes significantly impede understanding
 - Using simple vocabulary
 - Using simple sentence structure
 - Correctly employing some of the conventions of standard English grammar, usage, and mechanics but with distracting errors that sometimes impede understanding
 - Using simple but appropriate vocabulary
 - Using a little sentence variety, though most sentences are simple in structure
 - Correctly employing many of the conventions of standard English grammar, usage, and mechanics but with some distracting errors that may occasionally impede understanding
 - Using appropriate vocabulary
 - Using some varied kinds of sentence structures to vary pace
 - Correctly employing most conventions of standard English grammar, usage, and mechanics with a few distracting errors but none that impede understanding
 - Using some precise and varied vocabulary
 - Using several kinds of sentence structures to vary pace and to support meaning
 - Correctly employing most conventions of standard English grammar, usage, and mechanics with just a few, if any, errors
 - Using precise and varied vocabulary
 - Using a variety of kinds of sentence structures to vary pace and to support meaning

Appendix E: Pathway Content Standards

AGRICULTURE, FOOD, AND NATURAL RESOURCES (AFNR) PATHWAY CONTENT STANDARDS AND PERFORMANCE ELEMENTS

The AFNR Pathway Content Standards and Performance Elements are adapted from *National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards*. Reprinted with permission from the National Council for Agricultural Education, 1410 King Street, Suite 400, Alexandria, VA 22314. (800) 772-0939. Copyright © 2009. A complete copy of the National Standards can be downloaded from the Team Ag Ed Learning Center at <https://aged.learn.com>.

AGRIBUSINESS SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of principles and techniques for the development and management of agribusiness systems.

- ABS.01. Utilize economic principles to establish and manage an AFNR enterprise.**
 - ABS.01.01. Apply principles of capitalism in the business environment.
 - ABS.01.02. Apply principles of entrepreneurship in businesses.
- ABS.02. Utilize appropriate management planning principles in AFNR business enterprises.**
 - ABS.02.01. Compose and analyze a business plan for an enterprise.
 - ABS.02.02. Read, interpret, evaluate, and write a mission statement to guide business goals, objectives, and resource allocation.
 - ABS.02.03. Apply appropriate management skills to organize a business.
 - ABS.02.04. Recruit, train, and retain appropriate and productive human resources for business.
- ABS.03. Utilize record keeping to accomplish AFNR business objectives while complying with laws and regulations.**
 - ABS.03.01. Prepare and maintain all files needed to accomplish effective record keeping.
 - ABS.03.02. Implement appropriate inventory management practices.
- ABS.04. Apply generally accepted accounting principles and skills to manage cash budgets, credit budgets, and credit for AFNR businesses.**
 - ABS.04.01. Use accounting fundamentals to accomplish dependable bookkeeping and fiscal management.
- ABS.05. Assess accomplishment of goals and objectives by an AFNR business.**
 - ABS.05.01. Maintain and interpret financial information (income statements, balance sheets, inventory, purchase orders, accounts receivable, and cash-flow analyses) for businesses.
- ABS.06. Use industry-accepted marketing practices to accomplish AFNR business objectives.**
 - ABS.06.01. Conduct appropriate market and marketing research.
 - ABS.06.02. Develop a marketing plan.
 - ABS.06.03. Develop strategies for marketing plan implementation.
 - ABS.06.04. Develop specific tactics to market AFNR products and services.
- ABS.07. Create a production system plan.**
 - ABS.07.01. Prepare a step-by-step production plan that identifies needed resources.
 - ABS.07.02. Develop a production and operational plan.
 - ABS.07.03. Utilize appropriate techniques to determine the most likely strengths, weaknesses, and inconsistencies in a business plan, and relate these to risk management strategies.
 - ABS.07.04. Manage risk and uncertainty.

ANIMAL SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and practices to the production and management of animals.

AS.01. Examine the components, historical development, global implications, and future trends of the animal systems industry.

AS.01.01. Evaluate the development and implications of animal origin, domestication, and distribution.

AS.02. Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics.

AS.02.01. Classify animals according to hierarchical taxonomy and agricultural use.

AS.02.02. Apply principles of comparative anatomy and physiology to uses within various animal systems.

AS.02.03. Select animals for specific purposes and maximum performance based on anatomy and physiology.

AS.03. Provide for the proper health care of animals.

AS.03.01. Prescribe and implement a prevention and treatment program for animal diseases, parasites, and other disorders.

AS.03.02. Provide for the biosecurity of agricultural animals and production facilities.

AS.04. Apply principles of animal nutrition to ensure the proper growth, development, reproduction, and economic production of animals.

AS.04.01. Formulate feed rations to provide for the nutritional needs of animals.

AS.04.02. Prescribe and administer animal feed additives and growth promotants in animal production.

AS.05. Evaluate and select animals based on scientific principles of animal production.

AS.05.01. Evaluate the male and female reproductive systems in selecting animals.

AS.05.02. Evaluate animals for breeding readiness and soundness.

AS.05.03. Apply scientific principles in the selection and breeding of animals.

AS.06. Prepare and implement animal handling procedures for the safety of animals, producers and consumers of animal products.

AS.06.01. Demonstrate safe animal handling and management techniques.

AS.06.02. Implement procedures to ensure that animal products are safe.

AS.07. Select animal facilities and equipment that provide for the safe and efficient production, housing, and handling of animals.

AS.07.01. Design animal housing, equipment, and handling facilities for the major systems of animal production.

AS.07.02. Comply with government regulations and safety standards for facilities used in animal production.

AS.08. Analyze environmental factors associated with animal production.

AS.08.01. Reduce the effects of animal production on the environment.

AS.08.02. Evaluate the effects of environmental conditions on animals.

BIOTECHNOLOGY

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to biotechnology in agriculture.

BS.01. Recognize the historical, social, cultural, and potential applications of biotechnology.

BS.01.01. Distinguish major innovators, historical developments, and potential applications of biotechnology in agriculture.

BS.01.02. Determine regulatory issues, and identify agencies associated with biotechnology.

BS.01.03. Analyze the ethical, legal, social, and cultural issues relating to biotechnology.

BS.02 Demonstrate laboratory skills as applied to biotechnology.

BS.02.01. Maintain and interpret biotechnology laboratory records.

BS.02.02. Operate biotechnology laboratory equipment according to standard procedures.

BS.02.03. Demonstrate proper laboratory procedures using biological materials.

BS.02.04. Safely manage biological materials, chemicals, and wastes used in the laboratory.

BS.02.05. Perform microbiology, molecular biology, enzymology, and immunology procedures.

BS.03. Demonstrate the application of biotechnology to Agriculture, Food, and Natural Resources (AFNR).

BS.03.01. Evaluate the application of genetic engineering to improve products of AFNR systems.

BS.03.02. Perform biotechnology processes used in AFNR systems.

BS.03.03. Use biotechnology to monitor and evaluate procedures performed in AFNR systems.

ENVIRONMENTAL SERVICE SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the management of environmental service systems.

ESS.01. Use analytical procedures to plan and evaluate environmental service systems.

ESS.01.01. Analyze and interpret samples.

ESS.02. Assess the impact of policies and regulations on environmental service systems.

ESS.02.01. Interpret laws affecting environmental service systems.

ESS.03. Apply scientific principles to environmental service systems.

ESS.03.01. Apply meteorology principles to environmental service systems.

ESS.03.02. Apply soil science principles to environmental service systems.

ESS.03.03. Apply hydrology principles to environmental service systems.

ESS.03.04. Apply best management techniques associated with the properties, classifications, and functions of wetlands.

ESS.03.05. Apply chemistry principles to environmental service systems.

ESS.03.06. Apply microbiology principles to environmental service systems.

ESS.04. Operate environmental service systems to manage a facility environment.

ESS.04.01. Use pollution control measures to maintain a safe facility environment.

ESS.04.02. Manage safe disposal of all categories of solid waste.

ESS.04.03. Apply the principles of public drinking water treatment operations to ensure safe water at a facility.

ESS.04.04. Apply principles of wastewater treatment to manage wastewater disposal in keeping with rules and regulations.

ESS.04.05. Manage hazardous materials to assure a safe facility and to comply with applicable regulations.

ESS.05. Examine the relationships between energy sources and environmental service systems.

ESS.05.01. Compare and contrast the impact of conventional and alternative energy sources on the environment.

ESS.06. Use tools, equipment, machinery, and technology to accomplish tasks in environmental service systems.

ESS.06.01. Use technological and mathematical tools to map land, facilities, and infrastructure.

ESS.06.02. Maintain tools, equipment, and machinery in safe working order for tasks in environmental service systems.

FOOD PRODUCTS AND PROCESSING SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles, practices, and techniques in the processing, storage, and development of food products.

FPP.01. Examine components of the food industry and historical development of food products and processing.

FPP.01.01. Evaluate the significance and implications of changes and trends in the food products and processing industry.

FPP.01.02. Work effectively with industry organizations, groups, and regulatory agencies affecting the food products and processing industry.

FPP.02. Apply safety principles, recommended equipment, and facility management techniques to the food products and processing industry.

FPP.02.01. Manage operational procedures, and create equipment and facility maintenance plans.

FPP.02.02. Implement Hazard Analysis and Critical Control Point (HACCP) procedures to establish operating parameters.

FPP.02.03. Apply safety and sanitation procedures in the handling, processing, and storing of food products.

FPP.02.04. Demonstrate worker safety procedures with food product and processing equipment and facilities.

FPP.03. Apply principles of science to the food products and processing industry.

FPP.03.01. Apply principles of science to food processing to provide a safe, wholesome, and nutritious food supply.

FPP.04. Select and process food products for storage, distribution, and consumption.

FPP.04.01. Utilize harvesting, selection, and inspection techniques to obtain quality food products for processing.

FPP.04.02. Evaluate, grade, and classify processed food products.

FPP.04.03. Process, preserve, package, and present food and food products for sale and distribution.

NATURAL RESOURCE SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the management of natural resources.

NRS.01. Explain interrelationships between natural resources and humans necessary to conduct management activities in natural environments.

NRS.01.01. Apply knowledge of natural resource components to the management of natural resource systems.

- NRS01.02. Classify natural resources.
- NRS.02. Apply scientific principles to natural resource management activities.**
 - NRS.02.01. Develop a safety plan for work with natural resources.
 - NRS.02.02. Demonstrate cartographic skills to aid in developing, implementing, and evaluating natural resource management plans.
 - NRS.02.03. Measure and survey natural resource status to obtain planning data.
 - NRS.02.04. Demonstrate natural resource enhancement techniques.
 - NRS.02.05. Interpret laws related to natural resource management and protection.
 - NRS.02.06. Apply ecological concepts and principles to natural resource systems.
- NRS.03. Apply knowledge of natural resources to production and processing industries.**
 - NRS.03.01. Produce, harvest, process, and use natural resource products.
- NRS.04. Demonstrate techniques used to protect natural resources.**
 - NRS.04.01. Manage fires in natural resource systems.
 - NRS.04.02. Diagnose plant and wildlife diseases, and follow protocol to prevent their spread.
 - NRS.04.03. Manage insect infestations of natural resources.
- NRS.05. Use effective methods and venues to communicate natural resource processes to the public.**
 - NRS.05.01. Communicate natural resource information to the public.

PLANT SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the production and management of plants.

- PS.01. Apply knowledge of plant classification, plant anatomy, and plant physiology to the production and management of plants.**
 - PS.01.01. Classify agricultural plants according to taxonomy systems.
 - PS.01.02. Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.
 - PS.01.03. Apply knowledge of plant physiology and energy conversion to plant systems.
- PS.02. Prepare and implement a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.**
 - PS.02.01. Determine the influence of environmental factors on plant growth.
 - PS.02.02. Prepare growing media for use in plant systems.
 - PS.02.03. Develop and implement a fertilization plan for specific plants or crops.
- PS.03. Propagate, culture, and harvest plants.**
 - PS.03.01. Demonstrate plant propagation techniques.
 - PS.03.02. Develop and implement a plant management plan for crop production.
 - PS.03.03. Develop and implement a plan for integrated pest management.
 - PS.03.04. Apply principles and practices of sustainable agriculture to plant production.
 - PS.03.05. Harvest, handle, and store crops.
- PS.04. Employ elements of design to enhance an environment.**
 - PS.04.01. Create designs using plants.

POWER, STRUCTURAL AND TECHNICAL SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of principles and techniques for the development and management of power, structural, and technical systems.

- PST.01. Use physical science principles and engineering applications with power, structural, and technical systems to solve problems and improve performance.**
- PST.01.01. Select energy sources in power generation appropriate to the situation.
 - PST.01.02. Apply physical science laws and principles to identify, classify, and use lubricants.
 - PST.01.03. Identify and use hand and power tools and equipment for service, construction, and fabrication.
- PST.02. Design, operate, and maintain mechanical equipment, structures, biological systems, land treatment, power, and technology.**
- PST.02.01. Perform service routines to maintain power units and equipment.
 - PST.02.02. Operate, service, and diagnose the condition of power units and equipment.
- PST.03. Service and repair mechanical equipment and power systems.**
- PST.03.01. Troubleshoot and repair internal combustion engines.
 - PST.03.02. Utilize manufacturers' guidelines to service and repair the power transmission systems of equipment.
 - PST.03.03. Service and repair hydraulic and pneumatic systems.
 - PST.03.04. Troubleshoot and service electrical systems.
 - PST.03.05. Service vehicle heating and air-conditioning systems.
 - PST.03.06. Service and repair steering, suspension, traction, and vehicle performance systems.
- PST.04. Plan, build and maintain agricultural structures.**
- PST.04.01. Create sketches and plans of agricultural structures.
 - PST.04.02. Apply structural plans, specifications, and building codes.
 - PST.04.03. Examine structural requirements for materials and procedures, and estimate construction cost.
 - PST.04.05. Follow architectural and mechanical plans to construct and/or repair equipment, buildings, and facilities.
- PST.05. Apply technology principles in the use of agricultural technical systems.**
- PST.05.01. Use instruments and meters to test and monitor electrical and electronic processes.
 - PST.05.02. Prepare and/or use electrical drawings to design, install, and troubleshoot control systems.
 - PST.05.03. Use geospatial technologies in agricultural applications.

Appendix F:

National Educational Technology Standards for Students

- T1** Creativity and Innovation
- T2** Communication and Collaboration
- T3** Research and Information Fluency
- T4** Critical Thinking, Problem Solving, and Decision Making
- T5** Digital Citizenship
- T6** Technology Operations and Concepts

T1 Creativity and Innovation

Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students do the following:

- a. Apply existing knowledge to generate new ideas, products, or processes.
- b. Create original works as a means of personal or group expression.
- c. Use models and simulations to explore complex systems and issues.
- d. Identify trends and forecast possibilities.

T2 Communication and Collaboration

Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students do the following:

- a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media.
- b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats.
- c. Develop cultural understanding and global awareness by engaging with learners of other cultures.
- d. Contribute to project teams to produce original works or solve problems.

T3 Research and Information Fluency

Students apply digital tools to gather, evaluate, and use information. Students do the following:

- a. Plan strategies to guide inquiry.
- b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
- c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks.
- d. Process data and report results.

T4 Critical Thinking, Problem Solving, and Decision Making

Students use critical-thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. Students do the following:

- a. Identify and define authentic problems and significant questions for investigation.
- b. Plan and manage activities to develop a solution or complete a project.
- c. Collect and analyze data to identify solutions and/or make informed decisions.
- d. Use multiple processes and diverse perspectives to explore alternative solutions.

T5 Digital Citizenship

Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior. Students do the following:

- a. Advocate and practice safe, legal, and responsible use of information and technology.
- b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity.

- c. Demonstrate personal responsibility for lifelong learning.
- d. Exhibit leadership for digital citizenship.

T6 Technology Operations and Concepts

Students demonstrate a sound understanding of technology concepts, systems, and operations. Students do the following:

- a. Understand and use technology systems.
- b. Select and use applications effectively and productively.
- c. Troubleshoot systems and applications.
- d. Transfer current knowledge to learning of new technologies.

Science of Agricultural Mechanization

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Jean Massey, Associate Superintendent of Education for the Office of Vocational Education and Workforce Development, at the Mississippi Department of Education assembled an oversight committee to provide input throughout the development of the *Science of Agricultural Environment* curriculum framework and supporting materials. Members of this task force were as follows:

Mr. Sammy Blossom, Executive Director, Mississippi Cattleman's Association
Dr. Gwendolyn Boyd, Assistant Professor, Alcorn State University
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Mr. Harry Dendy, Capitol City Ag Services
Dr. Frank Flanders, Agricultural Education Subject Matter Specialist, Georgia Department of Workforce Development
Dr. Gary Jackson, Chair, School of Human Sciences, Mississippi State University
Mrs. Karen McKie, Green Oak Florist
Dr. Robert Merle, Owner, Agricultural Information Management Consulting
Dr. Tom Monaghan, Executive Director, Mississippi Forestry Association
Mr. Mike Pepper, Executive Director, Mississippi Poultry Association
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Mr. J. D. Sumrall, Grower Relations Coordinator, Mississippi Poultry Association
Dr. Kirk Swortzel, Associate Professor of Life Sciences, Mississippi State University
Mr. Mike Thomas, North American Coal Company
Mr. Briley Tomlinson, Agricultural Information Services
Mr. David Waide, President, Mississippi Farm Bureau
Ms. Donna West, Division Director, Marketing Management, Mississippi Department of Agriculture and Commerce

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Sterling Brown, AEST Instructor, Byhalia High School
Rodney Hopper, Agricultural Mechanics Instructor, Tishomingo County Career Center

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Wilbur Chancellor, Program Coordinator – Agriculture Education, Office of Vocational Education and Workforce Development, Mississippi Department of Education, Jackson, MS

Finally, standards in the *Science of Agricultural Environment Curriculum Framework and Supporting Materials* are based on the following:

National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards

The National AFNR Career Cluster Content Standards were developed by the National Council on Agricultural Education to serve as a guide for what students should know or be able to do through a study of agriculture in grades 9–12 and 2-year postsecondary programs. The standards were extensively researched and reviewed by leaders in the agricultural industry, secondary and postsecondary instructors, and university specialists. The standards consist of a pathway content standard for each of the eight career pathways. For each content standard, performance elements representing major topic areas with accompanying performance indicators were developed. Measurements of assessment of the performance elements and performance indicators were developed at the basic, intermediate, and advanced levels. A complete copy of the standards can be accessed at <https://aged.learn.com>. The National AFNR Career Cluster Content Standards are copyrighted to the National Council for Agricultural Education and are used by permission.

Applied Academic Credit Benchmarks

Mississippi Department of Education 2010 Mississippi Science Framework

21st Century Skills and Information and Communication Technologies Literacy Standards

In defining 21st century learning, the Partnership for 21st Century Skills has embraced five content and skill areas that represent the essential knowledge for the 21st century: global awareness; civic engagement; financial, economic, and business literacy; learning skills that encompass problem-solving, critical-thinking, and self-directional skills; and Information and Communication Technology (ICT) literacy.

National Educational Technology Standards for Students

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ACT College Readiness Standards



The College Readiness Standards are sets of statements intended to help students understand what is expected of them in preparation for the ACT. These standards are integrated into teaching and assessment strategies throughout the curriculum framework.

Preface

Secondary vocational–technical education programs in Mississippi are faced with many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing true learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, Mississippi Code of 1972, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, ch. 487, §14; Laws, 1991, ch. 423, §1; Laws, 1992, ch. 519, §4 eff. from and after July 1, 1992; Carl D. Perkins Vocational Education Act IV, 2007; and No Child Left Behind Act of 2001).

Research Synopsis

Agricultural and Environmental Science and Technology Research

The Agricultural Sciences Career Cluster covers the broad field of occupations related to the production and use of plants and animals for food, fiber, aesthetic, and environmental purposes. According to the U.S. Department of Labor, the growing interest in worldwide standardization of agricultural equipment should result in increased employment of agricultural engineers. Job opportunities should also result from the increasing demand for agricultural products, the continued efforts for more efficient agricultural production, and the increasing emphasis on the conservation of resources. The sales of food and fiber products amounted to 5.8 billion dollars in 2005 according to USDA statistics. Additionally, the Mississippi Department of Agriculture and Commerce estimates that 30% of the state's workforce is employed in jobs relating directly or indirectly to agriculture.

Agriculture and Environmental Science and Technology will target careers at the professional and technical levels in agriculture. Students enrolled in these courses should be better prepared to pursue degrees at the community college and 4-year college level.

Employment Projections

Data for this synopsis were compiled from employment projections prepared by the Mississippi Department of Employment Security and the U. S. Department of Labor. The National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards developed by the National Council for Agricultural Education and scholarly research articles were also reviewed as a guide for the redesign of the Agriculture and Natural Resources Cluster.

Industry Job Data – Employment Projections 2006 to 2016 for Mississippi

Note: Compiled by Mississippi Department of Employment Security and Labor Market Information Department

Occupational title	Employment, 2006	Projected employment, 2016	Change 2006– 2016		Total Projected Avg. Annual Job Openings
			Number	Percent	
Animal Breeders	9,770	9,870	100	1.0	165
Agricultural and Food Science Technicians	260	310	50	19.2	10
Agricultural Equipment Operators	1,090	1,190	100	9.2	40
Agricultural Sciences Teachers, Postsecondary	190	240	50	26.3	20
Conservation Scientists	790	890	100	12.7	30
Custodial and Caretaking Supervisors and Workers	46,920	54,110	7,190	15.3	2,320
Environmental Engineers	270	320	50	18.5	10

Occupational title	Employment, 2006	Projected employment, 2016	Change 2006– 2016		Total Projected Avg. Annual Job Openings
			Number	Percent	
Environmental Engineering Technicians	50	100	50	100.0	0
Environmental Scientists and Specialists	420	470	50	11.9	10
Environmental Science and Protection Technicians	100	150	50	50.0	5
Farmworkers and Laborers, Crop, Nursery, and Greenhouse	5,160	5,810	650	12.6	225
Farmworkers, Farm and Ranch Animals	1,400	1,550	150	10.7	65
First-Line Supervisors / Managers of Farming, Fishing, and Forestry Workers	1,390	1,540	150	10.8	40
Food Processing Workers	14,920	18,320	3,400	22.8	680
Foresters	470	520	50	10.6	20
Forest and Conservation Technicians	390	440	50	12.8	15
Forest and Conservation Workers	880	980	100	11.4	30
Grounds Maintenance Workers	10,310	11,810	1,500	14.5	375
Logging Equipment Operators	3,910	4,210	300	7.7	100
Purchasing Agents and Buyers, Farm Products	80	130	50	62.5	5
Soil and Plant Scientists	430	480	50	11.6	10
Veterinarians	540	640	100	18.5	25
Veterinary Assistants and Laboratory Animal Caretakers	690	890	200	29.0	35
Veterinary Technologists and Technicians	440	540	100	22.7	15

Note: Data was retrieved from the Mississippi Department of Employment Security (2009).

Occupational Employment and Wage Estimates for Mississippi May 2006

Occupation	Employment, 2006	Avg. Hourly Wage	Average Annual Wage
Farmers and Ranchers	2,760	\$17.85	\$43,560.00
Farm Managers and Supervisors	2,640	\$23.23	\$48,360.00
Logging Equipment Operators	3,890	\$14.28	\$30,880.00
Landscaping Supervisors	2,990	\$17.93	\$40,240.00
Landscape Workers	8,560	\$10.22	\$23,010.00
Agricultural Scientists/Technicians	29,680	\$18.33	\$38,555.00

Note: Data was retrieved from the U.S. Bureau of Labor Statistics (2009)

Curriculum Content

In compiling the research for the Agricultural Sciences cluster, face-to-face and telephone interviews were conducted with representatives of agricultural employers and agricultural agencies. The following comments summarize the results of these interviews:

- While opportunities to enter farming on a full-scale commercial enterprise basis are limited, opportunities do exist and are expected to increase as current operators retire and begin to rent their land to companies and individuals. Opportunities are also expected to increase for consultants and technicians who support production enterprises by providing specialized services to producers.
- There was general agreement among all persons interviewed that all students need to better develop skills related to leadership, teamwork, communication, and work ethics, habits, and values. All respondents also indicated that a basic knowledge of economics, recordkeeping, budgeting, and business decision-making skills will be essential in today's "lean" environment.
- Opportunities for high school graduates in all fields of agriculture are limited to the basic entry-level positions. More abundant opportunities exist for students who have received advanced training at the community college or 4-year college.
- All respondents agreed that a common core of knowledge and skills existed across all three major pathways related to the following themes: Leadership and personal development; principles of plant science and production; principles of soil science and air and water quality; principles of agricultural power, structures, and technology; and principles of economics and management. A sixth theme, principles of animal science and production, exists for students in the AEST and Agriculture and Natural Resources pathway.
- All respondents agreed that students in all three pathways should be exposed to the process by which agricultural products are grown, managed, harvested, processed, and marketed. As students study this process, they should be also exposed to the different careers that are involved in all segments of the industry.
- The role of federal and state agencies including the USDA, OSHA, FDA, EPA, and so forth should be discussed. Also, the role of agricultural organizations such as the Poultry Association, Nurseryman's Association, and Farm Bureau needs to be investigated.

Results of the survey of employers and agricultural agency representatives show that there are six major themes or topics that apply to a majority of occupations in the agriculture and natural resources area. These themes and their respective pathways are listed below.

Theme	AEST	Ag and Nat. Resources	Horticulture/Landscape
Principles of Leadership, Personal Development, and Career Success	X	X	X
Principles of Plant Science and Production	X	X	X
Principles of Animal Science and Production	X	X	
Principles of Soil, Water, and Air Quality, Conservation, and Use	X	X	X
Principles of Agricultural Power, Structures, and Technological Systems	X	X	X
Principles of Management, Economics, and Marketing	X	X	X

Executive Summary

Program Description

Science of Agricultural Mechanization is an advanced level course for the Agricultural and Environmental Science and Technology Program. The course focuses on the development of skills and knowledge related to the management, maintenance, and operation of agricultural machinery. Instruction is provided on machinery management, principles of electricity-electronics, hydraulics, and pneumatics, internal combustion engines, machinery maintenance, and metal fabrication. The course carries 1 Carnegie unit of credit that counts as an elective credit for high school graduation. Students may also earn an additional ½ Carnegie unit by completing a successful supervised agricultural experience program.

Industry Certification

No national industry recognized certifications are known to exist at this time in the field of Agriscience. Competencies and suggested performance indicators in the *Science of Agricultural Mechanization* course have been correlated, however to the National Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards that have been reviewed and endorsed at the national level by the National Council on Agricultural Education.

Articulation

There is no articulation for this course at this time.

Assessment

Students will be assessed using the AEST MS-CPAS2 test. All students will be tested on *Concepts of Agriscience* and the second course that they may take in their chosen path of study. The second course may be one of the following:

- Science of Agricultural Animals
- Science of Agricultural Environment
- Science of Agricultural Mechanization
- Science of Agricultural Plants

The MS-CPAS2 blueprint can be found at <http://redesign.rcu.msstate.edu/curriculum/>. If there are questions regarding assessment of this program, please contact the instructional design specialist at the Research and Curriculum Unit at 662.325.2510.

Student Prerequisites

Prior to enrolling in *Science of Agricultural Mechanization*, a student must have completed *Concepts of Agriscience*. *Science of Agricultural Mechanization* may be offered to students in grades 10–12. It is recommended that students enrolling in the course possess at least a C average in other science courses and a TABE reading score at the eighth grade level or higher.

Proposed Applied Academic Credit

The academic credit is still pending for this curriculum.

Licensure Requirements

A 992 endorsement is currently required to teach any course in the Agricultural and Environmental Science and Technology Program. In order to receive a 992 endorsement, applicants must do the following:

1. Hold a valid Mississippi Educator License with endorsement #301 – Vocational Agriculture Education Programs or #302 – Agriculture.
2. Possess a baccalaureate degree in an agricultural subject area.
3. Complete the 3 semester credit hour course devoted to the teaching of Agricultural and Environmental Science and Technology courses. The course, AIS 6113 - Methods of Teaching Agriscience, is currently offered by Mississippi State University.
4. Applicant must enroll immediately in the Vocational Instructor Preparation (VIP) or the Redesign Education Program (REP).
5. Applicant must complete the individualized Professional Development Plan (PDP) requirements of the VIP or REP prior to the expiration date of the 3-year vocational license.
6. Applicant must successfully complete an MDE-approved computer literacy certification exam.
7. Applicant must successfully complete a certification for an online learning workshop, module, or course that is approved by the MDE.

Note: If the applicant meets all requirements listed above, that applicant will be issued a (992) endorsement—a 5-year license. If the applicant does not meet **all** requirements, the applicant will be issued a 3-year endorsement (license), and all requirements stated above must be satisfied prior to the ending date of that license.

Professional Learning

The professional learning itinerary for the middle school or individual pathways can be found at <http://redesign.rcu.msstate.edu>. If you have specific questions about the content of each training session provided, please contact the Research and Curriculum Unit at 662.325.2510 and ask for the Professional Learning Specialist.

Course Outlines

Course Description: Science of Agricultural Mechanization is a course that includes physical science principles and applications in agricultural technology, agricultural mechanics, and agricultural mechanization. Topics of instruction are: safety; physics technology, including work and power, mechanics, heat, light, sound, and magnetism and electricity; concepts of agricultural mechanization; electricity/electronics technology systems; computer technology in agricultural mechanization; hydraulics and pneumatics systems; internal combustion engines; and preventive maintenance and diagnostics.

Science of Agricultural Mechanization (One Carnegie Unit) - Course Code: 991104

Unit	Title	Hours
1	Introduction to Agricultural Mechanization	10
2	Management and Operation of Agricultural Equipment	20
3	Analyzing Electrical and Electronic Systems	10
4	Using Hydraulic and Pneumatic Systems	15
5	Principles of Internal Combustion Engines	20
6	Principles of Metal Fabrication (Arc Welding)	15
7	Principles of Metal Fabrication (Oxyfuel Cutting)	10
		100

Using This Document

Unit Number and Title

Suggested Time on Task

An estimated number of clock hours of instruction that should be required to teach the competencies and objectives of the unit. A minimum of 140 hours of instruction is required for each Carnegie unit credit. The curriculum framework should account for approximately 75–80% of the time in the course.

Competencies and Suggested Objectives

A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies. The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.

Suggested Teaching Strategies

This section of each unit indicates research-based strategies that can be used to enable students to master each competency. Emphasis has been placed on strategies that reflect active learning methodologies. Teachers should feel free to modify or enhance these suggestions based on needs of their students and resources available in order to provide optimum learning experiences for their students.

Suggested Assessment Strategies

This section indicates research-based strategies that can be used to measure student mastery. Examples of suggested strategies could include rubrics, class participation, reflection, and journaling. Again, teachers should feel free to modify or enhance these suggested assessment strategies based on local needs and resources.

Integrated Academic Topics, 21st Century Skills and Information and Communication Technology Literacy Standards, ACT College Readiness Standards, and Technology Standards for Students

This section identifies related academic topics as required in the Subject Area Testing Program (SATP) in Algebra I, Biology I, English II, and U.S. History from 1877, which are integrated into the content of the unit. Research-based teaching strategies also incorporate ACT College Readiness standards. This section also identifies the 21st Century Skills and Information and Communication Technology Literacy skills. In addition, national technology standards for students associated with the competencies and suggested objectives for the unit are also identified.

References

A list of suggested references is provided for each unit. The list includes some of the primary instructional resources that may be used to teach the competencies and suggested objectives. Again, these resources are suggested, and the list may be modified or enhanced based on needs and abilities of students and on available resources.

Science of Agricultural Mechanization

Unit 1: Introduction to Agricultural Mechanization

10 Hours

Competency 1: Investigate the role of mechanical technology in agriculture. ^{PST.01}

Suggested Enduring Understandings

1. Mechanization and technology have resulted in a reduction in the amount of labor required to produce a crop and in more acreage and larger yields per acre.
2. Mechanization and technology continue to evolve as producers try to reduce costs while increasing returns.

Suggested Essential Questions

1. How has mechanization changed the way in which food and fiber are produced?
2. What are some evolving mechanization technologies being adopted by producers?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Discuss how mechanization and technology have changed the production of food and fiber. (DOK 1)	a. Introduce the competency by having students view the Web page A History of American Agriculture: Farm Machinery and Technology . Have students prepare a series of graphs showing how mechanization and technology have reduced the amount of labor and increased yields for agricultural crops such as corn, wheat, and cotton from 1830 to the present. ^{CS1, CS2, S4, T1, T2, T4, S1, M5}	a. Evaluate student graphs for accuracy and completeness.
b. Describe the role of emerging technologies in agricultural mechanization. (DOK 3)	b. Divide the class into pairs of students, and have each pair search for information on the Internet and through other sources regarding an emerging technology in agricultural mechanization (GPS, GIS, remote sensing, variable rate technology, yield mapping, auto steering, etc.). Have the students prepare a one-page fact sheet that shows a picture or graphic illustrating the technology and describes how, where, and why the technology is used. ^{CS1, CS2, CS3, CS4, T1, T2, T3, T4, T6, R1, R2, R4, R5, W2, W4, W5}	b. Use the <i>Emerging Technology Fact Sheet Rubric (1.1)</i> to evaluate student performance on this indicator.
c. Define power, and discuss how it is generated and measured. (DOK 1)	c. Use the PowerPoint presentation Tractor Power Flow to lead a discussion of the definition of power and how it is generated in a tractor and transmitted to the wheels. Distinguish between the terms work, torque, force, and power, and discuss the measurement of power in terms of horsepower or watts. ^{CS1, CS2, CS4}	c. Use a written test to evaluate student performance on this indicator.
d. Describe sources of power used in agricultural mechanization, and associate each source with common applications. (DOK 1)	d. Identify and describe the two most common sources of power for agricultural mechanization: internal combustion engines and electric motors. Lead a discussion on the advantages and limitations of each source, and provide illustrations of where each source is used. ^{CS1, CS2, CS4}	d. Use a written test to evaluate student performance on this indicator.
e. Trace the flow of power in a vehicle from the	e. Use the illustration from Tractor Power Flow to trace the flow of power from the engine to the flywheel	e. Evaluate flowchart for accuracy and

piston through the drive wheels or tracks. (DOK 1)	through the transmission and transaxle(s) to the drive wheels or tracks. Discuss the function of each component. Have students create a flowchart showing how power is transmitted. CS2, CS4, S1	completeness.

Competency 2: Identify science applications in agricultural mechanization technology. PST.01, PHYI 2

Suggested Enduring Understandings

1. Many basic mathematical skills and operations are related to agricultural mechanization.
2. All machines used in agriculture are combinations of the six basic simple machines.
3. Mechanical advantage is a mathematical statistic that tells how effective a simple machine is in accomplishing work.

Suggested Essential Questions

1. What mathematical operations are used in agricultural mechanization?
2. What are the six simple machines, and how are they used in agricultural mechanization?
3. What is mechanical advantage, and how is it applied in agricultural mechanization?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Name the six simple machines, and describe applications in agricultural mechanization for each machine. (DOK 2)	a. Use the PowerPoint presentation Understanding Simple Machines to identify and illustrate how the six simple machines are integrated into agricultural mechanization technology. Divide the class into groups of 2–3 students, and assign a simple machine to each group. Have the group develop a drawing of one application of its machines in agriculture. CS1, CS2, CS3, CS4	a. Evaluate the drawing of the application for clarity, accuracy, and completeness.
b. Calculate the mechanical advantage of a simple machine such as a lever, pulley, or wedge. (DOK 1)	b. Point out to the students that each of the six simple machines is used to provide an advantage that makes work easier. Demonstrate how a 5-lb sack of sand can be used with a lever to lift a 10-lb sack of sand. Define mechanical advantage (MA), and identify and demonstrate the use of the formula that is used to calculate MA. Have students complete an assignment to calculate MA of different machine applications. CS1, CS2, CS4, M1	b. Evaluate the assignment for accuracy and completion.

Competency 3: Demonstrate career and leadership skills required for employment in the agricultural mechanization industry.

Suggested Enduring Understandings

1. Most careers in the agricultural mechanization industry require knowledge of basic mechanical principles, electricity/electronics, hydraulics, pneumatics, internal combustion engines, and metal fabrication techniques.
2. In addition to technical skills in agricultural mechanization, leadership, human relations, and general workplace skills are essential for success and advancement in a career.

Suggested Essential Questions

1. What different skill areas are needed for agricultural mechanization careers?
2. What leadership, human relations, and general workplace skills are needed?

Suggested Performance Indicators:	Suggested Teaching Strategies:	Suggested Assessment Strategies:
a. Identify and explore careers in the agricultural mechanization industry including major skill areas required by employees. (DOK 2)	a. Provide a list of career areas in the agricultural mechanization industry. Have each student select an area of personal interest and prepare a PowerPoint presentation on the area. The presentation should include information on major skill areas, educational requirements, salary, specific skills, and occupational outlook. CS2, CS4, T2, T3, T4, T6, R1, R2, R4, R5, W4, W5	a. Evaluate student PowerPoint for accuracy and completeness.
b. Demonstrate leadership, human relations, and workplace skills. (DOK 2)	b. Provide students with the listing of <i>21st Century Life and Career Skills (1.3)</i> found in this unit. Lead students in a discussion of how these skills apply to their current career as students and will apply to their career success after school. Provide students with a copy of the rubric that will be used to evaluate each student's demonstration of life and career skills. Have students self-evaluate their current score on this rubric, and explain that they will be periodically (at least once a grading period) be graded on their ability to demonstrate these skills. CS1, CS2, CS3, CS4, CS5, T6	b. Use the <i>21st Century Life and Career Skills Rubric (1.4)</i> to evaluate student attainment. This is an ongoing assessment throughout the year.

Competency 4: Identify safety precautions and equipment for the work site and school laboratory.

Suggested Enduring Understandings

1. Safety in the workplace is a major concern for both employees and employers. Employees should be fully informed of all safety policies and expected to adhere to these policies at all times.
2. Employers are responsible for informing employees about all safety equipment and devices in a workplace, including fire alarms and extinguishers, safety color codes, first aid equipment, and procedures for reporting accidents and injuries.
3. All employees should be expected to wear appropriate personal protection devices and clothing while on the work site.
4. Power tools have increased productivity but increased danger to workers. A worker should be fully aware of hazards and safety precautions before operating any power tool.

Suggested Essential Questions

1. What procedures should be followed to maintain a safe and orderly workplace?
2. What safety equipment and indicators (colors, signs, etc.) are used to promote safety?
3. What personal protection devices are needed, and when should they be used in order to work safely?
4. What are the basic safety rules for working with power tools?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Apply procedures for working in and maintaining a safe and orderly	a. Provide students with policies related to working in and maintaining a safe and orderly work site. Have students and their parents sign that they have read and understand the policies. CS1, CS2, CS4, CS5	a. Observation of student behavior will be conducted on a continuous basis throughout the course and

workplace. (DOK 1)		integrated into all lab activities.
b. Describe work site and laboratory organization. (DOK 1)	b. Take students on a tour of the agricultural mechanization laboratory. Identify safety equipment and indicators (including safety colors) that promote safety. Discuss procedures to follow in case of an emergency, and identify specific hazards and dangerous equipment. CS1, CS2, CS4, CS5	b. Use a written test on laboratory safety equipment, organization, and procedures. Students must score 90% or higher on the test in order to work in the laboratory.
c. Demonstrate safe use of head, eye, hearing, body, hand, and foot protective devices. (DOK 2)	c. Identify and demonstrate the proper use of personal protection devices. Discuss the appropriate devices to be used with specific equipment and on specific jobs. CS1, CS2, CS4, CS5	c. Observation of student behavior will be conducted on a continuous basis throughout the course and integrated into all lab activities.
d. Demonstrate rules for power tools including basic operation, safeguards in place, danger points, observer safety, and electrical safety. (DOK 2)	d. Identify each power tool that is present in the laboratory and any potential danger points or hazards associated with the use of the tool. Demonstrate the safe and proper use of the tool and the use of appropriate personal protective devices. Have students summarize the important points about each tool, and transcribe them into their electronic journals or notebooks. CS1, CS2, CS3, CS4, CS5	d. Use a written test on power tool use and safety. Students must score 90% or higher before being allowed to use these tools.

Standards

AFNR Industry Standards

PST.01. Use physical science principles and engineering applications with power, structural, and technical systems to solve problems and improve performance.

Applied Academic Credit Standards

Physics I

PHYI 2 Develop an understanding of concepts related to forces and motion.

21st Century Learning Standards

CS1 Flexibility & Adaptability
CS2 Initiative & Self-Direction
CS3 Social & Cross-Cultural Skills
CS4 Productivity & Accountability
CS5 Leadership & Responsibility

National Education Technology Standards for Students (NETS)

T1 Creativity and Innovation
T2 Communication and Collaboration
T3 Research and Information Fluency
T4 Critical Thinking, Problem Solving, and Decision Making
T6 Technology Operations and Concepts

ACT College Readiness Standards

M1 Basic Operations and Applications
M5 Graphical Representations
R1 Main Ideas and Author's Approach
R2 Supporting Details
R4 Meaning of Words
R5 Generalizations and Conclusions
S1 Interpretation of Data
W2 Focusing on the Topic
W4 Organizing Ideas
W5 Using Language

Suggested References

CEV Video. (n.d.). *CEV Pathway: Power, Structural & Technical Systems Pathway* [DVD]. Lubbock, TX: Author.

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United States Department of Agriculture. (n.d.). *A history of American agriculture: Farm machinery and technology*. Retrieved June 11, 2010 from http://www.agclassroom.org/gan/timeline/farm_tech.htm

Science of Agricultural Mechanization

Unit 2: Management and Operation of Agricultural Equipment

10 Hours

Competency 1: Examine concepts of machinery management and maintenance. ^{PST.02, PST.03}

Suggested Enduring Understandings

1. Proper management and maintenance of equipment extends the life of the machine, reduces failures and operating costs, and increases safety for operators.
2. An important part of machinery management is the documentation of maintenance and repairs to the machine.
3. Work orders for machinery maintenance and repair should detail the parts and supplies used and the amount of labor required.

Suggested Essential Questions

1. Why are machinery management and maintenance important?
2. How are records of maintenance and repairs kept for a machine?
3. How is a work order for machinery maintenance and repair completed?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe the importance of machinery management and maintenance. (DOK 1)	a. Discuss the importance of a machinery management and maintenance from the standpoint of extended equipment life, reduced failures and operating costs, and increased worker safety. Ask students to cite examples of how machinery has failed because of poor management and maintenance. Have students find machinery owner's manuals on the Internet for different types of equipment. Ask them to locate the section on preventive maintenance and identify common maintenance jobs for all equipment. ^{CS1, CS2, CS4, T3, T6, R2, R4, R5}	a. Use a written test to evaluate student understanding of this indicator.
b. Complete a work order for a given repair or maintenance procedure, and calculate cost of the repair. (DOK 2)	b. Discuss the essential elements for a work order included identifying information, parts used, labor charges, and taxes. Have students set up a database or spreadsheet that can be used to generate work orders. Using the scenarios in <i>Equipment Repair Work Order Assignment (2.2)</i> , have students use their forms to calculate costs for different repairs. ^{CS1, CS2, CS4, T1, T3, T4, T6}	b. Evaluate assignment for accuracy and completeness.

Competency 2: Operate mechanized equipment in a safe and proper manner. ^{PST.02}

Suggested Enduring Understandings

1. Controls that are common on most agricultural vehicles include a throttle, clutch, transmission shift controls, brakes, hydraulic valves, switches, and solenoids.
2. Pre-inspection of an engine includes checking fluid levels, tires, controls and gauges.
3. Operating equipment in a safe and proper manner

Suggested Essential Questions

1. What are the common controls on most vehicles?
2. What is involved in inspecting an engine before starting?
3. What is involved in safely operating an engine or vehicle?

involves controlling engine and vehicle speed and maintaining control of the equipment at all times.		
Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify common equipment controls, and describe their use and function. (DOK 1)	a. Using a tractor, riding lawn mower, or ATV, identify the common machinery controls, and describe their function and use. (Common controls include throttle, clutch, transmission shift control, brakes, hydraulic valves, switches, solenoids, etc.) Have students list each control and its function in their electronic journals or notebooks. CS2, CS4, T6, W2, W4, W5	a. Use a written test to evaluate student performance on this indicator.
b. Demonstrate procedures for pre-inspection and start-up of an internal combustion engine. (DOK 1)	b. Using the <i>Vehicle Inspection, Start-up, and Operation Checklist (2.3)</i> , discuss and demonstrate the procedures in the checklist. Have students perform a pre-inspection and start-up on an engine. CS2, CS4	b. Use the <i>Vehicle Inspection, Start-up, and Operation Checklist (2.3)</i> to evaluate student ability to perform this task.
c. Operate equipment in a safe and proper manner. (DOK 1)	c. Using the <i>Vehicle Inspection, Start-up, and Operation Checklist (2.3)</i> , discuss and demonstrate the procedures for operating a vehicle in a safe and proper manner. Have students practice maneuvering an obstacle course to show that they understand the procedures. CS2, CS4	c. Use the <i>Vehicle Inspection, Start-up, and Operation Checklist (2.3)</i> to evaluate student ability to perform this task.

Competency 3: Describe and perform principles of preventive maintenance. PST.01, PST.02, PST.03, PHYI 5, PS 1, PS 2

Suggested Enduring Understandings

1. Preventive maintenance programs are designed to extend equipment life, reduce repair costs, and provide for better safety for operators.
2. In performing preventive maintenance, it is important to follow all safety procedures related to the use of tools and equipment, handling and disposal of hazardous materials, and personal protection.
3. The owner's manual is the primary reference for planning and performing preventive maintenance on a regular schedule.
4. Daily maintenance of equipment includes checking engine oil and transmission/hydraulic levels, checking tires, checking coolant levels, and visually inspecting the machine.

Suggested Essential Questions

1. What are the purpose and goals of preventive maintenance?
2. What safety procedures should be followed in performing preventive maintenance?
3. What information can be found in an owner's manual regarding preventive maintenance?
4. What items should be checked on a machine on a daily basis?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Discuss the meaning of "preventive maintenance."	a. Prior to teaching this competency, have students read the chapter on <i>Diesel Engines and Tractor Maintenance</i> in the text (Herren, 2010). Ask students	a. Use a written test to evaluate student understanding of this

(DOK 1)	how often oil is changed in their family cars and what determines when the oil is changed. Use this introduction to lead into the concept of preventive maintenance and how it can prevent costly repairs and extend the life of a piece of equipment. CS4, CS5, R2	indicator.
b. List and describe the safety precautions to follow while performing preventive maintenance. (DOK 1)	b. Use the PowerPoint presentation Tractor Safety, Operation and Maintenance to review safety precautions when operating and performing preventive maintenance on tractors and other large equipment. Have students summarize the major points and record in their electronic notebooks or journals. CS4, CS5, E1 E2, E3, M5, M7, R2, W2, W4, W5	b. Use a written test to evaluate student understanding of this indicator.
c. Locate and interpret preventative maintenance information in the owner's manual. (DOK 1)	c. Have students locate an owner's manual for a specific piece of equipment on the manufacturer's Web site or bring one from home. Have students complete the assignment <i>Tractor Service Intervals and Specifications (2.4)</i> to find specific service interval information on a piece of equipment. CS4, CS5, M5, M7, R2	c. Evaluate the <i>Tractor Service Intervals and Specifications (2.4)</i> assignment for accuracy and completeness.
d. Perform maintenance routines. (DOK 2)	d. Using the owner's manual for a specific piece of equipment, have students demonstrate the procedure for performing daily maintenance checks. CS4, CS5, M5, M7, R2 Using the operator's manual or technical manual for a specific piece of equipment, have the students inspect and service the following: CS1, CS2, CS4, T6, R2, R4, R5 • air cleaner. • lubrication system • fuel system • belts and hoses. • and liquid coolant system. The procedure must include disposing of used oil and filters. CS1, CS2, CS4, T6, R2, R4, R5	d. Use the <i>Daily Maintenance Checklist (2.5)</i> to evaluate the students' ability to perform this indicator. Use the <i>Preventive Maintenance Checklist (2.5)</i> to evaluate student ability to perform this service.

Competency 4: Perform preventive maintenance services. PST.01, PST.02, PST.03, PHYI 5, PS 1, PS 2

Suggested Enduring Understandings

1. Preventive maintenance jobs that are usually performed by the owner-operator include inspecting and servicing the air cleaner, inspecting and servicing the lubrication system, inspecting and servicing the fuel system, inspecting and servicing belts and hoses, and inspecting and servicing the cooling system.

Suggested Essential Questions

1. What are the general procedures for inspecting and servicing an air cleaner?
2. What are the general procedures for inspecting and servicing the lubrication system?
3. What are the general procedures for inspecting and servicing the fuel system?
4. What are the general procedures for inspecting and servicing belts and hoses?

5. What are the general procedures for inspecting and servicing the coolant system?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Inspect and service an air cleaner. (DOK 2)	a. Using the operator's manual or technical manual for a specific piece of equipment, have the students inspect and service the air cleaner. CS1, CS2, CS4, T6, R2, R4, R5	a. Use the <i>Preventive Maintenance Checklist</i> (2.7) to evaluate student ability to perform this service.
b. Inspect and service the lubrication system. (DOK 2)	b. Using the operator's manual or technical manual for a specific piece of equipment, have the students inspect and service the lubrication system. The procedure must include disposing of used oil and filters. CS1, CS2, CS4, T6, R2, R4, R5	b. Use the <i>Preventive Maintenance Checklist</i> (2.7) to evaluate student ability to perform this service.
c. Inspect and service the fuel system. (DOK 2)	c. Using an operator's manual for a specific piece of equipment, have the students inspect and service the fuel system. CS1, CS2, CS4, T6, R2, R4, R5	c. Use the <i>Preventive Maintenance Checklist</i> (2.7) to evaluate student ability to perform this service.
d. Inspect and service belts and hoses. (DOK 2)	d. Using the operator's manual or technical manual for a specific piece of equipment, have the students inspect and service belts and hoses on the machine. CS1, CS2, CS4, T6, R2, R4, R5	d. Use the <i>Preventive Maintenance Checklist</i> (2.7) to evaluate student ability to perform this service.
e. Inspect and service a liquid coolant system. (DOK 2)	e. Using the operator's manual or technical manual for a specific piece of equipment, have the students inspect and service the coolant system to include checking coolant condition and freeze point. CS1, CS2, CS4, T6, R2, R4, R5	e. Use the <i>Preventive Maintenance Checklist</i> (2.7) to evaluate student ability to perform this service.

Competency 5: Apply principles of engine diagnostics and testing. PST.01, PST.02, PST.03, PHYI 5, PS 1, PS 2

Suggested Enduring Understandings

1. Engine troubleshooting should begin by looking for the simplest solution to the problem and working forward. Troubleshooting involves determining if the problem is with the fuel, ignition, or compression system.
2. Testing an ignition system begins by establishing if the spark plug is sparking.
3. Low compression results in loss of power, excessive oil consumption, and hard starting capability.

Suggested Essential Questions

1. What are the steps in the troubleshooting process?
2. What is the process for testing a spark plug?
3. What is the process for testing compression?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe the steps in the diagnostic process. (DOK 1)	a. Use the Troubleshoot Small Engines PowerPoint presentation to provide information on the troubleshooting process and procedures. Provide the student with a scenario based on a piece of equipment that is not functioning properly. Ask the students to discuss what they think the potential cause of the problem is. From the discussion, lead into the meaning and importance of diagnosis as related to reducing repair costs and downtime. Based on scenario, identify the steps in the diagnosis problem, and provide specific examples of each step in solving the problem. CS1, CS2, T6, R2	a. Use a written test to evaluate student understanding of this indicator.
b. Test an ignition system. (DOK 2)	b. Use the Small Engine Troubleshooting PowerPoint presentation to discuss the procedures for testing an ignition system on a small engine. Have the students use these procedures to check a spark plug. CS1, CS2, T3, T6	b. Use the <i>Small Engine Troubleshooting Rubric</i> (2.6) to evaluate student performance on this indicator.
c. Test engine compression. (DOK 2)	c. Use the Small Engine Troubleshooting PowerPoint presentation to discuss the procedures for testing engine compression on a small engine. Have the students use these procedures to check a spark plug. CS1, CS2, T6	c. Use the <i>Small Engine Troubleshooting Rubric</i> (2.6) to evaluate student performance on this indicator.

Standards

AFNR Industry Standards

- PST.01. Use physical science principles and engineering applications with power, structural, and technical systems to solve problems and improve performance.
- PST.02. Design, operate, and maintain mechanical equipment, structures, biological systems, land treatment, power, and technology.
- PST.03. Service and repair mechanical equipment and power systems.

Applied Academic Credit Standards

Physics I

- PHYI 3 Develop an understanding of concepts related to work and energy.

Physical Science

- PS 2 Describe and explain how forces affect motion.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS4 Productivity & Accountability

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- R2 Supporting Details
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- S1 Interpretation of Data
- W2 Focusing on the Topic
- W4 Organizing Ideas
- W5 Using Language

Suggested References

- Burkybile, C., Johnson, D., Lee, J., & Shelhamer, C. (2005). *Agricultural power & technology*. Upper Saddle River, NJ: Pearson.
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- Spurlin, J. (n.d.). *Troubleshooting Small Engines*. Retrieved June 11, 2010 from http://aged.ces.uga.edu/Browseable_Folders/Power_Points/Mechanics/Troubleshooting_Small_Engines.ppt

Science of Agricultural Mechanization

Unit 3: Analyzing Electrical and Electronic Systems

10 Hours

Competency 1: Describe and apply the use of electronic components and systems in agricultural equipment. PST.01, PST.02, PST.05, PHYI 5, PS 2

Suggested Enduring Understandings

1. The ability to read and interpret electronic drawings and schematics is necessary in order to service, troubleshoot, and repair electronic devices and systems.
2. The ability to measure and calculate voltage, resistance, and current in an electronic circuit is necessary in order to service, troubleshoot, and repair electronic devices and systems.
3. Understanding of the functions of basic electronic devices is necessary in order to service, troubleshoot, and repair electronic devices and systems.
4. Understanding of series, parallel, and series-parallel circuits is necessary in order to service, troubleshoot, and repair electronic devices and systems.

Suggested Essential Questions

1. What symbols are used in drawings and schematics to represent electronic devices?
2. How are voltage, resistance, and current measured in electronic circuits?
3. What is the function of devices commonly used in electronic circuits?
4. How are series, parallel, and series-parallel circuits constructed and tested?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Explore the use of integrated systems in agriculture and natural resources. (DOK 1)	a. Students will complete exercises in the <i>Discovery IV Electronics Trainer</i> module to gain experience and understanding of the different types of integrated systems. CS1, CS2, CS4, T3, T4, T6, R2, R4, R5	a. Use the evaluation activities (worksheets and posttests) in the <i>Discovery IV Electronics Trainer</i> module to evaluate student performance on this indicator.
b. Interpret symbols, schematics, and drawings of electrical and electronic systems. (DOK 2)	b. Have students complete the activities in Day 2 of the <i>Discovery IV Electronics Trainer</i> module to include becoming familiar with the main components of the trainer and with graphic symbols and schematics. CS1, CS2, CS4, R2, R4	b. Use the evaluation activities (worksheets and posttests) in the <i>Discovery IV Electronics Trainer</i> module to evaluate student performance on this indicator.
c. Measure and calculate resistance, voltage, and current in a circuit. (DOK 1)	c. Have the students complete activities in Day 3, Day 6, and Day 7 of the <i>Discovery IV Electronics Trainer</i> module to include use of the multimeter and measurement of resistance, voltage, and current in a circuit. CS1, CS2, CS4, T4, T6, M1, M4, M7, R2, R4	c. Use the evaluation activities (worksheets and posttests) in the <i>Discovery IV Electronics Trainer</i> module to evaluate student performance

on this indicator.		
d. Explore functions of basic electric and electronic devices (conductors, switches, diodes, rheostats, resistors semiconductors, potentiometers, etc.). (DOK 2)	d. Students will study functions of basic electronic devices as integral parts of all of the activities in the <i>Discovery IV Electronics Trainer</i> module. ^{CS1, CS2, CS4, R2, R4}	d. Use the evaluation activities (worksheets and posttests) in the <i>Discovery IV Electronics Trainer</i> module to evaluate student performance on this indicator.
e. Construct, operate, and test electrical circuits for current, voltage, and resistance. (DOK 3)	e. Students will construct, operate, and test series, parallel, and series-parallel circuits as part of the activities in the <i>Discovery IV Electronics Trainer</i> module (days 9, 10, and 11). ^{CS1, CS2, CS4, T4, T6, M1, M4, R2, R4}	e. Use the evaluation activities (worksheets and posttests) in the <i>Discovery IV Electronics Trainer</i> module to evaluate student performance on this indicator.

Standards

AFNR Industry Standards

- PST.01. Use physical science principles and engineering applications with power, structural, and technical systems to solve problems and improve performance.
- PST.02. Design, operate, and maintain mechanical equipment, structures, biological systems, land treatment, power, and technology.
- PST.05. Apply technology principles in the use of agricultural technical systems.

Applied Academic Credit Standards

Physical Science

- PS 2 Describe and explain how forces affect motion.

Physics I

- PHYI 5 Apply an understanding of magnetism, electric fields, and electricity.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS4 Productivity & Accountability

National Education Technology Standards for Students (NETS)

- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- M1 Basic Operations and Applications
- M4 Expressions, Equations, and Inequalities
- M7 Measurement
- R2 Supporting Details
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- W2 Focusing on the Topic
- W4 Organizing Ideas
- W5 Using Language

Suggested References

Burkybile, C., Johnson, D., Lee, J., & Shelhamer, C. (2005). *Agricultural power & technology*. Upper Saddle River, NJ: Pearson.

CEV Video. (n.d.). *CEV Pathway: Power, Structural & Technical Systems Pathway* [DVD]. Lubbock, TX: Author.

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Science of Agricultural Mechanization

Unit 4: Using Hydraulic and Pneumatic Systems

15 Hours

Competency 1: Apply principles of hydraulics. PST.01, PST.02, PS 3

Suggested Enduring Understandings

1. Pascal's law states that when pressure is applied to a confined liquid, it is transmitted equally to all surfaces.
2. The amount of force that can be generated by a hydraulic cylinder is determined by the surface area of the cylinder and the amount of pressure that is applied to the cylinder.
3. All hydraulic systems must contain an input source (pump or cylinder), a method of transmission (hose or tube), a control (valve or switch), and an output source (cylinder or motor).
4. Schematics and flowcharts for hydraulic systems show the placement, sequence, and fluid flow path.
5. Hydraulic circuits control pressure, flow, and force using valves, regulators, pumps, motors, and cylinders.

Suggested Essential Questions

1. How does Pascal's law apply to hydraulic circuits?
2. What is the relationship between pressure and piston area?
3. What are the major parts of a hydraulic system, and how do they function?
4. What do symbols and graphics on a hydraulic system schematic represent?
5. How do I construct, operate, and test a hydraulic circuit?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe and apply Pascal's law. (DOK 2)	a. Have students read and complete Experiment 4 in the <i>Discovery II: Discovering Hydraulics</i> module. CS1, CS2, CS4, T3, T4, T6, M1, M4, M5, R3, R4, R5, S1, S2, S3	a. Evaluate the worksheets in the <i>Discovery II: Discovering Hydraulics</i> student guide and the posttest.
b. Apply the relationship of area and force to pressure in a hydraulic system. (DOK 2)	b. Have the students read and complete the activities in Experiment 8 of the <i>Discovery II: Discovering Hydraulics</i> module. CS1, CS2, CS4, T3, T4, T6, M1, M4, M5, R3, R4, R5, S1, S2, S3	b. Evaluate the worksheets in the <i>Discovery II: Discovering Hydraulics</i> student guide and the posttest.
c. Identify the major components of a hydraulic system, and describe their purpose and function. (DOK 1)	c. Have students read and complete the activities in Experiment 1 of the <i>Discovery II: Discovering Hydraulics</i> student guide. CS1, CS2, CS4, T3, T4, T6, M1, M4, M5, R3, R4, R5, S1, S2, S3	c. Evaluate the worksheets in the <i>Discovery II: Discovering Hydraulics</i> student guide and the posttest.
d. Read and interpret a flowchart and schematic for a	d. Have students read and complete the activities in Experiment 2 of the <i>Discovery II: Discovering Hydraulics</i> student guide. CS1, CS2, CS4, T3, T4, T6, M1, M4, M5, R3,	d. Evaluate the worksheets in the <i>Discovery II:</i>

hydraulic system. (DOK 2)	R4, R5, S1, S2, S3	<i>Discovering Hydraulics</i> student guide and the posttest.
e. Construct, operate, and test hydraulic systems using valves, cylinders, hoses, and other devices. (DOK 2)	e. Have students complete experiments 5, 6, 7, and 8 of the <i>Discovery II: Discovering Hydraulics</i> student guide. CS1, CS2, CS4, T3, T4, T6, M1, M4, M5, R3, R4, R5, S1, S2, S3	e. Evaluate the worksheets in the <i>Discovery II: Discovering Hydraulics</i> student guide and the posttest.

Competency 2: Apply principles of pneumatics. PST.01, PST.02, PS 3

Suggested Enduring Understandings

1. Pneumatic systems function through the use of compressed gas or air to transmit power. Basic laws of physics that apply to pneumatic systems include Pascal's, Boyles, Bernoulli's, and Charles'.
2. Pneumatic systems do not transmit force as efficiently as hydraulic systems but offer advantages of speed, cost, and maintenance.
3. Pneumatic circuits and systems consist of a source, lines, controller valves and switches, and cylinders and motors.

Suggested Essential Questions

1. How do the basic laws of gases and fluids apply to pneumatic systems?
2. How are pneumatic systems different from hydraulic systems?
3. How are pneumatic system circuits constructed?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe and apply basic laws of pneumatic systems. (DOK 2)	a. Have students read and complete activities for Experiment 3 in the <i>Discovery I: Discovering Pneumatics</i> laboratory manual. This experiment covers Pascal's, Boyles, Bernoulli's and Charles' laws on fluids and gases. CS1, CS2, CS4, T3, T4, T6, M1, M4, M5, R3, R4, R5, S1, S2, S3	a. Evaluate the worksheets and quiz associated with Experiment 3.
b. Compare and contrast the operation of a pneumatic system to the operation of a hydraulic system. (DOK 2)	b. After completing both the hydraulic and pneumatic systems competencies, have students create a chart that describes the commonalities and differences in the two systems. Characteristics that should be included on the chart include transport medium used (gas verses liquid), speed of action, safety factors, cost, compressibility of medium, and type of system (open, closed, or both). CS1, CS2, CS4, T3, T4, T6, R3, R4, R5, W2, W4, W5	b. Evaluate the students' charts using the <i>Hydraulic/Pneumatic System Comparison Chart Rubric (4.1)</i> .
c. Construct, operate, and test a pneumatic system using various valves, cylinders, and other devices. (DOK 2)	c. Have students complete experiments 4–13 in the <i>Discovery I: Discovering Pneumatics</i> laboratory manual covering the different components of a pneumatic system including filters, lubricators, flow control valves, regulators, flowmeters, directional control valves, and cylinders. CS1, CS2, CS4, T3, T4, T6, M1, M4, M5, R3, R4, R5, S1, S2, S3	c. Evaluate the worksheets and quiz associated with each experiment.

Standards

AFNR Industry Standards

- PST.01. Use physical science principles and engineering applications with power, structural, and technical systems to solve problems and improve performance.
- PST.02. Design, operate, and maintain mechanical equipment, structures, biological systems, land treatment, power, and technology.

Applied Academic Credit Standards

Physical Science

- PS 3 Demonstrate an understanding of general properties and characteristics of waves.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS4 Productivity & Accountability

National Education Technology Standards for Students (NETS)

- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- M1 Basic Operations and Applications
- M4 Expressions, Equations, and Inequalities
- M5 Graphical Representations
- R3 Sequential, Comparative, and Cause–Effect Relationships
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- S1 Interpretation of Data
- S2 Scientific Investigation
- S3 Evaluation of Models, Inferences, and Experimental Results
- W2 Focusing on the Topic
- W4 Organizing Ideas
- W5 Using Language

Suggested References

- Burkybile, C., Johnson, D., Lee, J., & Shelhamer, C. (2005). *Agricultural power & technology*. Upper Saddle River, NJ: Pearson.
- CEV Video. (n.d.). *CEV Pathway: Power, Structural & Technical Systems Pathway* [DVD]. Lubbock, TX: Author.
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Science of Agricultural Mechanization

Unit 5: Principles of Internal Combustion Engines

20 Hours

Competency 1: Describe the functions and operation of major systems of a small gasoline engine. ^{PST.01,}

PST.03, PS 1, PS 2, PS 5, PHYI 2, PHYI 3

Suggested Enduring Understandings

1. When working with any small engine, it is essential that proper safety procedures be followed to protect the person working on the engine and others.
2. In a small engine, power is obtained by the combustion of a fuel–air mixture that pushes a piston down and turns a crankshaft.
3. Four-stroke cycle engines generate one power stroke for each four strokes of the piston, while two-stroke cycle engines generate power on every second stroke.
4. Gasoline engines depend upon a spark for ignition, are usually lighter in weight, and are usually less expensive to purchase. Diesel engines use compression to ignite the fuel–air mixture to provide more power and are less expensive to operate and maintain.
5. The engine lubrication system functions to reduce friction and wear, increase compression, clean carbon deposits, and help cool the engine.
6. Engine oil is selected on the basis of quality (API classification) and viscosity (thickness). Gasoline is selected on the basis of its octane rating, and diesel fuel is selected based on a cetane rating. It is critical to select the proper fuel and lubricants for an engine.
7. In air cooled engines, most of the cooling is done by the flywheel fins and the shroud.
8. Small gasoline engine fuel systems are usually composed of a fuel tank and a carburetor.
9. Most small engines today use a solid-state (breakerless) ignition system.

Suggested Essential Questions

1. What safety rules must be followed in working with small engines?
2. Where does the power in a small engine come from?
3. What is the difference in a four-stroke and two-stroke small engine?
4. What are the major differences in gasoline and diesel small engines?
5. What are the functions of the lubrication system in a small engine?
6. How are engine lubricants and fuels selected?
7. How do the flywheel fins and engine shroud help keep a small engine cool?
8. What is the function of a small engine fuel system?
9. What is the function of a small gasoline engine ignition system?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Discuss and apply safety principles while working on engines. (DOK 1)	a. Prior to teaching this competency, have students read the chapter on <i>Fundamental of Small Engines</i> from the text (Herren, 2010). Introduce the competency by asking students how many different uses they can name for internal combustion engines. Use the PowerPoint presentation Small Engine Safety to discuss the importance of safety practices in working on or around small engines. Have students	a. Use a written test to evaluate student performance on this competency.

	summarize the major points of the presentation in their electronic journals or blogs. CS1, CS2, T6, R1, R2, R4, R5, W2, W4, W5	
b. Describe the basic principle of combustion and force as it is applied to an internal combustion engine. (DOK 1)	b. Use the PowerPoint presentation Small Engines: Principles of Operation to describe, discuss, and illustrate the basic principle of combustion and force in an internal combustion engine. Have students summarize the major points of the presentation in their electronic journals or blogs. CS1, CS2, T6, R1, R2, R4, R5, W2, W4, W5	b. Use a written test to evaluate student performance on this competency.
c. Compare and contrast the operating principles of four-stroke and two-stroke gasoline engines. (DOK 2)	c. Use the PowerPoint presentation Small Engines: Principles of Operation to describe, discuss, and contrast the operation of four-stroke and two-stroke internal combustion engines. Have students associate each engine with its different applications and discuss the advantages and disadvantages of each engine. CS1, CS2	c. Use a written test to evaluate student performance on this competency.
d. Compare and contrast the operating principles of gasoline and diesel engines. (DOK 2)	d. Have students research gasoline and diesel engines and complete a worksheet that compares and contrasts the operation principles and features of each. Conduct a class discussion to summarize major points, and have students record these points in their electronic journals or notebooks. CS1, CS2, T3, T6, R1, R2, R4, R5, W2, W4, W5	d. Use a written test to evaluate student performance on this competency.
e. Describe the parts and functions of the lubrication system. (DOK 1)	e. Have students view the video Engine Lubrication and make notes on the parts of different types of lubrication systems (splash, dipper, and pressure fed) and the functions that lubrication plays in the operation of an engine (reducing friction, cooling the engine, etc.). CS1, CS2, R1, R2, R4, R5	e. Have students post their work to their journals or blogs.
f. Select proper lubricants and fuels based on the manufacturer's recommendation. (DOK 1)	f. Using the information gained from the Engine Lubrication Systems Web page, discuss the concepts of grade and quality of fuel and lubricants including octane and cetane rating, viscosity, and quality grade. List major points on the LCD projector, and have students record these points in their electronic journals or notebooks. CS1, CS2, T6, W2, W4, W5	f. Use a written test to evaluate student performance on this competency.
g. Describe the parts and function of an air cooled engine cooling system. (DOK 1)	g. On a partially disassembled engine, show students how the shroud and cooling fins channel air over the engine to prevent it from overheating. Discuss the importance of keeping these items free of dust and debris to prevent overheating. CS1, CS2	g. Use a written test to evaluate student performance on this competency.
h. Describe the parts and function of small gasoline engine fuel system. (DOK 1)	h. Use the PowerPoint presentation Carburetion to show students how air and fuel are mixed in the carburetor of an engine to form a mixture for combustion. Discuss the concepts of air flow associated with carburetion and adjustments that can be made to the fuel-air mixture. CS1, CS2	h. Use a written test to evaluate student performance on this competency.
i. Describe the parts and functions of a small gasoline engine ignition system.	i. Have students read the information on the Ignition System Web page. Discuss the two types of ignition systems commonly used on small gasoline engines today (solid state and breaker point), and describe	i. Use a written test to evaluate student performance on this competency.

(DOK 1) how they function. ^{CS1, CS2}

Competency 2: Disassemble, inspect, and reassemble a small gasoline engine. ^{PST.03, PS 1, PS 2}

Suggested Enduring Understandings

1. Disassembly, inspection, and reassembly of an engine involve a knowledge of basic engine operating principles and the ability to follow directions and use tools.

Suggested Essential Questions

1. How is a small gasoline engine disassembled?
2. How are disassembled small gasoline engines inspected?
3. How are small gasoline engines reassembled?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Disassemble a small gasoline engine to include removing the head, oil pan, piston and crankshaft assembly, and valves. (DOK 2)	a. Divide the class into groups of 2–3 students, and assign each student an engine. Using the Web site Engine Dissection Project , have students follow the steps in dissecting an engine. ^{CS1, CS2, CS4, T3, T4, T6}	a. Use the <i>Engine Dissection, Inspection, and Reassembly Checklist (5.1)</i> to evaluate student performance on this indicator.
b. Inspect and measure parts part of the engine to verify that it is within tolerances as set by the manufacturer. (DOK 2)	b. Provide students with a set of manufacturer’s specifications and tolerances for engine parts. Demonstrate how to take proper measurements using feeler gauges, micrometers, or calipers. ^{CS1, CS2, CS4, T4, T6, M1, M7}	b. Use the <i>Engine Dissection, Inspection, and Reassembly Checklist (5.1)</i> to evaluate student performance on this indicator.
c. Reassemble the engine and test for proper operation (compression, ignition, etc.). (DOK 2)	c. Have students follow the reassembly steps found on the Web site Engine Dissection Project . ^{CS1, CS2, CS4, T4, T6}	c. Use the <i>Engine Dissection, Inspection, and Reassembly Checklist (5.1)</i> to evaluate student performance on this indicator.

Standards

AFNR Industry Standards

- PST.01. Use physical science principles and engineering applications with power, structural, and technical systems to solve problems and improve performance.
- PST.02. Design, operate, and maintain mechanical equipment, structures, biological systems, land treatment, power, and technology.
- PST.03. Service and repair mechanical equipment and power systems.

Applied Academic Credit Standards

Physical Science

- PS 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- PS 2 Describe and explain how forces affect motion.
- PS 5 Investigate and apply principles of physical and chemical changes in matter.

Physics I

- PHYI 2 Develop an understanding of concepts related to forces and motion.
- PHYI 3 Develop an understanding of concepts related to work and energy.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS4 Productivity & Accountability

National Education Technology Standards for Students (NETS)

- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- M1 Basic Operations and Applications
- M7 Measurement
- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- W2 Focusing on the Topic
- W3 Developing a Position
- W4 Organizing Ideas
- W5 Using Language

Suggested References

- Briggs & Stratton. (n.d.). *Ignition System* Retrieved February 23, 2009, from http://faqs.custhelp.com/cgi-bin/faqs.cfg/php/enduser/std_adp.php?p_faqid=3426&p_created=1098407641&p_sid=YOk1dcrj&p_accessibility=0&p_redirect=&p_lva=3427&p_sp=cF9zcmNoPTEmcF9zb3J0X2J5PSZwX2dyaWRzb3J0PSZwX3Jvd19jbnQ9NzcsNzcmcF9wcm9kc0mcF9jYXRzPTAmcF9wdj0
- Briggs & Stratton. (n.d.). *Engine lubrication, single*. Retrieved February 23, 2009, from http://www.briggsandstratton.com/videos/vp_modeltypecode4.html
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- Carburetion*. (n.d.). Retrieved February 23, 2009, from http://aged.ces.uga.edu/browseable_folders/power_points/Mechanics/Carburetion.ppt
- CEV Video. (n.d.). *CEV Pathway: Power, Structural & Technical Systems Pathway* [DVD]. Lubbock, TX: Author.
- Dufour, G., Chifor, G., & Frise, P. (n.d.). *Engine dissection project*. Retrieved on February 23, 2009, from http://staff.washington.edu/ryanlee/Engine/Handouts/01_hnd_EngineIntro.htm
- Engine Lubrication Systems*. (n.d.). Retrieved February 23, 2009, from <http://www.tarleton.edu/~mcgregor/A%20EN%202013/2013%20Labs/Lubrication/Lubric%20Systems%20Lab.pdf>
- Herren, R. (2010). *Agricultural mechanics: Fundamentals & applications*. Clifton Park, NJ: Delmar/Cengage.
- Morris, J. *Small engine safety*. (n.d.). (PowerPoint) Retrieved February 23, 2009, from http://aged.ces.uga.edu/Browseable_Folders/Power_Points/Mechanics/Small_Engine_Safety.ppt
- Olinger, Z. (n.d.). *Small engines: Principles of operation*. (PowerPoint) Retrieved February 23, 2009, from http://aged.ces.uga.edu/Browseable_Folders/Power_Points/Mechanics/Small_Engines_Principles_of_Operation.ppt
- Phipps, L., Miller, G., & Lee, J. (2004). *Introduction to agricultural mechanics*. Upper Saddle River, NJ: Pearson.

Science of Agricultural Mechanization

Unit 6: Principles of Metal Fabrication (Arc Welding)

15 Hours

Competency 1: Describe basic equipment, operations, and procedures, including safety precautions, of arc welding. ^{PST.03}

Suggested Enduring Understandings

1. Arc welding involves the use of high voltage electrical current and generates high temperatures and toxic fumes. The use of personal protective devices and safety precautions is essential to protect the health of the welder.
2. The most common types of arc welders are the SMAW (stick), GAMW (MIG), and GTAW (TIG). Each type has its strengths and limitations and can be used for several different types of welding.
3. Welding accessories that must be used in arc welding include electrode holders, grounding clamps, wire brushes, chipping hammers, and work clamps and guides.
4. SMAW electrodes consist of a metal rod surrounded by a flux that shields the arc from outside air. Electrodes are classified by tensile strength, diameter, type of metal, and welding position.
5. In setting up an arc welder for a given job, a welder must take into consideration the type and thickness of the metal being welded before selecting the appropriate electrode and setting the machine controls.
6. Welds are classified as to type (fillet or groove), joint (butt, corner, edge, lap and T), and position (flat, vertical horizontal, and overhead).
7. In making a weld, the angle of the electrode, speed of electrode travel, motion of the electrode, and machine settings must be controlled. Different welds and positions require different procedures.

Suggested Essential Questions

1. What personal protection devices are necessary for safely using an arc welder?
2. What safety procedures are necessary for safely using an arc welder?
4. What are the most common types of arc welding machines, and where are they used?
5. What accessories are used in arc welding, and what is their purpose?
6. What factors must be taken into account in selecting a specific electrode for a job?
7. What factors must be considered in setting up an arc welding machine for a specific job?
8. What are the different weld types, joints, and positions?
9. What factors must be taken into consideration in making a weld?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify and describe the function and use of personal safety equipment and apparel (clothing, gloves, helmets, safety glasses/goggles etc.). (DOK 1)	a. Prior to teaching this competency, have the students read the chapter on Arc Welding Mild Steel and GAMW/GTAW Welding in the text (Herren, 2010). Discuss potential dangers from arc welding including damage to eyes, lungs, and skin. Display each piece of safety equipment, and discuss how it contributes to a safe working environment. ^{CS1, CS2, CS4,R2, R4, R5}	a. Use a written test to initially evaluate student understanding of this indicator. Students must score 90% or more to work in lab. Students will be

		observed during laboratory practice and scored on their use of safety procedures and equipment.
b. Discuss and demonstrate safety precautions to use to prevent electrical shock, eye and skin damage, and respiratory damage while welding. (DOK 1)	b. Use the PowerPoint presentation Arc Welding Safety Notes to lead a discussion on common hazards associated with welding and the precautions that can be followed to prevent accidents or damages. Summarize major points, and have students record them in their electronic journals or notebooks. ^{CS1, CS2, CS4}	b. Observe students in preparing welding area for lab work. Make corrections as needed.
c. List the three major types of arc welders (SMAW, MIG, and TIG) used in agricultural equipment repair and fabrication, and discuss their characteristics and applications. (DOK 1)	c. Introduce the competency by providing a definition of arc welding. Use the PowerPoint presentation Arc Welding Methods and Processes to present information on types of welders, accessories and tools, and electrodes and their use and application. Invite a welder to speak to the class on his or her career and present information about the different types of welders and equipment used by welders. ^{CS1, CS2, CS4, T6}	c. Use a written test to evaluate student understanding of this indicator.
d. Describe the purpose/function of tools and accessories used in arc welding (electrode holder, ground clamp, cables, electrodes, wire, chipping hammer, and wire brushes). (DOK 1)	d. Demonstrate the proper use and function of welders and equipment. ^{CS1, CS2, CS4, T6}	d. Use a written test to evaluate student understanding of this indicator. Students will be further evaluated on proper use of tools and accessories during laboratory practice.
e. Associate common SMAW electrodes and GMAW wire with their weld characteristics and proper use. (DOK 2)	e. Prepare a PowerPoint presentation to present information on the following electrodes to the students including explaining their use and application (E6011, E6013 for AC, and E6010, E7014, E7018 for DC, GTAW wire). ^{CS1, CS2, CS4, T6}	e. Use a written test to evaluate student understanding of this indicator.
f. Examine the relationship of amperage, voltage, and electrode type and diameter to electrode and metal type and thickness. (DOK 1)	f. Have students read and interpret the amperage chart associated with the welding machines in the laboratory to determine the proper settings for different sizes and types of electrodes and thickness and type of metal. Discuss the results of improper amperage adjustment on weld appearance and strength. (Sample metals used should be mild steel, high strength steel to include stainless steel, cast iron, and aluminum.) ^{CS1, CS2, CS4, T6}	f. Use a written test to evaluate student understanding of this indicator. Students will be further evaluated on their ability to select the correct amperage and voltage for a given job during laboratory practice.

g. Identify the difference between a bead, groove, and fillet weld and how they are used in the four weld joints (butt, lap, corner, and T-weld). (DOK 1)	g. Using the PowerPoint presentation Types of Welds and Weld Joints , show the students a model of the difference types of welds. Show students how these welds are used in the four joints: butt, corner, edge, and fillet. CS1, CS2, CS4, T6	g. Use a written test to evaluate student understanding of this indicator.
h. Compare welding procedures for welding in different welding positions. (DOK 1)	h. Demonstrate to students the different types of welding positions, and explain how different techniques are used for each position including angle of electrode, speed of travel, machine adjustment, and electrode motion. CS1, CS2, CS4, T6	h. Use a written test to evaluate student understanding of this indicator. Students will be further evaluated on their ability to demonstrate correct welding procedures for a given job during laboratory practice.

Competency 2: Perform arc welding techniques. PST.03

Suggested Enduring Understandings

1. Striking an arc is very similar to striking a match. This procedure must be mastered before attempting to construct a weld.
2. A flat butt weld involves welding two pieces of metal that are side by side in the flat position.
3. A flat fillet weld involves welding two pieces of metal that are at an angle to each other.

Suggested Essential Questions

1. What is the procedure for striking an arc and running a flat bead?
2. What is the procedure for constructing a flat butt weld?
3. What is the procedure for constructing a flat fillet weld?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Demonstrate the procedure for striking an arc and running a flat bead. (DOK 2)	a. Use a SMAW welder and appropriate electrode such as an E6011 and a mild steel plate; demonstrate to students the proper procedure for striking and running a bead. Have students practice in the laboratory. CS1, CS2, CS4, T6	a. Use the <i>Weld Joint Construction Rubric (6.1)</i> to evaluate student performance on this indicator.
b. Construct a flat butt weld. (DOK 2)	b. Demonstrate how to construct a flat butt weld. Use a job sheet to detail the procedures for welding a flat butt weld. Have students complete a flat butt weld in the laboratory for evaluation. CS1, CS2, CS4, T6	b. Use the <i>Weld Joint Construction Rubric (6.1)</i> to evaluate student performance on this indicator.
c. Construct a flat fillet weld. (DOK 2)	c. Demonstrate how to make a fillet weld. Use a Job sheet to detail the procedure to follow in making a fillet weld. Have students complete a flat butt weld in the laboratory for evaluation. CS1, CS2, CS4, T6	c. Use the <i>Weld Joint Construction Rubric (6.1)</i> rubric to evaluate student performance on this indicator.

Standards

AFNR Industry Standards

PST.03 Service and repair mechanical equipment and power systems.

21st Century Learning Standards

CS1 Flexibility & Adaptability

CS2 Initiative & Self-Direction

CS4 Productivity & Accountability

National Education Technology Standards for Students (NETS)

T6 Technology Operations and Concepts

ACT College Readiness Standards

R2 Supporting Details

R4 Meaning of Words

R5 Generalizations and Conclusions

Suggested References

- Arc welding safety notes*. (n.d.). (PowerPoint). Retrieved June 11, 2010 from
http://www.nebo.edu/misc/learning_resources/ppt/6-12/arc_welding_safety.ppt
- Burkybile, C., Johnson, D., Lee, J., & Shelhamer, C. (2005). *Agricultural power & technology*. Upper Saddle River, NJ: Pearson.
- CEV Video. (n.d.). *CEV Pathway: Power, Structural & Technical Systems Pathway* [DVD]. Lubbock, TX: Author.
- Herren, R. (2010). *Agricultural mechanics: Fundamentals & applications*. Clifton Park, NJ: Delmar/Cengage.
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- Sadler, H. (n.d.). *Arc welding methods and processes* (PowerPoint). Retrieved June 11, 2010 from
http://www.ncsea.com/downloads/events/conference2008/Arc_Welding_Fundamentals.pdf

Science of Agricultural Mechanization

Unit 7: Principles of Metal Fabrication (Oxyacetylene Cutting Operations)

10 Hours

Competency 1: Describe and demonstrate principles of oxyfuel cutting procedures. ^{PST.03}

Suggested Enduring Understandings

1. Mixtures of oxygen and acetylene gases are potentially explosive, and proper safety procedures and personal protection are necessary for safe operation.
2. The major parts of an oxyacetylene cutting unit are the cylinders, regulators, hoses, torch body, and cutting attachment.
3. There is a set procedure for safely setting up, igniting, and shutting down an oxyacetylene torch unit that must be followed at all times.
4. There are three different types of flames that can be generated by an oxyacetylene torch: oxidizing, neutral, and carbonizing.
5. Making a cut with an oxyacetylene cutting torch involves preheating the metal and moving the torch in a steady smooth motion at the proper distance and speed across the metal.

Suggested Essential Questions

1. What safety and personal protection procedures are necessary for oxyacetylene torch operation?
2. What are the major parts of an oxyacetylene cutting unit?
3. What is the procedure for setting up, igniting, and shutting down an oxyacetylene torch?
4. What are the characteristics of the three different types of flames that can be generated by an oxyacetylene torch?
5. What is the procedure for making a cut in mild steel with an oxyacetylene cutting torch?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe and apply safety procedures and personal protection equipment for oxyfuel cutting. (DOK 3)	a. Prior to teaching this competency, have students read the chapter on Using Gas Welding Equipment in the text (Herren, 2010). Provide each student with a copy of the material on Oxyacetylene Welding Safety , and lead a class discussion with demonstrations where appropriate on safety procedures and equipment. ^{CS1, CS2, CS4, T6}	a. Use a written test to evaluate student understanding of this indicator. Students should score 90% or higher before being allowed to use the oxyfuel equipment. Student will be further rated on safety performance in laboratory activities.
b. Identify and describe the function of the different parts of the oxyfuel cutting unit. (DOK 1)	b. Use the PowerPoint presentation Oxyacetylene Welding and an actual welding and cutting unit to discuss parts and function of oxyfuel cutting unit to include cylinders, regulators, hoses, and torch styles and attachments. ^{CS4, CS5 NETS T1, T2, T3, T4, E1 E2, E3, M5, M7, R2 S1, W2, W4}	b. Have students record information in journals or blogs. Have students conduct a presentation to the instructor and corrections as needed.

c. Set up, ignite, and shut down oxyfuel cutting equipment. (DOK 3)	c. The instructor will provide students with detailed instructions on how to set up equipment for making cut in mild steel, ignite and adjust the torch, and shut down the equipment. The instructor will then demonstrate each step of the procedure. CS1, CS2, CS4, T6	c. Use a written test to evaluate student understanding of this indicator. Students will be further rated using the <i>Oxyacetylene Cutting Operations Checklist (7.1)</i> during laboratory exercises.
d. Describe the characteristics and uses of the different oxyfuel flames (neutral, oxidizing, and carbonizing). (DOK 3)	d. Use the PowerPoint presentation Oxyacetylene Welding and an actual welding and cutting unit, the instructor should demonstrate the set up of a cutting torch to produce neutral, carburizing, and oxidizing flames and describe the characteristics and uses of each flame. CS1, CS2, CS4, T6	d. Use the <i>Oxyacetylene Cutting Operations Checklist (7.1)</i> to evaluate student performance on this indicator.
e. Demonstrate how to make a cut in a mild steel plate. (DOK 3)	e. The instructor will provide students with a mild steel plate and observe students for safety and proper procedure. The instructor will make corrections as necessary. CS1, CS2, CS4, T6	e. Use the <i>Oxyacetylene Cutting Operations Checklist (7.1)</i> to evaluate student performance on this indicator.

Standards

AFNR Industry Standards

PST.03. Service and repair mechanical equipment and power systems.

21st Century Learning Standards

CS1 Flexibility & Adaptability

CS2 Initiative & Self-Direction

CS4 Productivity & Accountability

National Education Technology Standards for Students (NETS)

T6 Technology Operations and Concepts

Suggested References

- American Welding Society. (n.d.). *Oxyacetylene welding (OAW)* (PowerPoint). Retrieved February 24, 2009, from www.aws.org/educators/Library/0000/000631.ppt
- Burkybile, C., Johnson, D., Lee, J., & Shelhamer, C. (2005). *Agricultural power & technology*. Upper Saddle River, NJ: Pearson.
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- Kansas State University Research and Extension. (n.d.). *Agricultural engineering safety lesson plan: Oxyacetylene welding safety*. Retrieved February 24, 2009, from http://www.cdc.gov/nasd/docs/d000701_000800/d000785/d000785.html
- Phipps, L., Miller, G., & Lee, J. (2004). *Introduction to agricultural mechanics*. Upper Saddle River, NJ: Pearson.

Science of Agricultural Mechanization

Student Competency Profile

Student Name: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the course. In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Introduction to Agricultural Mechanization

- _____ 1. Investigate the role of mechanical technology in agriculture.
- _____ 2. Identify science applications in agricultural mechanization technology.
Demonstrate career and leadership skills required for employment in the agricultural
- _____ 3. mechanization industry.
- _____ 4. Identify safety precautions and equipment for the work site and school laboratory.

Unit 2: Management and Operation of Agricultural Equipment

- _____ 1. Examine concepts of machinery management and maintenance.
- _____ 2. Operate mechanized equipment in a safe and proper manner.
- _____ 3. Describe and perform principles of preventive maintenance.
- _____ 4. Perform preventive maintenance services.
- _____ 5. Apply principles of engine diagnostics and testing.

Unit 3: Analyzing Electrical and Electronic Systems

- _____ 1. Describe and apply the use of electronic components and systems in agricultural equipment.

Unit 4: Using Hydraulic and Pneumatic Systems

- _____ 1. Apply principles of hydraulics.
- _____ 2. Apply principles of pneumatics.

Unit 5: Principles of Internal Combustion Engines

- _____ 1. Describe the functions and operations of major systems of a small gasoline engine.
- _____ 2. Disassemble, inspect, and reassemble a small gasoline engine.

Unit 6: Principles of Metal Fabrication (Arc Welding)

Describe basic equipment, operations, and procedures, including safety precautions, of arc

- _____ 1. welding.
- _____ 2. Perform arc welding techniques.

Unit 7: Principles of Metal Fabrication (Oxyacetylene Cutting Operations)

- _____ 1. Describe and demonstrate principles of oxyfuel cutting procedures.

Appendix A: Suggested Rubrics, Assignments, and Checklists

Name: _____

Date: _____

Period: _____

Emerging Technology Fact Sheet Rubric (1.1)

Scoring Criteria				
<i>The student does the following:</i>	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Graphic or picture clearly illustrates the technology.				
A clear concise description of how the technology is used is provided.				
A clear concise description of where the technology is used is provided.				
Spelling, grammar, and punctuation are correct.				
Sentence structure including subject verb agreement is correct.				
All information provided is accurate and current.				

Name: _____

Date: _____

Period: _____

Calculating Area and Volume Assignment (1.2)

Use a calculator if necessary to solve the problems below. Show the formula or calculations that you used in each step.

1. A lawn is 200 ft wide and 120 ft long. How many square feet are in the lawn? If a soil test indicates that you need to apply 2.4 lb of 8-8-8 fertilized per 1,000 sq ft, how many pounds of fertilizer should be applied?
2. A field is 1,320 feet square. How many acres are in the field if an acre is equal to 43,560 sq ft? If you wanted to apply 50 lb of ammonium nitrate to each acre, how many pounds of this material would you need to buy?
3. A grain bin has a radius of 16 ft and stands 30 ft in height from the edge of the roof. How many cubic feet of grain can be stored in the bin if it is filled to the top of the wall? If cubic foot is equal to 0.8 bushel of grain, how many bushels of grain will the bin hold if filled to edge of the roof?
4. A grain bin has a diameter of 32 ft and stands 36 ft in height from the edge of the roof to the ground. How many cubic feet of grain can be stored in the bin if it is filled to the top of the wall? If cubic foot is equal to 0.8 bushel of grain, how many bushels of grain will the bin hold if filled to edge of the roof?
5. A fuel tank has a radius of 2 ft and a length of 8 ft. How many cubic feet are in the tank? If one cubic foot of fuel is equal to approximately 7.5 gal., how many gallons will the tank hold if filled to the top?

Name: _____

Date: _____

Period: _____

21st Century Life and Career Skills (1.3)

Today's life and work environments require far more than thinking skills and content knowledge. The ability to navigate the complex life and work environments in the globally competitive information age requires students to pay rigorous attention to developing adequate life and career skills.

CS1 Global Awareness

1. Using 21st century skills to understand and address global issues
2. Learning from and working collaboratively with individuals representing diverse cultures, religions and lifestyles in a spirit of mutual respect and open dialogue in personal, work and community contexts
3. Understanding other nations and cultures, including the use of non-English languages

CS2 Financial, Economic, Business and Entrepreneurial Literacy

1. Knowing how to make appropriate personal economic choices
2. Understanding the role of the economy in society
3. Using entrepreneurial skills to enhance workplace productivity and career options

CS3 Civic Literacy

1. Participating effectively in civic life through knowing how to stay informed and understanding governmental processes
2. Exercising the rights and obligations of citizenship at local, state, national and global levels
3. Understanding the local and global implications of civic decisions

CS4 Health Literacy

1. Obtaining, interpreting and understanding basic health information and services and using such information and services in ways that enhance health
2. Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance and stress reduction
3. Using available information to make appropriate health-related decisions
4. Establishing and monitoring personal and family health goals
5. Understanding national and international public health and safety issues

CS5 Environmental Literacy

1. Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water and ecosystems
2. Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.)
3. Investigate and analyze environmental issues, and make accurate conclusions about effective solutions
4. Take individual and collective action towards addressing environmental challenges (e.g., participating in global actions, designing solutions that inspire action on environmental issues)

CSS2-Learning and Innovation Skills

CS6 Creativity and Innovation

1. Think Creatively
2. Work Creatively with Others
3. Implement Innovations

CS7 Critical Thinking and Problem Solving

1. Reason Effectively
2. Use Systems Thinking
3. Make Judgments and Decisions
4. Solve Problems

CS8 Communication and Collaboration

1. Communicate Clearly
2. Collaborate with Others

CSS3-Information, Media and Technology Skills

CS9 Information Literacy

1. Access and Evaluate Information
2. Use and Manage Information

CS10 Media Literacy

1. Analyze Media
2. Create Media Products

CS11 ICT Literacy

1. Apply Technology Effectively

CSS4-Life and Career Skills

CS12 Flexibility and Adaptability

1. Adapt to change
2. Be Flexible

CS13 Initiative and Self-Direction

1. Manage Goals and Time
2. Work Independently
3. Be Self-directed Learners

CS14 Social and Cross-Cultural Skills

1. Interact Effectively with others
2. Work Effectively in Diverse Teams

CS15 Productivity and Accountability

1. Manage Projects
2. Produce Results

CS16 Leadership and Responsibility

1. Guide and Lead Others
2. Be Responsible to Others

Name: _____

Date: _____

Period: _____

21st Century Life and Career Skills Assessment Rubric (1.4)

The following scale can be used to assess application of each of the Life and Career Skills of students.

Superior	(18–20 points) The student consistently demonstrates all aspects of this skill in classroom and laboratory activities.
Exceptional	(15–17 points) The student consistently demonstrates most of the aspects of this skills in classroom and laboratory activities but lapses at times on one to two of the indicators.
Adequate	(12–14 points) The student demonstrates knowledge of the skill during classroom and laboratory activities but lapses on three or more indicators from time to time.
Improving	(9–11 points) The student is vaguely aware of the skill but shows only marginal evidence of being able to apply it in the classroom or laboratory.
Minimal	(0–8 points) The student consistently fails to demonstrate knowledge or application of the skill.

Skill	Comments	Score
Flexibility and Adaptability		
Initiative & Self-Direction		
Social & Cross-Cultural Skills		
Productivity & Accountability		
Leadership & Responsibility		
		TOTAL SCORE

Name: _____
Date: _____
Period: _____

Equipment Maintenance Record Rubric (2.1)

Component/Indicator	Possible Points	Student Score
Equipment Identification: Provided fields for equipment name, model number, serial number, date of purchase, purchase price, and expected life	20	
Scheduled Maintenance: For each item that is listed on the manufacturer's maintenance schedule, a field is provided for the date of service, materials and supplies used, and next estimated date of service.	40	
Repairs and Replacements: A field is provided for each repair or replacement not covered under scheduled maintenance to include date of repair, parts and materials used, and costs.	40	
TOTAL SCORE	100	

Name: _____

Date: _____

Period: _____

Equipment Repair Work Order Assignment (2.2)

Scenario #1: Replace belts and blades on a riding lawn mower. Parts used: 1 – main drive belt (\$22.00); 1 – secondary drive belt (18.00); 2- 22-in. lawnmower blades (\$13.50). Labor used 1.5 hr at \$22.00 per hour. Tax 7% of parts and labor

Scenario #2: Perform annual maintenance on a diesel tractor. Parts used: 1 oil filter (\$14.75); 6 qt SAE 30 motor oil (\$3.45/qt); 1 pleated air filter (\$35.00); 2 fuel filters (\$18.00); 1 hydraulic system filter (\$35.00); 8 gal. SAE90 hydraulic fluid (\$14.00/gal.); 3 gal. antifreeze (\$6.00/gal.). 1 lower radiator hose (\$16.70), 1 upper radiator hose (\$18.30). Labor 3 hr at \$35.00 per hour. Tax 7% of parts and labor

Scenario #3: Repair string trimmer engine. Parts used: 1 carburetor (\$35.00). Labor used: 1 hr at \$22.00 per hour. Tax 7% of parts and labor

Scenario #4: Service push type lawn mower. Parts used: 1 qt SAE 30 motor oil (\$3.00); 1 spark plug (\$3.25); 1 foam type air cleaner (\$4.45). Labor used 1 hr at \$22.00 per hour. Tax 7% of parts and labor

Name: _____
 Date: _____
 Period: _____

Vehicle Inspection, Start-up, and Operation Checklist (2.3)

Place a check mark in the appropriate space for each item.

OK	NOT OK	N/A
Pre-start Inspection		
		• Checked engine oil
		• Checked fuel level
		• Checked coolant level
		• Checked transmission and/or hydraulic fluid level
		• Checked tires
		• Checked engine, transmission, and hydraulic system for visible fluid leaks
		• Checked warning lamps or horns and/or SMV emblem
		• Checked brakes
		• Checked transmission shift control
		• Checked clutch position
		• Checked throttle position
		• Checked instrument panel warning lights for operation before starting
Post Start Inspection		
		• Checked engine oil pressure, ammeter, ammeter, and temperature instruments
Operating Procedures		
		• Smoothly engaged clutch or transmission shift lever
		• Selected proper engine speed
		• Selected proper ground speed
		• Wore seat belt at all times
		• Set throttle and parking brake before getting off tractor
		• Maintained control of tractor at all times
		• Retarded throttle and set parking brake before shutting down the engine

Name: _____

Date: _____

Period: _____

Tractor Service Intervals and Specifications Assignment (2.4)

Use an owner's manual to determine the following information regarding tractor maintenance intervals and specifications.

1. How often should engine oil be changed, and what viscosity and classification of oil should be used? _____
2. How often should be engine oil filter be changed?

3. How often should the transmission and/or hydraulic fluid be changed, and what viscosity and classification of fluid should be used?

4. How often should the air filter be serviced or replaced?

5. How often should the cooling system be flushed and refilled, and what type of coolant should be used?

6. How often should the fuel system be serviced?

7. How often should the battery be cleaned and inspected?

8. What items should be checked on a daily basis or every 10 hr of operation?

Name: _____

Date: _____

Period: _____

Daily Maintenance Checklist (2.5)

Rate the student's ability to perform the following maintenance checks and procedures using the following scale:

4 – Can perform consistently and accurately without need of any supervision or direction

3 – Can perform consistently and accurately with minimum supervision or direction

2 – Can perform consistently and accurately with moderate supervision or direction

1 – Cannot perform consistently or accurately without direct supervision

_____ 1. Check engine oil level.

_____ 2. Check transmission/hydraulic fluid level.

_____ 3. Check coolant level.

_____ 4. Check tires for proper inflation.

_____ 5. Visually inspect machine for visible fluid leaks, broken parts, and so forth.

Name: _____

Date: _____

Period: _____

Small Engine Troubleshooting Rubric (2.6)

Rate the student's ability to perform the following maintenance checks and procedures using the following scale:

- 4 – Can perform consistently and accurately without need of any supervision or direction
- 3 – Can perform consistently and accurately with minimum supervision or direction
- 2 – Can perform consistently and accurately with moderate supervision or direction
- 1 – Cannot perform consistently or accurately without direct supervision

Testing a Spark Plug

- _____ 1. Removed and visually inspected plug for excessive oil or carbon buildup
- _____ 2. Checked and adjusted spark plug gap
- _____ 3. Reinstalled spark plug and used spark plug tester to determine if electricity was being supplied

Testing Engine Compression

- _____ 1. Visually inspected cylinder head gasket for signs of leakage
- _____ 2. Checked compression by turning crankshaft backward and noting "rebound" or by using a compression tester

Name: _____

Date: _____

Period: _____

Preventive Maintenance Checklist (2.7)

Rate the student's ability to perform the following maintenance checks and procedures using the following scale:

4– Can perform consistently and accurately without need of any supervision or direction

3– Can perform consistently and accurately with minimum supervision or direction

2 – Can perform consistently and accurately with moderate supervision or direction

1 – Cannot perform consistently or accurately without direct supervision

Inspect and Service An Air Cleaner (Pleated Paper Type)

- _____ 1. Removed air cleaner element
- _____ 2. Visually inspected element and determined if it should be serviced or replaced
- _____ 3. If serviceable, serviced element by tapping out small amounts of visible dust and trash
- _____ 4. Replaced air cleaner element
- _____ 5. Used all tools and supplies in a safe and proper manner
- _____ 6. Observed personal safety rules and used appropriate personal safety equipment at all times

Inspect and Service Lubrication System

- _____ 1. Prepared engine for servicing by running to normal operating temperature
- _____ 2. Drained engine oil into appropriate container
- _____ 3. Removed and drained oil filter(s)
- _____ 4. Replaced oil filters with new filters after coating gaskets with light coat of engine oil
- _____ 5. Replaced drain plug and filled with manufacturer's recommended quantity and quality of oil
- _____ 6. Ran engine and checked for visible leaks and proper oil pressure
- _____ 7. Checked engine oil level
- _____ 8. Disposed of used oil and oil filters appropriately
- _____ 9. Used all tools and supplies in a safe and proper manner
- _____ 10. Observed personal safety rules and used appropriate personal safety equipment at all times

Inspect and Service Fuel System

- _____ 1. Allowed engine to cool
- _____ 2. Checked fuel sediment bowl for sediment or water. Removed and serviced if necessary
- _____ 3. Closed fuel tank shut off valve
- _____ 4. Removed, drained, and discarded old fuel filter
- _____ 5. Installed new fuel filter
- _____ 6. Installed sediment bowl
- _____ 7. Bled air from system (if required)
- _____ 8. Cranked engine and checked for visible leaks
- _____ 9. Used all tools and supplies in a safe and proper manner
- _____ 10. Observed personal safety rules and used appropriate personal safety equipment at all times

Inspect and Service Belts and Hoses

- _____ 1. Allowed machine to cool before proceeding
- _____ 2. Checked all fuel hoses for signs of cracking or leakage. Replaced as necessary
- _____ 3. Checked all belts for signs of cracking or excessive wear. Replaced as necessary
- _____ 4. Checked all belts for proper tension and made adjustments as necessary
- _____ 5. Used all tools and supplies in a safe and proper manner
- _____ 6. Observed personal safety rules and used appropriate personal safety equipment at all times

Inspect and Service Liquid Coolant Systems

- _____ 1. Allowed machine to cool before proceeding
- _____ 2. Checked coolant level, added coolant if necessary
- _____ 3. Checked radiator and hoses for signs of clogged fins, leaks, or other damage
- _____ 4. Cleaned dust and trash from radiator and area around it
- _____ 5. Checked condition and freezing point of coolant. Added coolant if necessary

(Steps 6–15 apply if coolant is to be replaced)

- _____ 6. Slowly opened radiator cap to relieve any pressure in the system
- _____ 7. Drained coolant from radiator into appropriate container
- _____ 8. Drained engine block coolant into appropriate container
- _____ 9. Drain coolant recovery tank (if present) into appropriate container
- _____ 10. Flushed cooling system with water, then drained engine, radiator, and coolant recovery tank again
- _____ 11. Replaced all drain plugs and refilled engine block, radiator, and coolant recovery tank with manufacturer's recommended coolant mixture
- _____ 12. Checked radiator cap for signs of gasket wear or excessive corrosion and replace if necessary

- _____ 13. Replaced radiator cap and ran engine to operating temperature
- _____ 14. Stopped engine, checked coolant recovery tank for proper level of coolant, and added coolant if necessary
- _____ 15. Disposed of old coolant mixture in appropriate manner
- _____ 16. Used all tools and supplies in a safe and proper manner
- _____ 17. Observed personal safety rules and used appropriate personal safety equipment at all times

Name: _____

Date: _____

Period: _____

Hydraulic/Pneumatic System Comparison Chart Rubric (4.1)

	Exemplary 4 Points	Accomplished 3 Points	Developing 2 Points	Beginning 1 Point	Score
Required Content	The chart includes all required content elements as well as additional information.	All required content elements are included on the chart.	All but 1–2 of the required content elements are included on the chart.	Three or more required content elements were missing.	
Labels	All items of importance on the chart are clearly labeled with labels that are easy to read.	Almost all items of importance on the chart are clearly labeled with labels that are easy to read.	Many items of importance on the chart are clearly labeled with labels that are easy to read.	Labels are too small to read, or no important items were labeled.	
Attractiveness	The chart is exceptionally attractive in terms of design, layout, and neatness.	The chart is attractive in terms of design, layout, and neatness.	The chart is acceptably attractive though it may be a bit messy.	The chart is distractingly messy or very poorly designed.	
Grammar	There are no grammatical or mechanical mistakes on the chart.	There are one to two grammatical or mechanical mistakes on the chart.	There are three to four grammatical or mechanical mistakes on the chart.	There are more than four grammatical or mechanical mistakes on the chart.	
TOTAL					

Name: _____

Date: _____

Period: _____

Engine Dissection, Inspection, and Reassembly Checklist (5.1)

Place a check by each step that the student completed satisfactorily.

Engine Disassembly

- _____ 1. Removed flywheel shroud, side shroud, and cylinder shroud
- _____ 2. Removed muffler, air vane, and fuel system (carburetor and fuel tank)
- _____ 3. Removed valve spring cover
- _____ 4. Removed spark plug
- _____ 5. Removed cylinder head
- _____ 6. Removed crankcase cover
- _____ 7. Removed camshaft and tappets
- _____ 8. Removed valves
- _____ 9. Removed flywheel
- _____ 10. Remove crankshaft, connecting rod and piston
- _____ 11. Inspected piston, connecting rod, and crankshaft for excessive wear

Engine Inspection

(Measure each part as specified, and compare it to the manufacturer's tolerance. Indicate if the part is still acceptable for use or if it needs to be replaced.)

Part Measurement	Manufacturer's Recommended Tolerance	Observed Measurement	Accept or Replace
Spark plug gap			
Armature air gap			
Piston diameter			
Cylinder diameter			
Crankshaft diameter			

- _____ 1. Inspected gaskets and seals for wear or leakage
- _____ 2. Inspected electrical system for cracked wiring, loose terminals, etc.
- _____ 3. Inspected muffler and exhaust system for wear

Engine Reassembly

- _____ 1. Replaced piston, connecting rod, and crankshaft
- _____ 2. Replaced valves, tappets, and camshaft
- _____ 3. Replaced crankcase cover
- _____ 4. Replaced cylinder head
- _____ 5. Replaced spark plug
- _____ 6. Replaced valve spring cover
- _____ 7. Replaced muffler, air vane, and fuel system
- _____ 8. Replaced shrouds

Engine Testing

- _____ 1. Tested engine compression
- _____ 2. Tested engine spark

General Skills

- _____ 1. Practiced general workplace skills (teamwork, responsibility, etc.)
- _____ 2. Consistently selected and used proper tools in a proper manner
- _____ 3. Consistently followed all safety practices and procedures

Name: _____

Date: _____

Period: _____

Weld Joint Construction Rubric (6.1)

Rate the student's ability to perform the following welding procedures using the following scale:

- 4 – Can perform consistently and accurately without need of any supervision or direction
- 3 – Can perform consistently and accurately with minimum supervision or direction
- 2 – Can perform consistently and accurately with moderate supervision or direction
- 1 – Cannot perform consistently or accurately without direct supervision

Striking an Arc and Running a Flat Bead

- _____ 1. Student used proper safety equipment and followed proper safety procedures.
- _____ 2. Student prepared metal for welding and set up equipment correctly (amperage, polarity, grounding, etc.).
- _____ 3. Student struck an arc and held it until puddle formed.
- _____ 4. Student maintained correct electrode angle, arc length, and speed of travel.
- _____ 5. Student ran a 1–2-in. flat bead that showed evidence of uniform width and proper penetration.
- _____ 6. Student filled in the crater at the end of the bead before breaking the arc.

Constructing a Flat Butt Weld

- _____ 1. Student used proper safety equipment and followed proper safety procedures.
- _____ 2. Student prepared metal for welding and set up equipment correctly (amperage, polarity, grounding, etc.).
- _____ 3. Student positioned metal pieces at proper distance to each other and tacked both ends.
- _____ 4. Student maintained correct electrode angle, arc length, and speed of travel in making the weld.
- _____ 5. Student cleaned weld by chipping slag and using a wire brush.
- _____ 6. Weld showed evidence of uniform width and proper penetration.

Constructing a Flat Fillet Weld

- _____ 1. Student used proper safety equipment and followed proper safety procedures.
- _____ 2. Student prepared metal for welding and set up equipment correctly (amperage, polarity, grounding, etc.).
- _____ 3. Student positioned metal pieces at proper distance to each other and tacked both ends.
- _____ 4. Student maintained correct electrode angle, arc length, and speed of travel in making the weld.
- _____ 5. Student cleaned weld by chipping slag and using a wire brush.
- _____ 6. Weld showed evidence of uniform width and proper penetration.

Name: _____

Date: _____

Period: _____

Oxyacetylene Cutting Operations Checklist (7.1)

Rate the student's ability to perform the following welding procedures using the following scale:

- 4 – Can perform consistently and accurately without need of any supervision or direction
- 3 – Can perform consistently and accurately with minimum supervision or direction
- 2 – Can perform consistently and accurately with moderate supervision or direction
- 1 – Cannot perform consistently or accurately without direct supervision

Set up an Oxyacetylene Cutting Torch

- _____ 1. Student used proper safety equipment and followed proper safety procedures.
- _____ 2. Student checked oxygen and acetylene torch valves to make sure they were closed.
- _____ 3. Student checked oxygen and acetylene regulator adjusting screws to make sure that regulators were not engaged.
- _____ 4. Student opened oxygen cylinder valve slowly until pressure was indicated on regulator, then all the way open.
- _____ 5. Student opened acetylene cylinder valve one-half turn.
- _____ 6. Student opened oxygen and acetylene torch valves one-eighth turn.
- _____ 7. Student set oxygen regulator to appropriate pressure for metal to be cut and tip size.
- _____ 8. Student set acetylene regulator to appropriate pressure for metal to be cut and tip size.
- _____ 9. Student closed the oxygen and acetylene torch valves.
- _____ 10. Student checked all fittings and hoses for visible leaks.

Ignite an Oxyacetylene Torch

- _____ 1. Student used proper safety equipment and followed proper safety procedures.
- _____ 2. Student opened acetylene torch valve one-eighth turn.
- _____ 3. Student held torch away from his or her body and any flammable materials and used a spark igniter to light the acetylene.
- _____ 4. Student opened acetylene torch valve until flame was ¼ in. off the torch tip.
- _____ 5. Student opened the oxygen torch valve until a neutral flame was obtained.

Cutting Mild Steel

- _____ 1. Student used proper safety equipment and followed proper safety procedures.
- _____ 2. Student prepared metal for cutting including making sure that slag from the cut would not ignite any flammable materials.
- _____ 3. Student checked torch flame while holding down the oxygen preheat lever and made adjustments as necessary.
- _____ 4. Student held the torch over the edge of the metal to be cut at a slight angle away from the direction of the cut until the edge of the metal became cherry red.

- _____ 5. Student pressed the oxygen lever and moved the torch at an appropriate speed and angle to make the cut.
- _____ 6. Student examined the cut and made adjustments to procedure before proceeding to next cut.

Shutting Down an Oxyacetylene Torch

- _____ 1. Student closed the acetylene torch valve first, then the oxygen torch valve to extinguish the flame.
- _____ 2. Student closed acetylene and oxygen tank valves completely.
- _____ 3. Student opened oxygen and acetylene torch valves to bleed existing gases from the regulators, hoses, and torch body.
- _____ 4. Student closed oxygen and acetylene torch valves.
- _____ 5. Student unscrewed oxygen and acetylene regulator screws until no pressure or resistance was felt on the screw.
- _____ 6. Student coiled hoses and stored all equipment and accessories in assigned location.

Appendix B: 21st Century Skills Standards¹

Today's life and work environments require far more than thinking skills and content knowledge. The ability to navigate the complex life and work environments in the globally competitive information age requires students to pay rigorous attention to developing adequate life and career skills.

CSS1-21st Century Themes

CS1 Global Awareness

1. Using 21st century skills to understand and address global issues
2. Learning from and working collaboratively with individuals representing diverse cultures, religions and lifestyles in a spirit of mutual respect and open dialogue in personal, work and community contexts
3. Understanding other nations and cultures, including the use of non-English languages

CS2 Financial, Economic, Business and Entrepreneurial Literacy

1. Knowing how to make appropriate personal economic choices
2. Understanding the role of the economy in society
3. Using entrepreneurial skills to enhance workplace productivity and career options

CS3 Civic Literacy

1. Participating effectively in civic life through knowing how to stay informed and understanding governmental processes
2. Exercising the rights and obligations of citizenship at local, state, national and global levels
3. Understanding the local and global implications of civic decisions

CS4 Health Literacy

1. Obtaining, interpreting and understanding basic health information and services and using such information and services in ways that enhance health
2. Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance and stress reduction
3. Using available information to make appropriate health-related decisions
4. Establishing and monitoring personal and family health goals
5. Understanding national and international public health and safety issues

CS5 Environmental Literacy

1. Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water and ecosystems
2. Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.)
3. Investigate and analyze environmental issues, and make accurate conclusions about effective solutions
4. Take individual and collective action towards addressing environmental challenges (e.g., participating in global actions, designing solutions that inspire action on environmental issues)

CSS2-Learning and Innovation Skills

CS6 Creativity and Innovation

1. Think Creatively
2. Work Creatively with Others
3. Implement Innovations

CS7 Critical Thinking and Problem Solving

1. Reason Effectively

¹21st century skills. (n.d.). Washington, DC: Partnership for 21st Century Skills.

2. Use Systems Thinking
3. Make Judgments and Decisions
4. Solve Problems

CS8 Communication and Collaboration

1. Communicate Clearly
2. Collaborate with Others

CSS3-Information, Media and Technology Skills

CS9 Information Literacy

1. Access and Evaluate Information
2. Use and Manage Information

CS10 Media Literacy

1. Analyze Media
2. Create Media Products

CS11 ICT Literacy

1. Apply Technology Effectively

CSS4-Life and Career Skills

CS12 Flexibility and Adaptability

1. Adapt to change
2. Be Flexible

CS13 Initiative and Self-Direction

1. Manage Goals and Time
2. Work Independently
3. Be Self-directed Learners

CS14 Social and Cross-Cultural Skills

1. Interact Effectively with others
2. Work Effectively in Diverse Teams

CS15 Productivity and Accountability

1. Manage Projects
2. Produce Results

CS16 Leadership and Responsibility

1. Guide and Lead Others
2. Be Responsible to Others

Appendix C: MS Academic Standards

MISSISSIPPI SCIENCE FRAMEWORK 2010

Marine and Aquatic Science

- AQ 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- AQ 2 Develop an understanding of physical and chemical properties of water and aquatic environments.
- AQ 3 Apply an understanding of the diverse organisms found in aquatic environments.
- AQ 4 Draw conclusions about the relationships between human activity and aquatic organisms.
- 1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
- Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
 - Formulate questions that can be answered through research and experimental design. (DOK 3)
 - Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
 - Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
 - Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
 - Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
- 2. Develop an understanding of physical and chemical properties of water and aquatic environments.**
- Analyze the physical and chemical properties of water, and justify why it is essential to living organisms. (DOK 1)
 - Explain the causes and characteristics of tides. (DOK 1)
 - Research, create diagrams, and summarize principles related to waves and current characteristics and formation. (DOK 2)
 - Compare and contrast the physical and chemical parameters of dissolved O₂, pH, temperature, salinity, and results obtained through analysis of different water column depths/zones. (DOK 2)
 - Investigate the causes and effects of erosion and discuss conclusions. (DOK 2)
 - Describe and differentiate among the major geologic features of specific aquatic environments. (DOK 1)
 - Plate tectonics
 - Rise, slope, elevation, and depth
 - Formation of dunes, reefs, barrier/volcanic islands, and coastal/flood plains
 - Watershed formation as it relates to bodies of freshwater
 - Compare and contrast the unique abiotic and biotic characteristics of selected aquatic ecosystems. (DOK 2)
 - Barrier island, coral reef, tidal pool, and ocean
 - River, stream, lake, pond, and swamp
 - Bay, sound, estuary, and marsh
- 3. Apply an understanding of the diverse organisms found in aquatic environments.**
- Analyze and explain the diversity and interactions among aquatic life. (DOK 3)
 - Adaptations of representative organisms for their aquatic environments

- Relationship of organisms in food chains/webs within aquatic environments
- b. Research, calculate, and interpret population data. (DOK 2)
- c. Research and compare reproductive processes in aquatic organisms. (DOK 2)
- d. Differentiate among characteristics of planktonic, nektonic, and benthic organisms. (DOK 1)
- e. Explore the taxonomy of aquatic organisms, and use dichotomous keys to differentiate among the organisms. (DOK 2)
- f. Research and explain the symbiotic relationships in aquatic ecosystems. (DOK 3)
- 4. **Draw conclusions about the relationships between human activity and aquatic organisms.**
 - a. Describe the impact of natural and human activity on aquatic ecosystems, and evaluate the effectiveness of various solutions to environmental problems. (DOK 3)
 - Sources of pollution in aquatic environments and methods to reduce the effects of the pollution
 - Effectiveness of a variety of methods of environmental management and stewardship
 - Effects of urbanization on aquatic ecosystems and the effects of continued expansion
 - b. Research and cite evidence of the effects of natural phenomena such as hurricanes, floods, or drought on aquatic habitats and organisms. (DOK 3)
 - c. Discuss the advantages and disadvantages involved in applications of modern technology in aquatic science. (DOK 2)
 - Careers related to aquatic science
 - Modern technology within aquatic science (e.g., mariculture and aquaculture)
 - Contributions of aquatic technology to industry and government

Biology I

BI01 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BI01 2	Describe the biochemical basis of life, and explain how energy flows within and between the living systems.
BI01 3	Investigate and evaluate the interaction between living organisms and their environment.
BI01 4	Analyze and explain the structures and function of the levels of biological organization.
BI01 5	Demonstrate an understanding of the molecular basis of heredity.
BI01 6	Demonstrate an understanding of principles that explain the diversity of life and biological evolution.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
 - a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
 - d. Formulate questions that can be answered through research and experimental design. (DOK 3)
 - e. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 2)
 - f. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
 - g. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - h. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
 - i. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. Describe the biochemical basis of life, and explain how energy flows within and between the living systems.

- a. Explain and compare with the use of examples the types of bond formation (e.g., covalent, ionic, hydrogen, etc.) between or among atoms. (DOK 2)
 - Subatomic particles and arrangement in atoms
 - Importance of ions in biological processes
- b. Develop a logical argument defending water as an essential component of living systems (e.g., unique bonding and properties including polarity, high specific heat, surface tension, hydrogen bonding, adhesion, cohesion, and expansion upon freezing). (DOK 2)
- c. Classify solutions as acidic, basic, or neutral, and relate the significance of the pH scale to an organism's survival (e.g., consequences of having different concentrations of hydrogen and hydroxide ions). (DOK 2)
- d. Compare and contrast the structure, properties, and principle functions of carbohydrates, lipids, proteins, and nucleic acids in living organisms. (DOK 2)
 - Basic chemical composition of each group
 - Building components of each group (e.g., amino acids, monosaccharides, nucleotides, etc.)
 - Basic functions (e.g., energy, storage, cellular, heredity) of each group
- e. Examine the life processes to conclude the role enzymes play in regulating biochemical reactions. (DOK 2)
 - Enzyme structure
 - Enzyme function, including enzyme-substrate specificity and factors that affect enzyme function (pH and temperature)
- f. Describe the role of adenosine triphosphate (ATP) in making energy available to cells. (DOK 1)
 - ATP structure
 - ATP function
- g. Analyze and explain the biochemical process of photosynthesis and cellular respiration, and draw conclusions about the roles of the reactant and products in each. (DOK 3)
 - Photosynthesis and respiration (reactants and products)
 - Light-dependent reactions and light independent reactions in photosynthesis, including requirements and products of each
 - Aerobic and anaerobic processes in cellular respiration, including products each and energy differences

3. Investigate and evaluate the interaction between living organisms and their environment.

- a. Compare and contrast the characteristics of the world's major biomes (e.g., deserts, tundra, taiga, grassland, temperate forest, tropical rainforest). (DOK 2)
 - Plant and animal species
 - Climate (temperature and rainfall)
 - Adaptations of organisms
- b. Provide examples to justify the interdependence among environmental elements. (DOK 2)
 - Biotic and abiotic factors in an ecosystem (e.g., water, carbon, oxygen, mold, leaves)
 - Energy flow in ecosystems (e.g., energy pyramids and photosynthetic organisms to herbivores, carnivores, and decomposers)
 - Roles of beneficial bacteria
 - Interrelationships of organisms (e.g., cooperation, predation, parasitism, commensalism, symbiosis, and mutualism)
- c. Examine and evaluate the significance of natural events and human activities on major ecosystems (e.g., succession, population growth, technology, loss of genetic diversity, consumption of resources). (DOK 2)

4. Analyze and explain the structures and function of the levels of biological organization.

- a. Differentiate among plant and animal cells and eukaryotic and prokaryotic cells. (DOK 2)
 - Functions of all major cell organelles and structures (e.g., nucleus, mitochondrion, rough ER, smooth ER, ribosomes, Golgi bodies, vesicles, lysosomes, vacuoles, microtubules,

- microfilaments, chloroplast, cytoskeleton, centrioles, nucleolus, chromosomes, nuclear membrane, cell wall, cell membrane [active and passive transport], cytosol)
- Components of mobility (e.g., cilia, flagella, pseudopodia)
- b. Differentiate between types of cellular reproduction. (DOK 1)
 - Main events in the cell cycle and cell mitosis (including differences in plant and animal cell divisions)
 - Binary fission (e.g., budding, vegetative propagation, etc.)
 - Significance of meiosis in sexual reproduction
 - Significance of crossing over
- c. Describe and differentiate among the organizational levels of organisms (e.g., cells, tissues, organs, systems, types of tissues.) (DOK 1)
- d. Explain and describe how plant structures (vascular and nonvascular) and cellular functions are related to the survival of plants (e.g., movement of materials, plant reproduction). (DOK 1)
- 5. **Demonstrate an understanding of the molecular basis of heredity.**
 - a. Analyze and explain the molecular basis of heredity and the inheritance of traits to successive generations by using the Central Dogma of Molecular Biology. (DOK 3)
 - Structures of DNA and RNA
 - Processes of replication, transcription, and translation
 - Messenger RNA codon charts
 - b. Utilize Mendel's laws to evaluate the results of monohybrid Punnett squares involving complete dominance, incomplete dominance, codominance, sex linked, and multiple alleles (including outcome percentage of both genotypes and phenotypes.) (DOK 2)
 - c. Examine inheritance patterns using current technology (e.g., pedigrees, karyotypes, gel electrophoresis). (DOK 2)
 - d. Discuss the characteristics and implications of both chromosomal and gene mutations. (DOK 2)
 - Significance of nondisjunction, deletion, substitutions, translocation, frame shift mutation in animals
 - Occurrence and significance of genetic disorders such as sickle cell anemia, Tay-Sachs disorder, cystic fibrosis, hemophilia, Down syndrome, color blindness
- 6. **Demonstrate an understanding of principles that explain the diversity of life and biological evolution.**
 - a. Draw conclusions about how organisms are classified into a hierarchy of groups and subgroups based on similarities that reflect their evolutionary relationships. (DOK 2)
 - Characteristics of the six kingdoms
 - Major levels in the hierarchy of taxa (e.g., kingdom, phylum/division, class, order, family, genus, and species)
 - Body plans (symmetry)
 - Methods of sexual reproduction (e.g., conjugation, fertilization, pollination)
 - Methods of asexual reproduction (e.g., budding, binary fission, regeneration, spore formation)
 - b. Critique data (e.g., comparative anatomy, Biogeography, molecular biology, fossil record, etc.) used by scientists (e.g., Redi, Needham, Spallanzani, Pasteur) to develop an understanding of evolutionary processes and patterns. (DOK 3)
 - c. Research and summarize the contributions of scientists (including Darwin, Malthus, Wallace, Lamarck, and Lyell) whose work led to the development of the theory of evolution. (DOK 2)
 - d. Analyze and explain the roles of natural selection, including the mechanisms of speciation (e.g., mutations, adaptations, geographic isolation) and applications of speciation (e.g., pesticide and antibiotic resistance). (DOK 3)
 - e. Differentiate among chemical evolution, organic evolution, and the evolutionary steps along the way to aerobic heterotrophs and photosynthetic autotrophs. (DOK 2)

Biology II

BIOII 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BIOII 2	Describe and contrast the structures, functions, and chemical processes of the cell.
BIOII 3	Investigate and discuss the molecular basis of heredity.
BIOII 4	Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.
BIOII 5	Develop an understanding of organism classification.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- Use current technologies such as CD-ROM, DVD, Internet, and on-line data search to explore current research related to a specific topic. (DOK 3)
- Clarify research questions and design laboratory investigations. (DOK 3)
- Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
- Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. Describe and contrast the structures, functions, and chemical processes of the cell.

- Relate the structure and function of a selectively permeable membrane to its role in diffusion and osmosis. (DOK 2)
- Summarize how cell regulation controls and coordinates cell growth and division. (DOK 2)
- Analyze and describe the function of enzymes in biochemical reactions. (DOK 2)
 - The impact of enzymatic reactions on biochemical processes
 - Factors that affect enzyme function (e.g., pH, concentration, temperature, etc.)
- Differentiate between photosynthesis and cellular respiration. (DOK 2)
 - Cellular sites and major pathways of anaerobic and aerobic respiration (with reactants, products, and ATP per monosaccharide)
 - Cellular respiration with respect to the sites at which they take place, the reactions involved, and the energy input and output in each stage (e.g., glycolysis, Krebs cycle, electron transport chain)
 - Pigments, absorption, reflection of light, and light-dependent and light-independent reactions of photosynthesis
 - Oxidation and reduction reactions

3. Investigate and discuss the molecular basis of heredity.

- Explain how the process of meiosis clarifies the mechanism underlying Mendel's conclusions about segregation and independent assortment on a molecular level. (DOK 1)
- Research and explain how major discoveries led to the determination of DNA structure. (DOK 2)
- Relate gene expression (e.g., replication, transcription, translation) to protein structure and function. (DOK 2)
 - Translation of a messenger RNA strand into a protein
 - Processing by organelles so that the protein is appropriately packaged, labeled, and eventually exported by the cell
 - Messenger RNA codon charts to determine the effects of different types of mutations on amino acid sequence and protein structure (e.g., sickle cell anemia resulting from base substitution mutation)
 - Gene expression regulated in organisms so that specific proteins are synthesized only when they are needed by the cell (e.g., allowing cell specialization)
- Assess the potential implications of DNA technology with respect to its impact on society. (DOK 3)

- Modern DNA technologies (e.g., polymerase chain reaction (PCR), gene splicing, gel electrophoresis, transformation, recombinant DNA) in agriculture, medicine, and forensics
- e. Develop a logical argument defending or refuting bioethical issues arising from applications of genetic technology (e.g., the human genome project, cloning, gene therapy, stem cell research). (DOK 3)
- 4. **Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.**
 - a. Explain the history of life on earth, and infer how geological changes provide opportunities and constraints for biological evolution. (DOK 2)
 - Main periods of the geologic timetable of earth's history
 - Roles of catastrophic and gradualistic processes in shaping planet Earth
 - b. Provide support for the argument based upon evidence from anatomy, embryology, biochemistry, and paleontology that organisms descended with modification from common ancestry. (DOK 2)
 - c. Identify and provide supporting evidence for the evolutionary relationships among various organisms using phylogenetic trees and cladograms. (DOK 2)
 - d. Formulate a scientific explanation based on fossil records of ancient life-forms, and describe how new species could originate as a result of geological isolation and reproductive isolation. (DOK 2)
 - e. Compare and contrast the basic types of selection (e.g., disruptive, stabilizing, directional, etc.). (DOK 2)
 - f. Cite examples to justify behaviors that have evolved through natural selection (e.g., migration, parental care, use of tools, etc.). (DOK 1)
 - g. Research and explain the contributions of 19th century scientists (e.g., Malthus, Wallace, Lyell, and Darwin) on the formulation of ideas about evolution. (DOK 2)
 - h. Develop a logical argument describing ways in which the influences of 20th century science have impacted the development of ideas about evolution (e.g., synthetic theory of evolution, molecular biology). (DOK 3)
 - i. Analyze changes in an ecosystem resulting from natural causes (succession), changes in climate, human activity (pollution and recycling), or introduction of nonnative species. (DOK 2)
- 5. **Develop an understanding of organism classification.**
 - a. Classify organisms according to traditional Linnaean classification characteristics (e.g., cell structure, biochemistry, anatomy, fossil record, methods of reproduction) and the cladistic approach. (DOK 2)
 - b. Categorize organisms according to the characteristics that distinguish them as Bacteria, Archaea, or Eucarya. (DOK 1)
 - Bacteria, fungi, and protists
 - Characteristics of invertebrates (e.g., habitat, reproduction, body plan, locomotion) as related to phyla (e.g., Porifera, Cnidarians, Nematoda, Annelida, Platyhelminthes, and Arthropoda) and classes (e.g., Insecta, Crustacea, Arachnida, Mollusca, Echinodermata)
 - Characteristics of vertebrates (e.g., habitat, reproduction, body plan, locomotion) as related to classes (e.g., Agnatha, Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, Mammalia)
 - Nomenclature of various types of plants (e.g., Bryophyta, Tracheophyta, Gymnospermae, Angiospermae, Monocotyledonae, Dicotyledonae, vascular plants, nonvascular plants)

Botany

BO 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BO 2	Distinguish among the characteristics of botanical organization, structure, and function.
BO 3	Demonstrate an understanding of plant reproduction.
BO 4	Draw conclusions about the factors that affect the adaptation and survival of plants.
BO 5	Relate an understanding of plant genetics to its uses in modern living.

- 1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
 - a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols

- Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
 - b. Formulate questions that can be answered through research and experimental design. (DOK 3)
 - c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
 - d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
 - e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
 - g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
2. **Distinguish among the characteristics of botanical organization, structure, and function.**
- a. Relate plant cell structures to their functions (e.g., major organelles, cell wall components, photosynthetic chemical reactions, plant pigments, plant tissues, roots, stems, leaves, flowers). (DOK 1)
 - b. Differentiate the characteristics found in various plant divisions. (DOK 2)
 - Differences and similarities of nonvascular plants
 - Characteristics of seed-bearing and non-seed bearing vascular plants relative to taxonomy
 - Major vegetative structures and their modifications in angiosperms and gymnosperms
 - c. Compare and contrast leaf modifications of gymnosperms and angiosperms (e.g., needles, overlapping scales, simple leaves, compound leaves, evergreen trees, and deciduous trees). (DOK 2)
 - d. Apply the modern classification scheme utilized in naming plants to identify plant specimens. (DOK 2)
 - Classification scheme used in botany
 - Classification of native Mississippi plants
 - e. Use inquiry to investigate and discuss the physical and chemical processes of plants. (DOK 3)
 - Relationships among photosynthesis, cellular respiration, and translocation
 - Importance of soil type and soil profiles to plant survival
 - Mechanism of water movement in plants
 - Effects of environmental conditions for plant survival
 - Tropic responses of a plant organ to a given stimulus
3. **Demonstrate an understanding of plant reproduction.**
- a. Compare and contrast reproductive structures (e.g., cones, flowers). (DOK 2)
 - b. Differentiate among the vegetative organs of monocots, herbaceous dicots, and woody dicots. (DOK 1)
 - c. Differentiate between the structures and processes of sexual and asexual reproduction in plants. (DOK 1)
 - Reproductive structures, their modifications, and the mechanisms involved in plant reproduction
 - Functions of flower parts, seeds, cones
 - Spore production in bryophytes and ferns
 - d. Explain and provide examples of the concept of alternation of generations and its examples. (DOK 2)
 - e. Categorize types of fruits and methods of seed distribution in plants. (DOK 1)
 - f. Research and compare various methods of plant propagation. (DOK 2)
4. **Draw conclusions about the factors that affect the adaptation and survival of plants.**
- a. List and assess several adaptations of plants to survive in a given biome. (DOK 2)
 - b. Design and conduct an experiment to determine the effects of environmental factors on photosynthesis. (DOK 3)
 - c. Explain how natural selection and the evolutionary consequences (e.g., adaptation or extinction) support scientific explanations for similarities of ancient life-forms in the fossil record and molecular similarities present in living organisms. (DOK 2)
 - d. Research factors that might influence or alter plant stability, and propose actions that may reduce the negative impacts of human activity. (DOK 2)
5. **Relate an understanding of plant genetics to its uses in modern living.**
- a. Research, prepare, and present a position relating to issues surrounding the current botanical trends involving biotechnology. (DOK 3)

- b. Apply an understanding of the principles of plant genetics to analyze monohybrid and dihybrid crosses, and predict the potential effects the crosses might have on agronomy and agriculture. (DOK 3)
- c. Discuss the effects of genetic engineering of plants on society. (DOK 2)
- d. Describe the chemical compounds extracted from plants, their economical importance, and the impact on humans. (DOK 3)
 - Plant extracts, their function, and origin
 - Impact of the timber industry on local and national economy

Chemistry I

- CHI 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- CHI 2 Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.
- CHI 3 Develop an understanding of the periodic table.
- CHI 4. Analyze the relationship between microscopic and macroscopic models of matter.
- CHI 5 Compare factors associated with acid/base and oxidation/reduction reactions.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
- b. Clarify research questions and design laboratory investigations. (DOK 3)
- c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
- e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.

- a. Describe and classify matter based on physical and chemical properties and interactions between molecules or atoms. (DOK 1)
 - Physical properties (e.g., melting points, densities, boiling points) of a variety of substances
 - Substances and mixtures
 - Three states of matter in terms of internal energy, molecular motion, and the phase transitions between them
- b. Research and explain crucial contributions and critical experiments of Dalton, Thomson, Rutherford, Bohr, de Broglie, and Schrödinger, and describe how each discovery contributed to the current model of atomic and nuclear structure. (DOK 2)
- c. Develop a model of atomic and nuclear structure based on theory and knowledge of fundamental particles. (DOK 2)
 - Properties and interactions of the three fundamental particles of the atom
 - Laws of conservation of mass, constant composition, definite proportions, and multiple proportions
- d. Write appropriate equations for nuclear decay reactions, describe how the nucleus changes during these reactions, and compare the resulting radiation with regard to penetrating ability. (DOK 1)
 - Three major types of radioactive decay (e.g., alpha, beta, gamma) and the properties of the emissions (e.g., composition, mass, charge, penetrating power)
 - The concept of half-life for a radioactive isotope (e.g., carbon-14 dating) based on the principle that the decay of any individual atom is a random process

- e. Compare the properties of compounds according to their type of bonding. (DOK 1)
 - Covalent, ionic, and metallic bonding
 - Polar and nonpolar covalent bonding
 - Valence electrons and bonding atoms
- f. Compare different types of intermolecular forces, and explain the relationship between intermolecular forces, boiling points, and vapor pressure when comparing differences in properties of pure substances. (DOK 1)
- g. Develop a three-dimensional model of molecular structure. (DOK 2)
 - Lewis dot structures for simple molecules and ionic compounds
 - Valence shell electron pair repulsion theory (VSEPR)

3. Develop an understanding of the periodic table.

- a. Calculate the number of protons, neutrons, and electrons in individual isotopes using atomic numbers and mass numbers, write electron configurations of elements and ions following the Aufbau principle, and balance equations representing nuclear reactions. (DOK 1)
- b. Analyze patterns and trends in the organization of elements in the periodic table, and compare their relationship to position in the periodic table. (DOK 2)
 - Atomic number, atomic mass, mass number, and number of protons, electrons, and neutrons in isotopes of elements
 - Average atomic mass calculations
 - Chemical characteristics of each region
 - Periodic properties (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius)
- c. Classify chemical reactions by type. (DOK 2)
 - Single displacement, double displacement, synthesis (combination), decomposition, disproportionation, combustion, or precipitation
 - Products (given reactants) or reactants (given products) for each reaction type
 - Solubility rules for precipitation reactions and the activity series for single and double displacement reactions
- d. Use stoichiometry to calculate the amount of reactants consumed and products formed. (DOK 3)
 - Difference between chemical reactions and chemical equations
 - Formulas and calculations of the molecular (molar) masses
 - Empirical formula given the percent composition of elements
 - Molecular formula given the empirical formula and molar mass

4. Analyze the relationship between microscopic and macroscopic models of matter.

- a. Calculate the number of protons, neutrons, and electrons in individual isotopes using atomic numbers and mass numbers, write electron configurations of elements and ions following the Aufbau principle, and balance equations representing nuclear reactions. (DOK 1)
- b. Analyze patterns and trends in the organization of elements in the periodic table, and compare their relationship to position in the periodic table. (DOK 2)
 - Atomic number, atomic mass, mass number, and number of protons, electrons, and neutrons in isotopes of elements
 - Average atomic mass calculations
 - Chemical characteristics of each region
 - Periodic properties (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius)
- c. Classify chemical reactions by type. (DOK 2)
 - Single displacement, double displacement, synthesis (combination), decomposition, disproportionation, combustion, or precipitation
 - Products (given reactants) or reactants (given products) for each reaction type
 - Solubility rules for precipitation reactions and the activity series for single and double displacement reactions
- d. Use stoichiometry to calculate the amount of reactants consumed and products formed. (DOK 3)

- Difference between chemical reactions and chemical equations
 - Formulas and calculations of the molecular (molar) masses
 - Empirical formula given the percent composition of elements
 - Molecular formula given the empirical formula and molar mass
5. **Compare factors associated with acid/base and oxidation/reduction reactions.**
- a. Analyze and explain acid/base reactions. (DOK 2)
 - Properties of acids and bases, including how they affect indicators and the relative pH of the solution
 - Formation of acidic and basic solutions
 - Definition of pH in terms of the hydronium ion concentration and the hydroxide ion concentration
 - The pH or pOH from the hydrogen ion or hydroxide ion concentrations of solution
 - How a buffer works and examples of buffer solutions
 - b. Classify species in aqueous solutions according to the Arrhenius and Bronsted-Lowry definitions respectively, and predict products for aqueous neutralization reactions. (DOK 2)
 - c. Analyze a reduction/oxidation reaction (REDOX) to assign oxidation numbers (states) to reaction species, and identify the species oxidized and reduced, the oxidizing agent, and reducing agent. (DOK 2)

Organic Chemistry

- ORGC 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ORGC 2 Demonstrate an understanding of the properties, structure, and function of organic compounds.
- ORGC 3 Discuss the versatility of polymers and the diverse application of organic chemicals.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
 - b. Formulate questions that can be answered through research and experimental design. (DOK 3)
 - c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
 - d. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
 - e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - f. Recognize and analyze alternative explanations for experimental results, and make predictions based on observations and prior knowledge. (DOK 3)
 - g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
2. **Demonstrate an understanding of the properties, structure, and function of organic compounds.**
- a. Apply International Union of Pure and Applied Chemistry (IUPAC) nomenclature, and differentiate the structure of aliphatic, aromatic, and cyclic hydrocarbon compounds. (DOK 1)
 - Structures of hydrocarbon compounds
 - Isomerism in hydrocarbon compounds
 - b. Relate structure to physical and chemical properties of hydrocarbon. (DOK 1)
 - c. Apply principles of geometry and hybridization to organic molecules. (DOK 2)
 - Lewis structures for organic molecules
 - Bond angles
 - Hybridization (as it applies to organic molecules)
 - d. Write, complete, and classify common reactions for aliphatic, aromatic, and cyclic hydrocarbons. (DOK 1)
 - e. Construct, solve, and explain equations representing combustion reactions, substitution reactions, dehydrogenation reactions, and addition reactions. (DOK 2)

- f. Classify functional groups (e.g., alcohols, ethers, aldehydes, ketones, carboxylic acids, esters, amines, amides, and nitriles) by their structure and properties. (DOK 2)
 - Structural formulas from functional group names and vice versa
 - Chemical and physical properties of compounds containing functional groups
 - Equations representing the transformation of one functional group into another
- 3. **Discuss the versatility of polymers and the diverse application of organic chemicals.**
 - a. Describe and classify the synthesis, properties, and uses of polymers. (DOK 2)
 - Common polymers
 - Synthesis of polymers from monomers by addition or condensation
 - Condensations of plastics according to their commercial types
 - Elasticity and other polymer properties
 - b. Develop a logical argument supporting the use of organic chemicals and their application in industry, drug manufacture, and biological chemistry. (DOK 1)
 - Common uses of polymers and organic compounds in medicine, drugs, and personal care products
 - Compounds that have the property to dye materials
 - Petrochemical production
 - Biologically active compounds in terms of functional group substrate interaction
 - c. Research and summarize the diversity, applications, and economics of industrial chemicals (solvents, coatings, surfactants, etc.). (DOK 3)

Earth and Space Science

- E1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- E2 Develop an understanding of the history and evolution of the universe and earth.
- E3 Discuss factors that are used to explain the geological history of earth.
- E4 Demonstrate an understanding of earth systems relating to weather and climate.
- E5 Apply an understanding of ecological factors to explain relationships between earth systems.

- 1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
 - a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers.
 - b. Formulate questions that can be answered through research and experimental design. (DOK 3)
 - c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
 - d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
 - e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
 - g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
- 2. **Develop an understanding of the history and evolution of the universe and earth.**
 - a. Summarize the origin and evolution of the universe. (DOK 2)
 - Big bang theory
 - Microwave background radiation
 - The Hubble constant
 - Evidence of the existence of dark matter and dark energy in the universe and the history of the universe

- b. Differentiate methods used to measure space distances, including astronomical unit, light-year, stellar parallax, Cepheid variables, and the red shift. (DOK 1)
 - c. Interpret how gravitational attraction played a role in the formation of the planetary bodies and how the fusion of hydrogen and other processes in “ordinary” stars and supernovae lead to the formation of all other elements. (DOK 2)
 - d. Summarize the early evolution of the earth, including the formation of Earth’s solid layers (e.g., core, mantle, and crust), the distribution of major elements, the origin of internal heat sources, and the initiation of plate tectonics. (DOK 2)
 - How the decay of radioactive isotopes is used to determine the age of rocks, earth, and the solar system
 - How Earth acquired its initial oceans and atmosphere
- 3. Discuss factors which are used to explain the geological history of earth.**
- a. Develop an understanding of how plate tectonics create certain geological features, materials, and hazards. (DOK 1)
 - Plate tectonic boundaries (e.g., divergent, convergent, and transform)
 - Modern and ancient geological features to each kind of plate tectonic boundary
 - Production of particular groups of igneous and metamorphic rocks and mineral resources
 - Sedimentary basins created and destroyed through time
 - b. Compare and contrast types of mineral deposits/groups (e.g., oxides, carbonates, halides, sulfides, sulfates, silicates, phosphates). (DOK 2)
 - c. Categorize minerals and rocks by determining their physical and/or chemical characteristics. (DOK 2)
 - d. Justify the causes of certain geological hazards (e.g., earthquakes, volcanoes, tsunamis) to their effects on specific plate tectonic locations. (DOK 2)
 - e. Interpret and explain how rock relationships and fossils are used to reconstruct the geologic history of the earth. (DOK 2)
 - f. Apply principles of relative age (e.g., superposition, original horizontality, crosscutting relations, and original lateral continuity) to support an opinion related to earth’s geological history. (DOK 3)
 - Types of unconformity (e.g., disconformity, angular unconformity, nonconformity)
 - Geological timetable
 - g. Apply the principle of uniformitarianism to relate sedimentary rock associations and their fossils to the environments in which the rocks were deposited. (DOK 2)
 - h. Compare and contrast the relative and absolute dating methods (e.g., the principle of fossil succession, radiometric dating, and paleomagnetism) for determining the age of the earth. (DOK 1)
- 4. Demonstrate an understanding of earth systems relating to weather and climate.**
- a. Explain the interaction of earth systems that affect weather and climate. (DOK 1)
 - Latitudinal variations in solar heating
 - The effects of Coriolis forces on ocean currents, cyclones, anticyclones, ocean currents, topography, and air masses (e.g., warm fronts, cold fronts, stationary fronts, and occluded fronts).
 - b. Interpret the patterns in temperature and precipitation that produce the climate regions on earth, and relate them to the hazards associated with extreme weather events and climate change (e.g., hurricanes, tornadoes, El Niño/La Niña, global warming). (DOK 2)
 - c. Justify how changes in global climate and variation in earth/sun relationships contribute to natural and anthropogenic (human-caused) modification of atmospheric composition. (DOK 2)
 - d. Summarize how past and present actions of ice, wind, and water contributed to the types and distributions of erosional and depositional features in landscapes. (DOK 1)
 - e. Research and explain how external forces affect earth’s topography. (DOK 2)
 - How surface water and groundwater act as the major agents of physical and chemical weathering
 - How soil results from weathering and biological processes
 - Processes and hazards associated with both sudden and gradual mass wasting
- 5. Apply an understanding of ecological factors to explain relationships between earth systems.**
- a. Draw conclusions about how life on earth shapes earth systems and responds to the interaction of earth systems (lithosphere, hydrosphere, atmosphere, and biosphere). (DOK 3)

- Nature and distribution of life on earth, including humans, to the chemistry and availability of water
- Distribution of biomes (e.g., terrestrial, freshwater, and marine) to climate regions through time
- Geochemical and ecological processes (e.g., rock, hydrologic, carbon, nitrogen) that interact through time to cycle matter and energy and how human activity alters the rates of these processes (e.g., fossil fuel formation and combustion, damming and channeling of rivers)
- b. Interpret the record of shared ancestry (fossils), evolution, and extinction as related to natural selection. (DOK 2)
- c. Identify the cause and effect relationships of the evolutionary innovations that most profoundly shaped earth systems. (DOK 1)
 - Photosynthesis and the atmosphere
 - Multicellular animals and marine environments
 - Land plants and terrestrial environments
- d. Cite evidence about how dramatic changes in earth's atmosphere influenced the evolution of life. (DOK 1)

Environmental Science

- ES 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ES 2 Develop an understanding of the relationship of ecological factors that affect an ecosystem.
- ES 3 Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Formulate questions that can be answered through research and experimental design. (DOK 3)
- c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
- f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
- g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK3)

2. Develop an understanding of the relationship of ecological factors that affect an ecosystem.

- a. Compare ways in which the three layers of the biosphere change over time and their influence on an ecosystem's ability to support life. (DOK 2)
- b. Explain the flow of matter and energy in ecosystems. (DOK 2)
 - Interactions between biotic and abiotic factors
 - Indigenous plants and animals and their roles in various ecosystems
 - Biogeochemical cycles within the environment
- c. Predict the impact of the introduction, removal, and reintroduction of an organism on an ecosystem. (DOK 3)
- d. Develop a logical argument explaining the relationships and changes within an ecosystem. (DOK 2)
 - How a species adapts to its niche
 - Process of primary and secondary succession and its effects on a population
 - How changes in the environment might affect organisms
- e. Explain the causes and effects of changes in population dynamics (e.g., natural selection, exponential growth, predator/prey relationships) to carrying capacity and limiting factors. (DOK 2)

- f. Research and explain how habitat destruction leads to the loss of biodiversity. (DOK 2)
 - g. Compare and contrast the major biomes of the world's ecosystems, including location, climate, adaptations and diversity. (DOK 1)
3. **Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.**
- a. Summarize the effects of human activities on resources in the local environments. (DOK 2)
 - Sources, uses, quality, and conservation of water
 - Renewable and nonrenewable resources
 - Effects of pollution (e.g., water, noise, air, etc.) on the ecosystem
 - b. Research and evaluate the impacts of human activity and technology on the lithosphere, hydrosphere, and atmosphere, and develop a logical argument to support how communities restore ecosystems. (DOK 3)
 - c. Research and evaluate the use of renewable and nonrenewable resources, and critique efforts to conserve natural resources and reduce global warming in the United States including (but not limited) to Mississippi. (DOK 3)

Genetics

- G 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- G 2 Analyze the structure and function of the cell and cellular organelles.
- G 3 Apply the principles of heredity to demonstrate genetic understandings.

1. **Use critical thinking and scientific problem solving in designing and performing biological research and experimentation. (L, P, E)**

- a. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
- b. Clarify research questions and design laboratory investigations. (DOK 3)
- c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for pie, bar, and line graphs) to draw conclusions and make inferences. (DOK 3)
- e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. **Review the structure and function of the cell as it applies to genetics. (L)**

- a. Cite evidence to illustrate how the structure and function of cells are involved in the maintenance of life. (DOK 2)
- b. Describe how organic components are integral to biochemical processes. (DOK 2)
- c. Differentiate among the processes by which plants and animals reproduce. (DOK 1)
 - Cell cycle and mitosis
 - Meiosis, spermatogenesis, and oogenesis
- d. Explain the significance of the discovery of nucleic acids. (DOK 1)
- e. Analyze and explain the structure and function of DNA and RNA in replication, transcription, translation and DNA repair. (DOK 2)
- f. Cite examples to compare the consequences of the different types of mutations. (DOK 1)
- g. Draw conclusions about the importance and potential impacts of the process of gene transfer used in biotechnology. (DOK 3)

3. **Analyze the structure and function of DNA and RNA molecules. (L, P)**

- a. Cite evidence that supports the significance of Mendel's concept of "particulate inheritance" to explain the understanding of heredity. (DOK 1)

- b. Apply classical genetics principles to solve basic genetic problems. (DOK 2)
 - Genes and alleles, dominance, recessiveness, the laws of segregation, and independent assortment
 - Inheritance of autosomal and sex-linked traits
 - Inheritance of traits influenced by multiple alleles and traits with polygenetic inheritance
 - Chromosomal theory of inheritance
- c. Apply population genetic concepts to summarize variability of multicellular organisms. (DOK 2)
 - Genetic variability
 - Hardy-Weinberg formula
 - Migration and genetic drift
 - Natural selection in humans
- d. Distinguish and explain the applications of various tools and techniques used in DNA manipulation. (DOK 1)
 - Steps in genetic engineering experiments
 - Use of restriction enzymes
 - Role of vectors in genetic research
 - Use of transformation techniques
- e. Research and present a justifiable explanation the practical uses of biotechnology (e.g., chromosome mapping, karyotyping, and pedigrees). (DOK 2)
- f. Develop and present a scientifically-based logical argument for or against moral and ethical issues related to genetic engineering. (DOK 3)
- g. Research genomics (human and other organisms), and predict benefits and medical advances that may result from the use of genome projects. (DOK 2)

Geology

GE1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
GE2	Develop an understanding of plate tectonics and geochemical and ecological processes that affect earth.

- 1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
 - a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
 - b. Formulate questions that can be answered through research and experimental design. (DOK 3)
 - c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
 - d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
 - e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
 - g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
- 2. **Develop an understanding of plate tectonics and geochemical and ecological processes that affect earth.**
 - a. Differentiate the components of the earth's atmosphere and lithosphere. (DOK 1)
 - b. Research and summarize explanations of how earth acquired its initial atmosphere and oceans. (DOK 3)
 - c. Compare the causes and effects of internal and external components that shape earth's topography. (DOK 2)
 - Physical weathering (e.g., atmospheric, glacial, etc.)
 - Chemical weathering agents (e.g., acid precipitation, carbon dioxide, oxygen, water, etc.)

- d. Develop an understanding of how plate tectonics create certain geologic features, materials, and hazards. (DOK 2)
 - Types of crustal movements and the resulting landforms (e.g., seafloor spreading, paleomagnetic measurements, and orogenesis)
 - Processes that create earthquakes and volcanoes
 - Asthenosphere
- e. Summarize the theories of plate development and continental drift, and describe the causes and effects involved in each. (DOK 2)
- f. Develop a logical argument to explain how geochemical and ecological processes (e.g., rock, hydrologic, carbon, nitrogen) interact through time to cycle matter and energy and how human activity alters the rates of these processes (e.g., fossil fuel formation and combustion, damming, and channeling of rivers). (DOK 2)
- g. Interpret how the earth's geological time scale relates to geological history, landforms, and life-forms. (DOK 2)
- h. Research and describe different techniques for determining relative and absolute age of the earth (e.g., index of fossil layers, superposition, radiometric dating, etc.) (DOK 1)
- i. Summarize the geological activity of the New Madrid fault line, and compare and contrast it to geological activity in other parts of the world. (DOK 2)
- j. Identify and differentiate the major geological features in Mississippi (e.g., Delta, Coastal Areas, etc.). (DOK 1)
- k. Evaluate an emergency preparedness plan for natural disasters associated with crustal movement. (DOK 3)

Physical Science

PS 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
PS 2	Describe and explain how forces affect motion.
PS 3	Demonstrate an understanding of general properties and characteristics of waves.
PS 4	Develop an understanding of the atom.
PS 5	Investigate and apply principles of physical and chemical changes in matter.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Use appropriate laboratory safety symbols and procedures to design and conduct a scientific investigation. (DOK 2)
 - Safety symbols and safety rules in all laboratory activities
 - Proper use and care of the compound light microscope
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Identify questions that can be answered through scientific investigations. (DOK 3)
- c. Identify and apply components of scientific methods in classroom investigations. (DOK 3)
 - Predicting, gathering data, drawing conclusions
 - Recording outcomes and organizing data from a variety of sources (e.g., scientific articles, magazines, student experiments, etc.)
 - Critically analyzing current investigations/problems using periodicals and scientific scenarios
- d. Interpret and generate graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures and data to draw conclusions about the validity of research. (DOK 3)
- f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- g. Communicate effectively to present and explain scientific results, using appropriate terminology and graphics. (DOK 3)

2. Describe and explain how forces affect motion.

- a. Demonstrate and explain the basic principles of Newton's three laws of motion including calculations of acceleration, force, and momentum. (DOK 2)

- Inertia and distance-time graphs to determine average speed
 - Net force (accounting for gravity, friction, and air resistance) and the resulting motion of objects
 - Effects of the gravitational force on objects on Earth and effects on planetary and lunar motion
 - Simple harmonic motion (oscillation)
 - b. Explain the connection between force, work, and energy. (DOK 2)
 - Force exerted over a distance (results in work done)
 - Force-distance graph (to determine work)
 - Network on an object that contributes to change in kinetic energy (work-to-energy theorem)
 - c. Describe (with supporting details and diagrams) how the kinetic energy of an object can be converted into potential energy (the energy of position) and how energy is transferred or transformed (conservation of energy). (DOK 2)
 - d. Draw and assess conclusions about charges and electric current. (DOK 2)
 - Static/current electricity and direct current/alternating current
 - Elements in an electric circuit that are in series or parallel
 - Conductors and insulators
 - Relationship between current flowing through a resistor and voltage flowing across a resistor
 - e. Cite evidence and explain the application of electric currents and magnetic fields as they relate to their use in everyday living (e.g., the application of fields in motors and generators and the concept of electric current using Ohm's Law). (DOK 2)
- 3. Demonstrate an understanding of general properties and characteristics of waves.**
- a. Differentiate among transverse, longitudinal, and surface waves as they propagate through a medium (e.g., string, air, water, steel beam). (DOK 1)
 - b. Compare properties of waves (e.g., superposition, interference, refraction, reflection, diffraction, Doppler effect), and explain the connection among the quantities (e.g., wavelength, frequency, period, amplitude, and velocity). (DOK 2)
 - c. Classify the electromagnetic spectrum's regions according to frequency and/or wavelength, and draw conclusions about their impact on life. (DOK 2)
 - The emission of light by electrons when moving from higher to lower levels
 - Energy (photons as quanta of light)
 - Additive and subtractive properties of colors
 - Relationship of visible light to the color spectrum
 - d. Explain how sound intensity is measured and its relationship to the decibel scale. (DOK 1)
- 4. Develop an understanding of the atom.**
- a. Cite evidence to summarize the atomic theory. (DOK 1)
 - Models for atoms
 - Hund's rule and Aufbau process to specify the electron configuration of elements
 - Building blocks of matter (e.g., proton, neutron, and electron) and elementary particles (e.g., positron, mesons, neutrinos, etc.)
 - Atomic orbitals (s, p, d, f) and their basic shapes
 - b. Explain the difference between chemical and physical changes, and demonstrate how these changes can be used to separate mixtures and compounds into their components. (DOK 2)
 - c. Research the history of the periodic table of the elements, and summarize the contributions that led to the atomic theory. (DOK 2)
 - Contributions of scientists (e.g., John Dalton, J.J. Thomson, Ernest Rutherford, Newton, Einstein, Neils, Bohr, Louis de Broglie, Erwin Schrödinger, etc.)
 - Technology (e.g., X-rays, cathode-ray tubes, spectroscopes)
 - Experiments (e.g., gold-foil, cathode-ray, etc.)
 - d. Utilize the periodic table to predict and explain patterns and draw conclusions about the structure, properties, and organization of matter. (DOK 2)
 - Atomic composition and valence electron configuration (e.g., atomic number, mass number of protons, neutrons, electrons, isotopes, and ions)
 - Periodic trends using the periodic table (e.g., valence, reactivity, atomic radius)

- Average atomic mass from isotopic abundance
- Solids, liquids, and gases
- Periodic properties of elements (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius) and how they relate to position in the periodic table

5. Investigate and apply principles of physical and chemical changes in matter.

- Write chemical formulas for compounds comprising monatomic and polyatomic ions. (DOK 1)
- Balance chemical equations. (DOK 2)
- Classify types of chemical reactions (e, g., composition, decomposition, single displacement, double displacement, combustion, acid/base reactions). (DOK 2)

Physics I

PHYI 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
PHYI 2	Develop an understanding of concepts related to forces and motion.
PHYI 3	Develop an understanding of concepts related to work and energy.
PHYI 4	Discuss the characteristics and properties of light and sound.
PHYI 5	Apply an understanding of magnetism, electric fields, and electricity.
PHYI 6	Analyze and explain concepts of nuclear physics.

1. Investigate and apply principles of physical and chemical changes in matter.

- Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
- Clarify research questions, and design laboratory investigations. (DOK 3)
- Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
- Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. Develop an understanding of concepts related to forces and motion.

- Use inquiry to investigate and develop an understanding of the kinematics and dynamics of physical bodies. (DOK 3)
 - Vector and scalar quantities
 - Vector problems (solved mathematically and graphically)
 - Vector techniques and free-body diagrams to determine the net force on a body when several forces are acting on it
 - Relations among mass, inertia, and weight
- Analyze, describe, and solve problems by creating and utilizing graphs of one-dimensional motion (e.g., position, distance, displacement, time, speed, velocity, acceleration, the special case of freefall). (DOK 2)
- Analyze real-world applications to draw conclusions about Newton's three laws of motion. (DOK 2)
- Apply the effects of the universal gravitation law to graph and interpret the force between two masses, acceleration due to gravity, and planetary motion. (DOK 2)
 - Situations where g is constant (falling bodies)
 - Concept of centripetal acceleration undergoing uniform circular motion
 - Kepler's third law
 - Oscillatory motion and the mechanics of waves

3. Develop an understanding of concepts related to work and energy.

- Explain and apply the conservation of energy and momentum. (DOK 2)

- Concept of work and applications
 - Concept of kinetic energy, using the elementary work-energy theorem
 - Concept of conservation of energy with simple examples
 - Concepts of energy, work, and power (qualitatively and quantitatively)
 - Principles of impulse in inelastic and elastic collisions
- b. Analyze real-world applications to draw conclusions about mechanical potential energy (the energy of configuration). (DOK 3)
- c. Apply the principles of impulse, and compare conservation of momentum and conservation of kinetic energy in perfectly inelastic and elastic collisions. (DOK 1)
- d. Investigate and summarize the principles of thermodynamics. (DOK 2)
- How heat energy is transferred from higher temperature to lower temperature until equilibrium is reached
 - Temperature and thermal energy as related to molecular motion and states of matter
 - Problems involving specific heat and heat capacity
 - First and second laws of thermodynamics as related to heat engines, refrigerators, and thermal efficiency
- e. Develop the kinetic theory of ideal gases and explain the concept of Carnot efficiency. (DOK 2)
- 4. Discuss the characteristics and properties of light and sound.**
- a. Describe and model the characteristics and properties of mechanical waves. (DOK 2)
- Simple harmonic motion
 - Relationships among wave characteristics such as velocity, period, frequency, amplitude, phase, and wavelength
 - Energy of a wave in terms of amplitude and frequency.
 - Standing waves and waves in specific media (e.g., stretched string, water surface, air, etc.)
- b. Differentiate and explain the Doppler effect as it relates to a moving source and to a moving observer. (DOK 1)
- c. Explain the laws of reflection and refraction, and apply Snell's law to describe the relationship between the angles of incidence and refraction. (DOK 2)
- d. Use ray tracing and the thin lens equation to solve real-world problems involving object distance from lenses. (DOK 2)
- e. Investigate and draw conclusions about the characteristics and properties of electromagnetic waves. (DOK 2)
- 5. Apply an understanding of magnetism, electric fields, and electricity.**
- a. Analyze and explain the relationship between electricity and magnetism. (DOK 2)
- Characteristics of static charge and how a static charge is generated
 - Electric field, electric potential, current, voltage, and resistance as related to Ohm's law
 - Magnetic poles, magnetic flux and field, Ampère's law and Faraday's law
 - Coulomb's law
- b. Use schematic diagrams to analyze the current flow in series and parallel electric circuits, given the component resistances and the imposed electric potential. (DOK 2)
- c. Analyze and explain the relationship between magnetic fields and electrical current by induction, generators, and electric motors. (DOK 2)
- 6. Analyze and explain concepts of nuclear physics.**
- a. Analyze and explain the principles of nuclear physics. (DOK 1)
- The mass number and atomic number of the nucleus of an isotope of a given chemical element
 - The conservation of mass and the conservation of charge
 - Nuclear decay
- b. Defend the wave-particle duality model of light, using observational evidence. (DOK 3)
- Quantum energy and emission spectra
 - Photoelectric and Compton effects

Spatial Information Science

- SP 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
SP 2 Develop an understanding of geographic information systems.

1. Demonstrate the basic concepts of global positioning systems (GPS). (E)

- a. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
- b. Clarify research questions, and design laboratory investigations. (DOK 3)
- c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, and theory development). (DOK 3)
- d. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences). (DOK 3)
- e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. Demonstrate the basic concepts of remote sensing. (E, P)

- a. Describe the characteristics of the electromagnetic spectrum.
- b. Using images and graphs, interpret the absorption/reflection spectrum.
- c. Distinguish between passive vs. active sensor systems.
- d. Analyze the effects of changes in spatial, temporal, and spectral resolution.
- e. Analyze the effects on images due to changes in scale.
- f. Identify the types of sensor platforms.

Zoology

- ZO 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
ZO 2 Develop an understanding of levels of organization and animal classification.
ZO 3 Differentiate among animal life cycles, behaviors, adaptations, and relationships.
ZO 4 Demonstrate an understanding of the principles of animal genetic diversity and evolution.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Formulate questions that can be answered through research and experimental design. (DOK 3)
- c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
- f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
- g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. Develop an understanding of levels of organization and animal classification.

- a. Explain how organisms are classified, and identify characteristics of major groups. (DOK 1)
 - Levels of organization of structures in animals (e.g., cells, tissues, organs, and systems)

- Characteristics used to classify organisms (e.g., cell structure, biochemistry, anatomy, fossil record, and methods of reproduction)
 - b. Identify and describe characteristics of the major phyla. (DOK 1)
 - Symmetry and body plan
 - Germ layers and embryonic development
 - Organ systems (e.g., digestive, circulatory, excretory, and reproductive)
 - Locomotion and coordination
 - c. Distinguish viruses from bacteria and protists, and give examples. (DOK 1)
 - d. Differentiate among the characteristics of bacteria, archaea, and eucarya. (DOK 1)
 - Phylogenic sequencing of the major phyla
 - Invertebrate characteristics (e.g., habitat, reproduction, body plan, locomotion) of the following phyla: Porifera, Cnidarians, Nematoda, Annelida, Platyhelminthes, Arthropoda, Insecta, Crustacea, Arachnida, Mollusca [Bivalvia and Gastropoda], and Echinodermata
 - Vertebrate characteristics (e.g., habitat, reproduction, body plan, locomotion) of the following classes: Agnatha, Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, and Mammalia
- 3. Differentiate among animal life cycles, behaviors, adaptations, and relationships.**
- a. Describe life cycles, alternation of generations, and metamorphosis of various animals, and evaluate the advantages and disadvantages of asexual and sexual reproduction. (DOK 1)
 - b. Describe and explain concepts of animal behavior, and differentiate between learned and innate behavior. (DOK 1)
 - Division of labor within a group of animals
 - Communication within animals groups
 - Degree of parental care given in animal groups
 - c. Evaluate the unique protective adaptations of animals as they relate to survival. (DOK 2)
 - d. Compare and contrast ecological relationships, and make predictions about the survival of populations under given circumstances. (DOK 3)
 - Terrestrial and aquatic ecosystems
 - Herbivores, carnivores, omnivores, decomposers and other feeding relationships
 - Symbiotic relationships such as mutualism, commensalisms, and parasitism
 - e. Contrast food chains and food webs. (DOK 2)
- 4. Demonstrate an understanding of the principles of animal genetic diversity and evolution.**
- a. Categorize and explain sources of genetic variation on the cellular level (e.g., mutations, crossing over, and nondisjunction) and the population level (e.g., nonrandom mating, migration, etc.). (DOK 2)
 - Relationship between natural selection and evolution
 - Mutations, crossing over, non-disjunction
 - Nonrandom mating, migration, etc.
 - Effects of genetic drift on evolution
 - b. Develop a logical argument defending or refuting issues related to genetic engineering of animals. (DOK 3)

Appendix D: ACT College Readiness Standards

English

E1 Topic Development in Terms of Purpose and Focus

- Identify the basic purpose or role of a specified phrase or sentence.
- Delete a clause or sentence because it is obviously irrelevant to the essay.
- Identify the central idea or main topic of a straightforward piece of writing.
- Determine relevancy when presented with a variety of sentence-level details.
- Identify the focus of a simple essay, applying that knowledge to add a sentence that sharpens that focus or to determine if an essay has met a specified goal.
- Delete material primarily because it disturbs the flow and development of the paragraph.
- Add a sentence to accomplish a fairly straightforward purpose such as illustrating a given statement.
- Apply an awareness of the focus and purpose of a fairly involved essay to determine the rhetorical effect and suitability of an existing phrase or sentence or to determine the need to delete plausible but irrelevant material.
- Add a sentence to accomplish a subtle rhetorical purpose such as to emphasize, to add supporting detail, or to express meaning through connotation.
- Determine whether a complex essay has accomplished a specific purpose.
- Add a phrase or sentence to accomplish a complex purpose, often expressed in terms of the main focus of the essay.

E2 Organization, Unity, and Coherence

- Use conjunctive adverbs or phrases to show time relationship in simple narrative essays (e.g., *then, this time, etc.*).
- Select the most logical place to add a sentence in a paragraph.
- Use conjunctive adverbs or phrases to express straightforward logical relationships (e.g., *first, afterward, in response*).
- Decide the most logical place to add a sentence in an essay.
- Add a sentence that introduces a simple paragraph.
- Determine the need for conjunctive adverbs or phrases to create subtle logical connections between sentences (e.g., *therefore, however, in addition*).
- Rearrange the sentences in a fairly uncomplicated paragraph for the sake of logic.
- Add a sentence to introduce or conclude the essay or to provide a transition between paragraphs when the essay is fairly straightforward.
- Make sophisticated distinctions concerning the logical use of conjunctive adverbs or phrases, particularly when signaling a shift between paragraphs.
- Rearrange sentences to improve the logic and coherence of a complex paragraph.
- Add a sentence to introduce or conclude a fairly complex paragraph.
- Consider the need for introductory sentences or transitions, basing decisions on a thorough understanding of both the logic and rhetorical effect of the paragraph and essay.

E3 Word Choice in Terms of Style, Tone, Clarity, and Economy

- Revise sentences to correct awkward and confusing arrangements of sentence elements.
- Revise vague nouns and pronouns that create obvious logic problems.
- Delete obviously synonymous and wordy material in a sentence.
- Revise expressions that deviate from the style of an essay.
- Delete redundant material when information is repeated in different parts of speech (e.g., *alarmingly startled*).
- Use the word or phrase most consistent with the style and tone of a fairly straightforward essay.
- Determine the clearest and most logical conjunction to link clauses.
- Revise a phrase that is redundant in terms of the meaning and logic of the entire sentence.
- Identify and correct ambiguous pronoun references.
- Use the word or phrase most appropriate in terms of the content of the sentence and tone of the essay.
- Correct redundant material that involves sophisticated vocabulary and sounds acceptable as conversational English (e.g., *an aesthetic viewpoint* versus *the outlook of an aesthetic viewpoint*).
- Correct vague and wordy or clumsy and confusing writing containing sophisticated language.
- Delete redundant material that involves subtle concepts or that is redundant in terms of the paragraph as a whole.

E4 Sentence Structure and Formation

- Use conjunctions or punctuation to join simple clauses.
- Revise shifts in verb tense between simple clauses in a sentence or between simple adjoining sentences.
- Determine the need for punctuation and conjunctions to avoid awkward sounding sentence fragments and fused sentences.
- Decide the appropriate verb tense and voice by considering the meaning of the entire sentence.
- Recognize and correct marked disturbances of sentence flow and structure (e.g., participial phrase fragments, missing or incorrect relative pronouns, dangling or misplaced modifiers).
- Revise to avoid faulty placement of phrases and faulty coordination and subordination of clauses in sentences with subtle structural problems.
- Maintain consistent verb tense and pronoun person on the basis of the preceding clause or sentence.
- Use sentence-combining techniques, effectively avoiding problematic comma splices, run-on sentences, and sentence fragments, especially in sentences containing compound subjects or verbs.
- Maintain a consistent and logical use of verb tense and pronoun person on the basis of information in the paragraph or essay as a whole.
- Work comfortably with long sentences and complex clausal relationships within sentences, avoiding weak conjunctions between independent clauses and maintaining parallel structure between clauses.

E5 Conventions of Usage

- Solve such basic grammatical problems as how to form the past and past participle of irregular but commonly used verbs and how to form comparative and superlative adjectives.
- Solve such grammatical problems as whether to use an adverb or adjective form, how to ensure straightforward subject–verb and pronoun–antecedent agreement, and which preposition to use in simple contexts.
- Recognize and use the appropriate word in frequently confused pairs such as *there* and *their*, *past* and *passed*, and *led* and *lead*.
- Use idiomatically appropriate prepositions, especially in combination with verbs (e.g., *long for*, *appeal to*).
- Ensure that a verb agrees with its subject when there is some text between the two.
- Ensure that a pronoun agrees with its antecedent when the two occur in separate clauses or sentences.
- Identify the correct past and past participle forms of irregular and infrequently used verbs, and form present–perfect verbs by using *have* rather than *of*.
- Correctly use reflexive pronouns, the possessive pronouns *its* and *your*, and the relative pronouns *who* and *whom*.

- Ensure that a verb agrees with its subject in unusual situations (e.g., when the subject–verb order is inverted or when the subject is an indefinite pronoun).
- Provide idiomatically and contextually appropriate prepositions following verbs in situations involving sophisticated language or ideas.
- Ensure that a verb agrees with its subject when a phrase or clause between the two suggests a different number for the verb.

E6 Conventions of Punctuation

- Delete commas that create basic sense problems (e.g., between verb and direct object).
- Provide appropriate punctuation in straightforward situations (e.g., items in a series).
- Delete commas that disturb the sentence flow (e.g., between modifier and modified element).
- Use commas to set off simple parenthetical phrases.
- Delete unnecessary commas when an incorrect reading of the sentence suggests a pause that should be punctuated (e.g., between verb and direct object clause).
- Use punctuation to set off complex parenthetical phrases.
- Recognize and delete unnecessary commas based on a careful reading of a complicated sentence (e.g., between the elements of a compound subject or compound verb joined by *and*).
- Use apostrophes to indicate simple possessive nouns.
- Recognize inappropriate uses of colons and semicolons.
- Use commas to set off a nonessential/nonrestrictive appositive or clause.
- Deal with multiple punctuation problems (e.g., compound sentences containing unnecessary commas and phrases that may or may not be parenthetical).
- Use an apostrophe to show possession, especially with irregular plural nouns.
- Use a semicolon to indicate a relationship between closely related independent clauses.
- Use a colon to introduce an example or an elaboration.

Math

M1 Basic Operations and Applications

- Perform one-operation computation with whole numbers and decimals.
- Solve problems in one or two steps using whole numbers.
- Perform common conversions (e.g., inches to feet or hours to minutes).
- Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent.
- Solve some routine two-step arithmetic problems.
- Solve routine two-step or three-step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and computing with a given average.
- Solve multistep arithmetic problems that involve planning or converting units of measure (e.g., feet per second to miles per hour).
- Solve word problems containing several rates, proportions, or percentages.
- Solve complex arithmetic problems involving percent of increase or decrease and problems requiring integration of several concepts from pre-algebra and/or pre-geometry (e.g., comparing percentages or averages, using several ratios, and finding ratios in geometry settings).

M2 Probability, Statistics, and Data Analysis

- Calculate the average of a list of positive whole numbers.
- Perform a single computation using information from a table or chart.
- Calculate the average of a list of numbers.
- Calculate the average, given the number of data values and the sum of the data values.
- Read tables and graphs.
- Perform computations on data from tables and graphs.

- Use the relationship between the probability of an event and the probability of its complement.
- Calculate the missing data value, given the average and all data values but one.
- Translate from one representation of data to another (e.g., a bar graph to a circle graph).
- Determine the probability of a simple event.
- Exhibit knowledge of simple counting techniques.*
- Calculate the average, given the frequency counts of all the data values.
- Manipulate data from tables and graphs.
- Compute straightforward probabilities for common situations.
- Use Venn diagrams in counting.*
- Calculate or use a weighted average.
- Interpret and use information from figures, tables, and graphs.
- Apply counting techniques.
- Compute a probability when the event and/or sample space is not given or obvious.
- Distinguish between mean, median, and mode for a list of numbers.
- Analyze and draw conclusions based on information from figures, tables, and graphs.
- Exhibit knowledge of conditional and joint probability.

M3 Numbers: Concepts and Properties

- Recognize equivalent fractions and fractions in lowest terms.
- Recognize one-digit factors of a number.
- Identify a digit's place value.
- Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor.
- Find and use the least common multiple.
- Order fractions.
- Work with numerical factors.
- Work with scientific notation.
- Work with squares and square roots of numbers.
- Work problems involving positive integer exponents.*
- Work with cubes and cube roots of numbers.*
- Determine when an expression is undefined.*
- Exhibit some knowledge of the complex numbers.†
- Apply number properties involving prime factorization.
- Apply number properties involving even and odd numbers and factors and multiples.
- Apply number properties involving positive and negative numbers.
- Apply rules of exponents.
- Multiply two complex numbers.†
- Draw conclusions based on number concepts, algebraic properties, and/or relationships between expressions and numbers.
- Exhibit knowledge of logarithms and geometric sequences.
- Apply properties of complex numbers.

M4 Expressions, Equations, and Inequalities

- Exhibit knowledge of basic expressions (e.g., identify an expression for a total as $b + g$).
- Solve equations in the form $x + a = b$, where a and b are whole numbers or decimals.
- Substitute whole numbers for unknown quantities to evaluate expressions.
- Solve one-step equations having integer or decimal answers.
- Combine like terms (e.g., $2x + 5x$).
- Evaluate algebraic expressions by substituting integers for unknown quantities.
- Add and subtract simple algebraic expressions.
- Solve routine first-degree equations.

- Perform straightforward word-to-symbol translations.
- Multiply two binomials.*
- Solve real-world problems using first-degree equations.
- Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions).
- Identify solutions to simple quadratic equations.
- Add, subtract, and multiply polynomials.*
- Factor simple quadratics (e.g., the difference of squares and perfect square trinomials).*
- Solve first-degree inequalities that do not require reversing the inequality sign.*
- Manipulate expressions and equations.
- Write expressions, equations, and inequalities for common algebra settings.
- Solve linear inequalities that require reversing the inequality sign.
- Solve absolute value equations.
- Solve quadratic equations.
- Find solutions to systems of linear equations.
- Write expressions that require planning and/or manipulating to accurately model a situation.
- Write equations and inequalities that require planning, manipulating, and/or solving.
- Solve simple absolute value inequalities.

M5 Graphical Representations

- Identify the location of a point with a positive coordinate on the number line.
- Locate points on the number line and in the first quadrant.
- Locate points in the coordinate plane.
- Comprehend the concept of length on the number line.*
- Exhibit knowledge of slope.*
- Identify the graph of a linear inequality on the number line.*
- Determine the slope of a line from points or equations.*
- Match linear graphs with their equations.*
- Find the midpoint of a line segment.*
- Interpret and use information from graphs in the coordinate plane.
- Match number line graphs with solution sets of linear inequalities.
- Use the distance formula.
- Use properties of parallel and perpendicular lines to determine an equation of a line or coordinates of a point.
- Recognize special characteristics of parabolas and circles (e.g., the vertex of a parabola and the center or radius of a circle).†
- Match number line graphs with solution sets of simple quadratic inequalities.
- Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$.
- Solve problems integrating multiple algebraic and/or geometric concepts.
- Analyze and draw conclusions based on information from graphs in the coordinate plane.

M6 Properties of Plane Figures

- Exhibit some knowledge of the angles associated with parallel lines.
- Find the measure of an angle using properties of parallel lines.
- Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90° , 180° , and 360°).
- Use several angle properties to find an unknown angle measure.
- Recognize Pythagorean triples.*
- Use properties of isosceles triangles.*
- Apply properties of 30° - 60° - 90° , 45° - 45° - 90° , similar, and congruent triangles.
- Use the Pythagorean theorem.
- Draw conclusions based on a set of conditions.

- Solve multistep geometry problems that involve integrating concepts, planning, visualization, and/or making connections with other content areas.
- Use relationships among angles, arcs, and distances in a circle.

M7 Measurement

- Estimate or calculate the length of a line segment based on other lengths given on a geometric figure.
- Compute the perimeter of polygons when all side lengths are given.
- Compute the area of rectangles when whole number dimensions are given.
- Compute the area and perimeter of triangles and rectangles in simple problems.
- Use geometric formulas when all necessary information is given.
- Compute the area of triangles and rectangles when one or more additional simple steps are required.
- Compute the area and circumference of circles after identifying necessary information.
- Compute the perimeter of simple composite geometric figures with unknown side lengths.*
- Use relationships involving area, perimeter, and volume of geometric figures to compute another measure.
- Use scale factors to determine the magnitude of a size change.
- Compute the area of composite geometric figures when planning or visualization is required.

M8 Functions

- Evaluate quadratic functions, expressed in function notation, at integer values.
- Evaluate polynomial functions, expressed in function notation, at integer values.†
- Express the sine, cosine, and tangent of an angle in a right triangle as a ratio of given side lengths.†
- Evaluate composite functions at integer values.†
- Apply basic trigonometric ratios to solve right-triangle problems.†
- Write an expression for the composite of two simple functions.†
- Use trigonometric concepts and basic identities to solve problems.†
- Exhibit knowledge of unit circle trigonometry.†
- Match graphs of basic trigonometric functions with their equations.

Notes

- Students who score in the 1–12 range are most likely beginning to develop the knowledge and skills assessed in the other ranges.
- Standards followed by an asterisk (*) apply to the PLAN and ACT Mathematics tests only.
- Standards followed by a dagger (†) apply to the ACT Mathematics test only.

Reading

R1 Main Ideas and Author's Approach

- Recognize a clear intent of an author or narrator in uncomplicated literary narratives.
- Identify a clear main idea or purpose of straightforward paragraphs in uncomplicated literary narratives.
- Infer the main idea or purpose of straightforward paragraphs in uncomplicated literary narratives.
- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in uncomplicated passages.
- Identify a clear main idea or purpose of any paragraph or paragraphs in uncomplicated passages.
- Infer the main idea or purpose of straightforward paragraphs in more challenging passages.
- Summarize basic events and ideas in more challenging passages.
- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in more challenging passages.
- Infer the main idea or purpose of more challenging passages or their paragraphs.
- Summarize events and ideas in virtually any passage.

- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in virtually any passage.
- Identify clear main ideas or purposes of complex passages or their paragraphs.

R2 Supporting Details

- Locate basic facts (e.g., names, dates, events) clearly stated in a passage.
- Locate simple details at the sentence and paragraph level in uncomplicated passages.
- Recognize a clear function of a part of an uncomplicated passage.
- Locate important details in uncomplicated passages.
- Make simple inferences about how details are used in passages.
- Locate important details in more challenging passages.
- Locate and interpret minor or subtly stated details in uncomplicated passages.
- Discern which details, though they may appear in different sections throughout a passage, support important points in more challenging passages.
- Locate and interpret minor or subtly stated details in more challenging passages.
- Use details from different sections of some complex informational passages to support a specific point or argument.
- Locate and interpret details in complex passages.
- Understand the function of a part of a passage when the function is subtle or complex.

R3 Sequential, Comparative, and Cause—Effect Relationships

- Determine when (e.g., first, last, before, after) or if an event occurred in uncomplicated passages.
- Recognize clear cause—effect relationships described within a single sentence in a passage.
- Identify relationships between main characters in uncomplicated literary narratives.
- Recognize clear cause—effect relationships within a single paragraph in uncomplicated literary narratives.
- Order simple sequences of events in uncomplicated literary narratives.
- Identify clear relationships between people, ideas, and so forth in uncomplicated passages.
- Identify clear cause—effect relationships in uncomplicated passages.
- Order sequences of events in uncomplicated passages.
- Understand relationships between people, ideas, and so forth in uncomplicated passages.
- Identify clear relationships between characters, ideas, and so forth in more challenging literary narratives.
- Understand implied or subtly stated cause—effect relationships in uncomplicated passages.
- Identify clear cause—effect relationships in more challenging passages.
- Order sequences of events in more challenging passages.
- Understand the dynamics between people, ideas, and so forth in more challenging passages.
- Understand implied or subtly stated cause—effect relationships in more challenging passages.
- Order sequences of events in complex passages.
- Understand the subtleties in relationships between people, ideas, and so forth in virtually any passage.
- Understand implied, subtle, or complex cause—effect relationships in virtually any passage.

R4 Meaning of Words

- Understand the implication of a familiar word or phrase and of simple descriptive language.
- Use context to understand basic figurative language.
- Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in uncomplicated passages.
- Use context to determine the appropriate meaning of virtually any word, phrase, or statement in uncomplicated passages.
- Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in more challenging passages.

- Determine the appropriate meaning of words, phrases, or statements from figurative or somewhat technical contexts.
- Determine, even when the language is richly figurative and the vocabulary is difficult, the appropriate meaning of context-dependent words, phrases, or statements in virtually any passage.

R5 Generalizations and Conclusions

- Draw simple generalizations and conclusions about the main characters in uncomplicated literary narratives.
- Draw simple generalizations and conclusions about people, ideas, and so forth in uncomplicated passages.
- Draw generalizations and conclusions about people, ideas, and so forth in uncomplicated passages.
- Draw simple generalizations and conclusions using details that support the main points of more challenging passages.
- Draw subtle generalizations and conclusions about characters, ideas, and so forth in uncomplicated literary narratives.
- Draw generalizations and conclusions about people, ideas, and so forth in more challenging passages.
- Use information from one or more sections of a more challenging passage to draw generalizations and conclusions about people, ideas, and so forth.
- Draw complex or subtle generalizations and conclusions about people, ideas, and so forth, often by synthesizing information from different portions of the passage.
- Understand and generalize about portions of a complex literary narrative.

Science

S1 Interpretation of Data

- Select a single piece of data (numerical or non-numerical) from a simple data presentation (e.g., a table or graph with two or three variables, a food web diagram).
- Identify basic features of a table, graph, or diagram (e.g., headings, units of measurement, axis labels).
- Select two or more pieces of data from a simple data presentation.
- Understand basic scientific terminology.
- Find basic information in a brief body of text.
- Determine how the value of one variable changes as the value of another variable changes in a simple data presentation.
- Select data from a complex data presentation (e.g., a table or graph with more than three variables, a phase diagram).
- Compare or combine data from a simple data presentation (e.g., order or sum data from a table).
- Translate information into a table, graph, or diagram.
- Compare or combine data from two or more simple data presentations (e.g., categorize data from a table using a scale from another table).
- Compare or combine data from a complex data presentation.
- Interpolate between data points in a table or graph.
- Determine how the value of one variable changes as the value of another variable changes in a complex data presentation.
- Identify and/or use a simple (e.g., linear) mathematical relationship between data.
- Analyze given information when presented with new, simple information.
- Compare or combine data from a simple data presentation with data from a complex data presentation.
- Identify and/or use a complex (e.g., nonlinear) mathematical relationship between data.
- Extrapolate from data points in a table or graph.
- Compare or combine data from two or more complex data presentations.
- Analyze given information when presented with new, complex information.

S2 Scientific Investigation

- Understand the methods and tools used in a simple experiment.
- Understand the methods and tools used in a moderately complex experiment.
- Understand a simple experimental design.
- Identify a control in an experiment.
- Identify similarities and differences between experiments.
- Understand the methods and tools used in a complex experiment.
- Understand a complex experimental design.
- Predict the results of an additional trial or measurement in an experiment.
- Determine the experimental conditions that would produce specified results.
- Determine the hypothesis for an experiment.
- Identify an alternate method for testing a hypothesis.
- Understand precision and accuracy issues.
- Predict how modifying the design or methods of an experiment will affect results.
- Identify an additional trial or experiment that could be performed to enhance or evaluate experimental results.

S3 Evaluation of Models, Inferences, and Experimental Results

- Select a simple hypothesis, prediction, or conclusion that is supported by a data presentation or a model.
- Identify key issues or assumptions in a model.
- Select a simple hypothesis, prediction, or conclusion that is supported by two or more data presentations or models.
- Determine whether given information supports or contradicts a simple hypothesis or conclusion and why.
- Identify strengths and weaknesses in one or more models.
- Identify similarities and differences between models.
- Determine which model(s) is/are supported or weakened by new information.
- Select a data presentation or a model that supports or contradicts a hypothesis, prediction, or conclusion.
- Select a complex hypothesis, prediction, or conclusion that is supported by a data presentation or model.
- Determine whether new information supports or weakens a model and why.
- Use new information to make a prediction based on a model.
- Select a complex hypothesis, prediction, or conclusion that is supported by two or more data presentations or models.
- Determine whether given information supports or contradicts a complex hypothesis or conclusion and why.

Writing

W1 Expressing Judgments

- Show a little understanding of the persuasive purpose of the task, but neglect to take or to maintain a position on the issue in the prompt.
- Show limited recognition of the complexity of the issue in the prompt.
- Show a basic understanding of the persuasive purpose of the task by taking a position on the issue in the prompt but may not maintain that position.
- Show a little recognition of the complexity of the issue in the prompt by acknowledging, but only briefly describing, a counterargument to the writer's position.
- Show understanding of the persuasive purpose of the task by taking a position on the issue in the prompt.
- Show some recognition of the complexity of the issue in the prompt by doing the following:
 - Acknowledging counterarguments to the writer's position
 - Providing some response to counterarguments to the writer's position
- Show clear understanding of the persuasive purpose of the task by taking a position on the specific issue in the prompt and offering a broad context for discussion.

- Show recognition of the complexity of the issue in the prompt by doing the following:
 - Partially evaluating implications and/or complications of the issue
 - Posing and partially responding to counterarguments to the writer's position
- Show clear understanding of the persuasive purpose of the task by taking a position on the specific issue in the prompt and offering a critical context for discussion.
- Show understanding of the complexity of the issue in the prompt by doing the following:
 - Examining different perspectives
 - Evaluating implications or complications of the issue
 - Posing and fully discussing counterarguments to the writer's position

W2 Focusing on the Topic

- Maintain a focus on the general topic in the prompt through most of the essay.
- Maintain a focus on the general topic in the prompt throughout the essay.
- Maintain a focus on the general topic in the prompt throughout the essay, and attempt a focus on the specific issue in the prompt.
- Present a thesis that establishes focus on the topic.
- Maintain a focus on discussion of the specific topic and issue in the prompt throughout the essay.
- Present a thesis that establishes a focus on the writer's position on the issue.
- Maintain a clear focus on discussion of the specific topic and issue in the prompt throughout the essay.
- Present a critical thesis that clearly establishes the focus on the writer's position on the issue.

W3 Developing a Position

- Offer a little development, with one or two ideas; if examples are given, they are general and may not be clearly relevant; resort often to merely repeating ideas.
- Show little or no movement between general and specific ideas and examples.
- Offer limited development of ideas using a few general examples; resort sometimes to merely repeating ideas.
- Show little movement between general and specific ideas and examples.
- Develop ideas by using some specific reasons, details, and examples.
- Show some movement between general and specific ideas and examples.
- Develop most ideas fully, using some specific and relevant reasons, details, and examples.
- Show clear movement between general and specific ideas and examples.
- Develop several ideas fully, using specific and relevant reasons, details, and examples.
- Show effective movement between general and specific ideas and examples.

W4 Organizing Ideas

- Provide a discernible organization with some logical grouping of ideas in parts of the essay.
- Use a few simple and obvious transitions.
- Present a discernible, though minimally developed, introduction and conclusion.
- Provide a simple organization with logical grouping of ideas in parts of the essay.
- Use some simple and obvious transitional words, though they may at times be inappropriate or misleading.
- Present a discernible, though underdeveloped, introduction and conclusion.
- Provide an adequate but simple organization with logical grouping of ideas in parts of the essay but with little evidence of logical progression of ideas.
- Use some simple and obvious, but appropriate, transitional words and phrases.
- Present a discernible introduction and conclusion with a little development.
- Provide unity and coherence throughout the essay, sometimes with a logical progression of ideas.
- Use relevant, though at times simple and obvious, transitional words and phrases to convey logical relationships between ideas.
- Present a somewhat developed introduction and conclusion.

- Provide unity and coherence throughout the essay, often with a logical progression of ideas.
- Use relevant transitional words, phrases, and sentences to convey logical relationships between ideas.
- Present a well-developed introduction and conclusion.

W5 Using Language

- Show limited control of language by doing the following:
 - Correctly employing some of the conventions of standard English grammar, usage, and mechanics but with distracting errors that sometimes significantly impede understanding
 - Using simple vocabulary
 - Using simple sentence structure
 - Correctly employing some of the conventions of standard English grammar, usage, and mechanics but with distracting errors that sometimes impede understanding
 - Using simple but appropriate vocabulary
 - Using a little sentence variety, though most sentences are simple in structure
 - Correctly employing many of the conventions of standard English grammar, usage, and mechanics but with some distracting errors that may occasionally impede understanding
 - Using appropriate vocabulary
 - Using some varied kinds of sentence structures to vary pace
 - Correctly employing most conventions of standard English grammar, usage, and mechanics with a few distracting errors but none that impede understanding
 - Using some precise and varied vocabulary
 - Using several kinds of sentence structures to vary pace and to support meaning
 - Correctly employing most conventions of standard English grammar, usage, and mechanics with just a few, if any, errors
 - Using precise and varied vocabulary
 - Using a variety of kinds of sentence structures to vary pace and to support meaning

Appendix E: Pathway Content Standards

AGRICULTURE, FOOD, AND NATURAL RESOURCES (AFNR) PATHWAY CONTENT STANDARDS AND PERFORMANCE ELEMENTS

The AFNR Pathway Content Standards and Performance Elements are adapted from *National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards*. Reprinted with permission from the National Council for Agricultural Education, 1410 King Street, Suite 400, Alexandria, VA 22314. (800) 772-0939. Copyright © 2009. A complete copy of the National Standards can be downloaded from the Team Ag Ed Learning Center at <https://aged.learn.com>.

AGRIBUSINESS SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of principles and techniques for the development and management of agribusiness systems.

- ABS.01. Utilize economic principles to establish and manage an AFNR enterprise.**
 - ABS.01.01. Apply principles of capitalism in the business environment.
 - ABS.01.02. Apply principles of entrepreneurship in businesses.
- ABS.02. Utilize appropriate management planning principles in AFNR business enterprises.**
 - ABS.02.01. Compose and analyze a business plan for an enterprise.
 - ABS.02.02. Read, interpret, evaluate, and write a mission statement to guide business goals, objectives, and resource allocation.
 - ABS.02.03. Apply appropriate management skills to organize a business.
 - ABS.02.04. Recruit, train, and retain appropriate and productive human resources for business.
- ABS.03. Utilize record keeping to accomplish AFNR business objectives while complying with laws and regulations.**
 - ABS.03.01. Prepare and maintain all files needed to accomplish effective record keeping.
 - ABS.03.02. Implement appropriate inventory management practices.
- ABS.04. Apply generally accepted accounting principles and skills to manage cash budgets, credit budgets, and credit for AFNR businesses.**
 - ABS.04.01. Use accounting fundamentals to accomplish dependable bookkeeping and fiscal management.
- ABS.05. Assess accomplishment of goals and objectives by an AFNR business.**
 - ABS.05.01. Maintain and interpret financial information (income statements, balance sheets, inventory, purchase orders, accounts receivable, and cash-flow analyses) for businesses.
- ABS.06. Use industry-accepted marketing practices to accomplish AFNR business objectives.**
 - ABS.06.01. Conduct appropriate market and marketing research.
 - ABS.06.02. Develop a marketing plan.
 - ABS.06.03. Develop strategies for marketing plan implementation.
 - ABS.06.04. Develop specific tactics to market AFNR products and services.
- ABS.07. Create a production system plan.**
 - ABS.07.01. Prepare a step-by-step production plan that identifies needed resources.
 - ABS.07.02. Develop a production and operational plan.
 - ABS.07.03. Utilize appropriate techniques to determine the most likely strengths, weaknesses, and inconsistencies in a business plan, and relate these to risk management strategies.
 - ABS.07.04. Manage risk and uncertainty.

ANIMAL SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and practices to the production and management of animals.

AS.01. Examine the components, historical development, global implications, and future trends of the animal systems industry.

AS.01.01. Evaluate the development and implications of animal origin, domestication, and distribution.

AS.02. Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics.

AS.02.01. Classify animals according to hierarchical taxonomy and agricultural use.

AS.02.02. Apply principles of comparative anatomy and physiology to uses within various animal systems.

AS.02.03. Select animals for specific purposes and maximum performance based on anatomy and physiology.

AS.03. Provide for the proper health care of animals.

AS.03.01. Prescribe and implement a prevention and treatment program for animal diseases, parasites, and other disorders.

AS.03.02. Provide for the biosecurity of agricultural animals and production facilities.

AS.04. Apply principles of animal nutrition to ensure the proper growth, development, reproduction, and economic production of animals.

AS.04.01. Formulate feed rations to provide for the nutritional needs of animals.

AS.04.02. Prescribe and administer animal feed additives and growth promotants in animal production.

AS.05. Evaluate and select animals based on scientific principles of animal production.

AS.05.01. Evaluate the male and female reproductive systems in selecting animals.

AS.05.02. Evaluate animals for breeding readiness and soundness.

AS.05.03. Apply scientific principles in the selection and breeding of animals.

AS.06. Prepare and implement animal handling procedures for the safety of animals, producers and consumers of animal products.

AS.06.01. Demonstrate safe animal handling and management techniques.

AS.06.02. Implement procedures to ensure that animal products are safe.

AS.07. Select animal facilities and equipment that provide for the safe and efficient production, housing, and handling of animals.

AS.07.01. Design animal housing, equipment, and handling facilities for the major systems of animal production.

AS.07.02. Comply with government regulations and safety standards for facilities used in animal production.

AS.08. Analyze environmental factors associated with animal production.

AS.08.01. Reduce the effects of animal production on the environment.

AS.08.02. Evaluate the effects of environmental conditions on animals.

BIOTECHNOLOGY

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to biotechnology in agriculture.

- BS.01. Recognize the historical, social, cultural, and potential applications of biotechnology.**
 - BS.01.01. Distinguish major innovators, historical developments, and potential applications of biotechnology in agriculture.
 - BS.01.02. Determine regulatory issues, and identify agencies associated with biotechnology.
 - BS.01.03. Analyze the ethical, legal, social, and cultural issues relating to biotechnology.
- BS.02 Demonstrate laboratory skills as applied to biotechnology.**
 - BS.02.01. Maintain and interpret biotechnology laboratory records.
 - BS.02.02. Operate biotechnology laboratory equipment according to standard procedures.
 - BS.02.03. Demonstrate proper laboratory procedures using biological materials.
 - BS.02.04. Safely manage biological materials, chemicals, and wastes used in the laboratory.
 - BS.02.05. Perform microbiology, molecular biology, enzymology, and immunology procedures.
- BS.03. Demonstrate the application of biotechnology to Agriculture, Food, and Natural Resources (AFNR).**
 - BS.03.01. Evaluate the application of genetic engineering to improve products of AFNR systems.
 - BS.03.02. Perform biotechnology processes used in AFNR systems.
 - BS.03.03. Use biotechnology to monitor and evaluate procedures performed in AFNR systems.

ENVIRONMENTAL SERVICE SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the management of environmental service systems.

- ESS.01. Use analytical procedures to plan and evaluate environmental service systems.**
 - ESS.01.01. Analyze and interpret samples.
- ESS.02. Assess the impact of policies and regulations on environmental service systems.**
 - ESS.02.01. Interpret laws affecting environmental service systems.
- ESS.03. Apply scientific principles to environmental service systems.**
 - ESS.03.01. Apply meteorology principles to environmental service systems.
 - ESS.03.02. Apply soil science principles to environmental service systems.
 - ESS.03.03. Apply hydrology principles to environmental service systems.
 - ESS.03.04. Apply best management techniques associated with the properties, classifications, and functions of wetlands.
 - ESS.03.05. Apply chemistry principles to environmental service systems.
 - ESS.03.06. Apply microbiology principles to environmental service systems.
- ESS.04. Operate environmental service systems to manage a facility environment.**
 - ESS.04.01. Use pollution control measures to maintain a safe facility environment.
 - ESS.04.02. Manage safe disposal of all categories of solid waste.
 - ESS.04.03. Apply the principles of public drinking water treatment operations to ensure safe water at a facility.
 - ESS.04.04. Apply principles of wastewater treatment to manage wastewater disposal in keeping with rules and regulations.
 - ESS.04.05. Manage hazardous materials to assure a safe facility and to comply with applicable regulations.

ESS.05. Examine the relationships between energy sources and environmental service systems.

ESS.05.01. Compare and contrast the impact of conventional and alternative energy sources on the environment.

ESS.06. Use tools, equipment, machinery, and technology to accomplish tasks in environmental service systems.

ESS.06.01. Use technological and mathematical tools to map land, facilities, and infrastructure.

ESS.06.02. Maintain tools, equipment, and machinery in safe working order for tasks in environmental service systems.

FOOD PRODUCTS AND PROCESSING SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles, practices, and techniques in the processing, storage, and development of food products.

FPP.01. Examine components of the food industry and historical development of food products and processing.

FPP.01.01. Evaluate the significance and implications of changes and trends in the food products and processing industry.

FPP.01.02. Work effectively with industry organizations, groups, and regulatory agencies affecting the food products and processing industry.

FPP.02. Apply safety principles, recommended equipment, and facility management techniques to the food products and processing industry.

FPP.02.01. Manage operational procedures, and create equipment and facility maintenance plans.

FPP.02.02. Implement Hazard Analysis and Critical Control Point (HACCP) procedures to establish operating parameters.

FPP.02.03. Apply safety and sanitation procedures in the handling, processing, and storing of food products.

FPP.02.04. Demonstrate worker safety procedures with food product and processing equipment and facilities.

FPP.03. Apply principles of science to the food products and processing industry.

FPP.03.01. Apply principles of science to food processing to provide a safe, wholesome, and nutritious food supply.

FPP.04. Select and process food products for storage, distribution, and consumption.

FPP.04.01. Utilize harvesting, selection, and inspection techniques to obtain quality food products for processing.

FPP.04.02. Evaluate, grade, and classify processed food products.

FPP.04.03. Process, preserve, package, and present food and food products for sale and distribution.

NATURAL RESOURCE SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the management of natural resources.

NRS.01. Explain interrelationships between natural resources and humans necessary to conduct management activities in natural environments.

NRS.01.01. Apply knowledge of natural resource components to the management of natural resource systems.

- NRS01.02. Classify natural resources.
- NRS.02. Apply scientific principles to natural resource management activities.**
 - NRS.02.01. Develop a safety plan for work with natural resources.
 - NRS.02.02. Demonstrate cartographic skills to aid in developing, implementing, and evaluating natural resource management plans.
 - NRS.02.03. Measure and survey natural resource status to obtain planning data.
 - NRS.02.04. Demonstrate natural resource enhancement techniques.
 - NRS.02.05. Interpret laws related to natural resource management and protection.
 - NRS.02.06. Apply ecological concepts and principles to natural resource systems.
- NRS.03. Apply knowledge of natural resources to production and processing industries.**
 - NRS.03.01. Produce, harvest, process, and use natural resource products.
- NRS.04. Demonstrate techniques used to protect natural resources.**
 - NRS.04.01. Manage fires in natural resource systems.
 - NRS.04.02. Diagnose plant and wildlife diseases, and follow protocol to prevent their spread.
 - NRS.04.03. Manage insect infestations of natural resources.
- NRS.05. Use effective methods and venues to communicate natural resource processes to the public.**
 - NRS.05.01. Communicate natural resource information to the public.

PLANT SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the production and management of plants.

- PS.01. Apply knowledge of plant classification, plant anatomy, and plant physiology to the production and management of plants.**
 - PS.01.01. Classify agricultural plants according to taxonomy systems.
 - PS.01.02. Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.
 - PS.01.03. Apply knowledge of plant physiology and energy conversion to plant systems.
- PS.02. Prepare and implement a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.**
 - PS.02.01. Determine the influence of environmental factors on plant growth.
 - PS.02.02. Prepare growing media for use in plant systems.
 - PS.02.03. Develop and implement a fertilization plan for specific plants or crops.
- PS.03. Propagate, culture, and harvest plants.**
 - PS.03.01. Demonstrate plant propagation techniques.
 - PS.03.02. Develop and implement a plant management plan for crop production.
 - PS.03.03. Develop and implement a plan for integrated pest management.
 - PS.03.04. Apply principles and practices of sustainable agriculture to plant production.
 - PS.03.05. Harvest, handle, and store crops.
- PS.04. Employ elements of design to enhance an environment.**
 - PS.04.01. Create designs using plants.

POWER, STRUCTURAL AND TECHNICAL SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of principles and techniques for the development and management of power, structural, and technical systems.

- PST.01. Use physical science principles and engineering applications with power, structural, and technical systems to solve problems and improve performance.**
- PST.01.01. Select energy sources in power generation appropriate to the situation.
 - PST.01.02. Apply physical science laws and principles to identify, classify, and use lubricants.
 - PST.01.03. Identify and use hand and power tools and equipment for service, construction, and fabrication.
- PST.02. Design, operate, and maintain mechanical equipment, structures, biological systems, land treatment, power, and technology.**
- PST.02.01. Perform service routines to maintain power units and equipment.
 - PST.02.02. Operate, service, and diagnose the condition of power units and equipment.
- PST.03. Service and repair mechanical equipment and power systems.**
- PST.03.01. Troubleshoot and repair internal combustion engines.
 - PST.03.02. Utilize manufacturers' guidelines to service and repair the power transmission systems of equipment.
 - PST.03.03. Service and repair hydraulic and pneumatic systems.
 - PST.03.04. Troubleshoot and service electrical systems.
 - PST.03.05. Service vehicle heating and air-conditioning systems.
 - PST.03.06. Service and repair steering, suspension, traction, and vehicle performance systems.
- PST.04. Plan, build and maintain agricultural structures.**
- PST.04.01. Create sketches and plans of agricultural structures.
 - PST.04.02. Apply structural plans, specifications, and building codes.
 - PST.04.03. Examine structural requirements for materials and procedures, and estimate construction cost.
 - PST.04.05. Follow architectural and mechanical plans to construct and/or repair equipment, buildings, and facilities.
- PST.05. Apply technology principles in the use of agricultural technical systems.**
- PST.05.01. Use instruments and meters to test and monitor electrical and electronic processes.
 - PST.05.02. Prepare and/or use electrical drawings to design, install, and troubleshoot control systems.
 - PST.05.03. Use geospatial technologies in agricultural applications.

Appendix F:

National Educational Technology Standards for Students

T1 Creativity and Innovation

T2 Communication and Collaboration

T3 Research and Information Fluency

T4 Critical Thinking, Problem Solving, and Decision Making

T5 Digital Citizenship

T6 Technology Operations and Concepts

T1 Creativity and Innovation

Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students do the following:

- a. Apply existing knowledge to generate new ideas, products, or processes.
- b. Create original works as a means of personal or group expression.
- c. Use models and simulations to explore complex systems and issues.
- d. Identify trends and forecast possibilities.

T2 Communication and Collaboration

Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students do the following:

- a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media.
- b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats.
- c. Develop cultural understanding and global awareness by engaging with learners of other cultures.
- d. Contribute to project teams to produce original works or solve problems.

T3 Research and Information Fluency

Students apply digital tools to gather, evaluate, and use information. Students do the following:

- a. Plan strategies to guide inquiry.
- b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
- c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks.
- d. Process data and report results.

T4 Critical Thinking, Problem Solving, and Decision Making

Students use critical-thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. Students do the following:

- a. Identify and define authentic problems and significant questions for investigation.
- b. Plan and manage activities to develop a solution or complete a project.
- c. Collect and analyze data to identify solutions and/or make informed decisions.
- d. Use multiple processes and diverse perspectives to explore alternative solutions.

T5 Digital Citizenship

Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior. Students do the following:

- a. Advocate and practice safe, legal, and responsible use of information and technology.
- b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity.
- c. Demonstrate personal responsibility for lifelong learning.

- d. Exhibit leadership for digital citizenship.

T6 Technology Operations and Concepts

Students demonstrate a sound understanding of technology concepts, systems, and operations. Students do the following:

- a. Understand and use technology systems.
- b. Select and use applications effectively and productively.
- c. Troubleshoot systems and applications.
- d. Transfer current knowledge to learning of new technologies.