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Agriculture and Natural Resources

Agricultural and Natural Resources

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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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Dr. Tom Burnham, State Superintendent
Mr. William Harold Jones, Chair
Mr. Charles McClelland, Vice Chair
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Standards

Standards are superscripted in each unit and are referenced in the appendices. Standards in the *Agricultural and Natural Resources 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 online (https://www.ffa.org/ffaresources/ffalearn/. The National AFNR Career Cluster Content Standards are copyrighted to the National Council for Agricultural Education and are used by permission.

Common Core State Standards Initiative
The Common Core State Standards provide a consistent, clear understanding of what students are expected to learn, so teachers and parents know what they need to do to help them. The standards are designed to be robust and relevant to the real world, reflecting the knowledge and skills that our young people need for success in college and careers. With American students fully prepared for the future, our communities will be best positioned to compete successfully in the global economy. **Copyright 2010. National Governors Association Center for Best Practices and Council of Chief State School Officers**. All rights reserved. **States and territories of the United States as well as the District of Columbia that have adopted the Common Core State Standards in whole are exempt from this provision and no attribution to the National Governors Association Center for Best Practices and Council of Chief State School Officers is required.** Reprinted from http://www.corestandards.org/.

National Educational Technology Standards for Students
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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.

Preface

Secondary career and 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).

Agricultural and Natural Resources Executive Summary

Pathway Description

Agricultural and Natural Resources is a pathway to introduce the student to the broad field of agriculture and natural resources, including the production of plants and animals and the management of natural resources. The program includes instruction in the applied sciences related to plant and animal production and natural resource conservation and management, as well as introducing the student to agribusiness management practices and maintenance of facilities and equipment. Students in the pathway will participate in active learning exercises including integral activities of the FFA organization and supervised experiences. Students who successfully complete the competencies in this pathway will possess fundamental knowledge and skills that can be used to secure entry-level employment or as a foundation for continuing their education. Industry standards are adapted from the publication Career Cluster Resources for Agriculture, Food, and Natural Resources, developed by the National Association of State Directors of Career and Technical Education.

Industry Certification

No national industry-recognized certifications are known to exist at this time. Competencies and suggested performance indicators in the ANR 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.

Assessment

Students will be assessed using the Agricultural and Natural Resources (ANR) MS-CPAS2 test. At the end of the first year, first-year students will be assessed using the ANR first-year MS-CPAS2 test. The first-year test is based on content from first-year ANR curriculum material. At the end of the second year, the second-year students will be assessed using the ANR second-year MS-CPAS2 test. The second-year test is based on content from the second-year ANR curriculum material. The MS-CPAS2 blueprint can be found at www.rcu.msstate.edu/Curriculum/CurriculumDownload.aspx 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

In order for students to be able to experience success in the ANR program, the following student prerequisites are in place:

1. C or higher in English (the previous year)
2. C or higher in Math (last course taken or the instructor can specify the math)
3. Instructor Approval and TABE Reading Score (eighth grade or higher)

or

1. TABE Reading Score (eighth grade or higher)
2. Instructor Approval

or

1. Instructor Approval

Applied Academic Credit

Content of the Concepts of ANR course has been aligned to the *2010 Mississippi Science Curriculum Framework*. Students who successfully complete the first- and second-year ANR curriculum will receive two elective science credits that will count toward high-school science graduation requirements.

Professional Learning

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

Option 1 — Four One-Carnegie-Unit Courses

Course Description: Fundamentals of Agricultural and Natural Resources is designed to introduce the student to fundamental concepts and principles of the modern agricultural and natural resources industry. Emphasis is placed on career and leadership skills and basic principles of plant, animal, and soil science.

Course Description: Agricultural and Natural Resources: Soils and Ag Lab Operations is designed to provide knowledge and skills concerning basic mechanical technologies in the field.

Course Description: Agricultural and Natural Resources: Environmental Science is designed to provide concepts and principles associated with agriculture and natural resources. Emphasis is placed on the conservation and management of natural resources; agricultural business management practices; and the environment as it relates to water quality, forestry, and wildlife.

Course Description: Agricultural and Natural Resources: Equipment Operation and Business MGT is designed to provide instruction on basic agriculture construction techniques and agriculture business management and processes.

Fundamentals of Agricultural and Natural Resources — Course Code: 991102

Unit Number	Unit Name	Hours
1	Intro to ANR*	10
2	Leadership and Human Relations*	15
3	Supervised Agricultural Experience (SAE) Programs*	15
4	Science of Animals	35
5	Science of Plants	30
Total		105

Agricultural and Natural Resources: Soils and Ag Lab Operations — Course Code: 991103

Unit Number	Unit Name	Hours
6	Science of Soil	30
7	Agricultural Lab Operations and Safety	75
Total		105

Agricultural and Natural Resources: Environmental Science — Course Code: 991104

Unit Number	Unit Name	Hours
8	Orientation/Careers/Leadership*	25
9	Science of the Ag Environment	15
10	Water Quality	15
11	Forestry and the Environment	15
12	Wildlife and the Environment	15
13	Environmental Stewardship	20
Total		105

Agricultural and Natural Resources: Equipment Operation and Business MGT — Course Code: 991105

Unit Number	Unit Name	Hours
14	Construction and Agricultural Equipment Operation and Maintenance	75
15	Agricultural Business Management and Processes	30
Total		105

Option 2 — Two Two-Carnegie-Unit Courses

Course Description: Agricultural and Natural Resources I is designed to introduce the student to fundamental concepts and principles of the modern agricultural and natural resources industry. Emphasis is placed on career and leadership skills; basic principles of plant, animal, and soil science; and basic mechanical technologies in the field. (2–2.5 Carnegie units depending on time spent in course)

Course Description: Agricultural and Natural Resources II is designed to continue the exploration of fundamental concepts and principles associated with agriculture and natural resources. Emphasis is placed on the conservation and management of natural resources; agricultural business management practices; and the environment as it relates to water quality, forestry, and wildlife. Instruction is provided on basic agriculture construction techniques and agriculture business management and processes. (2–2.5 Carnegie units depending on time spent in course)

Agricultural and Natural Resources I — Course Code: 991100

Unit Number	Unit Name	Hours
1	Intro to ANR*	10
2	Leadership and Human Relations*	15
3	Supervised Agricultural Experience (SAE) Programs*	15
4	Science of Animals	35
5	Science of Plants	30
6	Science of Soil	30
7	Agricultural Lab Operations and Safety	75
Total		210

Agricultural and Natural Resources II—Course Code: 991101

Unit Number	Unit Name	Hours
8	Orientation/Careers/Leadership*	25
9	Science of the Ag Environment	15
10	Water Quality	15
11	Forestry and the Environment	15
12	Wildlife and the Environment	15
13	Environmental Stewardship	20
14	Construction and Agricultural Equipment Operation and Maintenance	75
15	Agricultural Business Management and Processes	30
Total		210

Agricultural and Natural Resources Research Synopsis

Introduction

The Agricultural and Natural Resources 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-related jobs. 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. According to the Division of Agriculture, Forestry, and Veterinary Medicine at Mississippi State University, Mississippi's value of production estimates for 2010 amounted to $6.875 billion. Additionally, the Mississippi Department of Agriculture and Commerce estimates that 29% of the state's workforce is employed in jobs relating directly or indirectly to agriculture. The total economic impact is $12.7 billion each year. Agriculture makes an impact in all 82 counties in the state of Mississippi, throughout our nation, and around the world.

The Agricultural and Natural Resources (ANR) Career Pathway 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.

Needs of the Future Workforce

Data for this synopsis was 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 Agricultural and Natural Resources Pathway.

Employment (with industry job data BLS/EMSI table)

Occupational title	Employment, 2011	Projected employment, 2019	Change 2011–2019		Mean annual wage (in dollars)
			Number	Percent	
Biological technicians	469	537	68	14	$16.44
Vocational education teachers, secondary school	1437	1562	125	9	$26.92
First-line supervisors/managers of landscaping, lawn service, and groundskeeping workers	2759	3521	762	28	$10.56
Conservation scientists	624	684	60	10	$22.63
Agricultural inspectors	319	352	33	10	$17.33
Chemical technicians	360	373	13	4	$18.90
Chemists	294	314	20	7	$28.57
Environmental scientists and specialists, including health	548	614	86	16	$14.64

Soil and plant Scientists	191	211	20	10	$28.26
Zoologists and wildlife biologists	201	222	21	10	$28.56
Food scientists and technologists	156	169	13	8	$16.50
Agricultural and food science technicians	264	287	23	9	$18.21
Forest and conservation technicians	287	312	25	9	$18.95
Forest and conservation workers	117	121	4	3	$13.01
Foresters	281	303	22	8	$18.69
Physical scientists, all other	344	382	38	11	$37.68
Survey researchers	332	440	108	33	$26.04
Life, physical, and social science technicians, all other	181	205	24	13	$16.08
Environmental science and protection technicians, including health	161	198	37	23	$14.64
Microbiologists	46	50	4	9	$25.62
Farm and home management advisors	139	141	2	1	$20.33
Animal scientists	53	58	5	9	$17.70
Social scientists and related workers, all other	161	189	20	17	$29.03
Geological and petroleum technicians	281	367	86	31	$16.09
Hydrologists	21	24	3	14	$26.04

Perkins IV Requirements

The ANR curriculum meets Perkins IV requirements of high-skill, high-wage, and/or high-demand occupations by introducing students to and preparing students for occupations. It also offers students a program of study including secondary, postsecondary, and IHL courses that will prepare them for occupations in these fields. Additionally, the ANR curriculum is integrated with academic common core standards. Lastly, the ANR curriculum focuses on ongoing and meaningful professional development for teachers as well as relationships with industry.

Curriculum Content

Summary of Standards

The standards to be included in the ANR curriculum are the Common Core Standards for Mathematics and Science, 21st Century Skills, and the National Educational Technology Standards (NETS) for Students. Combining these standards to create this document will result in highly skilled, well-rounded students who are prepared to enter a secondary academic or career and technical program of study. They will also be prepared to academically compete nationally, as the Common Core Standards are designed to prep students for success in community colleges, Institutions of Higher Learning and careers.

Academic Infusion

The ANR curriculum is aligned to the Mississippi Academic Science Standards. Content of the ANR courses has been aligned to the Mississippi Science Curriculum Framework. It is proposed that students who complete ANR will receive two electives and two equivalent science credits or four elective credits that will count toward high-school science graduation requirements. When academic credit is awarded for this curriculum, this paragraph will be updated.

The ANR curriculum is tied to the 2010 Mississippi Science Curriculum Framework Common Core Science and Mathematics standards. The curriculum provides multiple opportunities to enhance and reinforce these academic skills. Since students will be required to communicate effectively in the classroom as well as in the workforce, there is a considerable amount of writing in this curriculum. The academic content in the ANR curriculum provides several opportunities for focus in science and mathematics, as it directly relates to ANR content. Overall the ANR content requires students to perform calculations and use strategic and critical thinking skills to solve real world problems.

Transition to Postsecondary Education

The following articulation plan is in place for the ANR Pathway.

Statewide Guidelines on Articulated Credit

Eligibility

- To be eligible for articulated credit, a student must do the following:
    - Complete the articulated Secondary Career and Technical Program.
    - Score 80% or higher on the Mississippi Career Planning and Assessment System (MS CPAS2) in his or her secondary program of study.
- To be awarded articulated credit, a student must do the following:
    - Complete application for articulated credit at the community or junior college.
    - Enroll in the community or junior college within 18 months of graduation.
    - Successfully complete 12 non-developmental career/technical or academic credit hours in the corresponding articulated postsecondary career/technical program of study.

How MS CPAS2 will be documented

- The Research and Curriculum Unit of Mississippi State University will provide the MS Community College Board (MCCB) a list of all secondary CTE students scoring at or above the 80th percentile for the articulated programs.
- The MCCB will forward the list of students eligible for articulated credit to the colleges.

Transcripting of Articulated Credit

- Students must complete 12 non-developmental career/technical or academic credit hours in the articulated postsecondary career/technical program of study before the articulated credit is transcripted.
- No grade will be given on the transcript for articulated courses; only hours granted will be transcripted (thus resulting in no change in quality points).

Time Limit

- MS-CPAS2 scores will be accepted to demonstrate competencies for up to 18 months after high-school graduation.

Cost

- No costs will be assessed on hours earned through articulated credit.
- Articulation credit from Secondary to the Postsecondary will be awarded beginning upon implementation of this curriculum by the college. Courses to be articulated are listed in the chart below with the stipulation of passing the MS-CPAS2 according to MCCB guidelines.

Articulated Secondary Program	Community College Program	Articulated Postsecondary Course
Agricultural & Natural Resources – Program CIP: 01.0003 – Agricultural and Natural Resources	Ag Business & Mgmt Tech (Program CIP: 01.0304 – Field Crops)	AGT 1111 - Survey of Agriculture
	Ag Business & Mgmt Tech (Program CIP: 01.0304 – Field Crops)	AGT 1313 - Applied Principles of Plant Production
	Horticulture Cluster (Program CIP: 01.0601 – Horticulture Service Operations and Management) (Program CIP: 01.0605 – Landscaping) (Program CIP: 01.0607 – Turf Management)	HLT 1411 – Leadership Management

Professional Preparation

Teacher Licensure

990 Career Pathway: Agricultural and Natural Resources

This is an "add on" endorsement that may be earned only by persons who hold a currently valid Mississippi Educator License with endorsement #301—Vocational Agriculture-Related Program or #302 Agriculture.

A #990 endorsement allows a person to teach the following courses:

991100 Agricultural and Natural Resources I

991101 Agricultural and Natural Resources II

991102 Fundamentals of Agricultural and Natural Resources

991103 Agricultural and Natural Resources: Soils and Ag Lab Operations

991104 Agricultural and Natural Resources: Environmental Science

991105 Agricultural and Natural Resources: Equipment Operation and Business MGT

This endorsement requires the following:

1. Currently valid Mississippi Educator License with endorsement in Vocational Agriculture-Related Program #301 or Agriculture #302.

2. Complete and submit MDE licensure application form.

3. Applicant must validate technology competency by attaining the established minimum score or higher on an assessment approved by the Mississippi Department of Education (MDE). The assessment must be directly related to technology competency required by the grade level and subject matter being taught. Approved assessments for this license are IC3, Propulse, or other specific assessment created by third-party vendors, authorized by the Local Education Agency (LEA) and approved by the MDE.

4. Applicant must successfully complete a Certification for online-learning workshop, module, or course that is approved by the Mississippi Department of Education.

5. Applicant must successfully complete an Agricultural and Natural Resources Certification workshop, module, or course that is approved by the Mississippi Department of Education.

6. Applicant must enroll immediately in Vocational Instructor Preparation (VIP) program or the College and Career Readiness Educator Program (CCREP) program. Applicant must complete the individualized Professional Development Plan (PDP) requirements of the VIP or CCREP program prior to the expiration date of the three-year vocational license.

Note #1: If the applicant meets all requirements listed above, that applicant will be issued a 990 endorsement—a five-year license. If the applicant does not meet all requirements, the applicant may be issued a three-year endorsement (license), and all requirements stated above must be satisfied prior to the ending date of that license**.**

Best Practices

Experiential Learning (SAE)

The Experiential Learning (SAE) has long been and continues to be the backbone of every agriculture program. The experiential learning projects can be used in a variety of situations to reinforce and complement classroom theory and content. The experiential learning project consists of entrepreneurship, placement, research/experimentation, and exploratory activities.

Innovative Instructional Technologies

Recognizing that today's students are digital learners, the classroom should be equipped with tools that will teach them in the way they need to learn. The ANR teacher's goal should be to include teaching strategies that incorporate current technology. It is suggested that each classroom house a classroom set of desktop student computers and one teacher laptop. To make use of the latest online communication tools such as wikis, blogs, and podcasts, the classroom teacher is encouraged to use a learning management system, for example, the Agriculture Teacher Blackboard Content Management System, that introduces students to education in an online environment and places the responsibility of learning on the student.

Differentiated Instruction

Students learn in a variety of ways. Some are visual learners, needing only to read information and study it to succeed. Others are auditory learners, thriving best when information is read aloud to them. Still others are

tactile learners, needing to participate actively in their learning experiences. Add the student's background, emotional health, and circumstances, and a very unique learner emerges. To combat this, the ANR curriculum is written to include several instructional methods by using the Understanding by Design (UbD) approach. This method of instructional design leads students to a deeper understanding of course material and provides multiple opportunities for students to succeed in different ways. Many activities are graded by rubrics that allow students to choose the type of product they will produce. By providing various teaching and assessment strategies, students with various learning styles can succeed.

Career and Technical Education Student Organizations

Teachers should investigate opportunities to sponsor a student organization. There are several here in Mississippi that will foster the types of learning expected from the ANR curriculum. The FFA is the student's organization for ANR. The FFA provides students with growth opportunities and competitive events. It also opens the doors to the world of agriculture and scholarship opportunities.

Cooperative Learning

Cooperative learning can help students understand topics when independent learning cannot. Therefore, you will see several opportunities in the ANR curriculum for group work. To function in today's workforce, students need to be able to work collaboratively with others and solve problems without excessive conflict. The ANR curriculum provides opportunities for students to work together and to help each other complete complex tasks.

Conclusions

The ANR is one of Mississippi's most comprehensive agriculture curriculums. Students that complete these programs are well equipped for a variety of endeavors. Instructors are urged to encourage ANR students to pursue educational opportunities at community colleges and universities in Mississippi.

Professional Organizations

American Association for Agricultural Education; http://aaaeonline.org/

B.R.I.D.G.E. - Mississippi Agriculture Education; http://rcu.blackboard.com

Mississippi ACTE; http://www.mississippiacte.com/

Mississippi FFA/ Mississippi Association of Vocational Agriculture Teachers (MAVAT); www.mississippiffa.org

National FFA Organization
P.O. Box 68960, 6060 FFA Drive
Indianapolis, IN 46268
317.802.6060
https://www.ffa.org/

National Association of Agricultural Educators
300 Garrigus Building
University of Kentucky
Lexington, KY 40546
800. 509.0204
http://www.naae.org/

Using this Document

Unit Number and Title

Suggested Time on Task
This is the estimated number of clock hours of instruction that should be required to teach the competencies and objectives of the unit. A minimum of 140 hr 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 Performance Indicators
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 performance indicators 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.

Unit 1: Introduction to ANR

Understandings and Goals

Enduring Understandings
In this unit, the student will learn:

- 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.
- Advances in technology and techniques have allowed American agriculture to produce more products on reduced acreages and with reduced labor requirements.
- 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.
- Education and training opportunities for careers in agriculture and natural resources exist in community/junior colleges, technical institutes, and colleges and universities.
- 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.
- The applied agricultural sciences represent extensions of several of the pure sciences.
- Both the pure sciences and the agricultural sciences depend upon the scientific method for conducting experiments.
- Using proper safety precautions and equipment is the responsibility of every member of a work team or class. Safety precautions are learned and transferred to the workplace.
- Each student is responsible for understanding the safety rules and practices that must be followed in the ANR classroom and lab, including the use of personal protection devices.
- 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.
- Workers should be fully aware of safety devices and warnings in the workplace and their meaning or operation.
- The use of personal protection devices and proper dress is critical to worker safety.
- There are four different types of fires, and each different type requires different methods of control.

Essential Questions

- How has the nature of agriculture and natural resources changed over the past century?
- How have new technologies and practices affected agricultural and natural resources production?
- What products are manufactured today from agriculture and natural resources enterprises?
- What education and training opportunities exist in agriculture and natural resources?
- How has the globalization of trade affected agriculture and natural resources industries in the United States?
- What is the relationship of the pure sciences to the applied agricultural sciences?
- What is the scientific method?
- What are the general safety standards that apply to work teams in the workplace?
- What are the specific safety rules and practices that must be followed when working in the ANR classroom and laboratory?
- What information can be obtained from an MSDS?
- What safety devices and warning devices are used in the Agriculture Mechanization laboratory? What do the warnings mean? How do the devices operate?
- What personal safety devices and clothing should be worn in the workplace or laboratory?

- What should be done if a fire breaks out in the laboratory or workplace?

Vocabulary

Identify and review the unit vocabulary. Definitions will be located in Appendix B.

Agriculture
Agriscience
Hazardous material
MSDS
Natural resources
Renewable natural resource
Scientific method

Suggested Learning Experiences

Competency 1: Examine the nature of the agriculture and natural resources industry. (DOK1, AB, AS, AO, AE, AF, AN, AP, AT)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Investigate the scope of the agricultural and natural resources industry. (CCR1, CCR2, CCR3, CS1, CS2, CS3)	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.	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 the United States. (CR1, CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6)	b. Pair students and assign a specific agricultural science or technology such as machinery, chemicals, genetics, environmental services, natural resources, biotechnology, and so forth. 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.	b. Use the ANR Timeline Graphic Rubric to evaluate the students' performance on the development time line.
c. Associate the major areas of agriculture and natural resources with their products and practices. (CCR4, CCR5, CS1, CS2, CS4, T1, T3, T6)	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.	c. Use the ANR Areas Graphic Rubric to evaluate the students' performance in creating the graphic.
d. Investigate education and training opportunities in agriculture and natural resources. (CCR1, CCR2, CCR3, CS1, CS2, CS4, T1, T3, T6)	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.	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. (CCR1, CCR2, CCR3, CS1, CS2, CS4, T1, T3, T6)	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.	e. Use a written test to evaluate student understanding.

Competency 2: Examine the relationships between the pure sciences, agriculture, and agriscience. (DOK 1, AN)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**

a. Associate the pure sciences with agriculture and agriscience areas. (CCR4, CCR5, CS2, AQ1, BIOI1, BIOII1, BO1, ES1, G1, PS1, ZO1)	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.	a. Use Relationship of Pure Sciences to Agricultural Sciences Assignment to evaluate student performance.
b. Develop a plan for conducting an experiment using the scientific method. (CCR1, CCR2, CCR3, CS4, T1, T2, T6 AQ1, BIOI1, BIOII1, BO1, ES1, G1, PS1, ZO1)	b. Use the video *The Scientific Method* 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 develop a plan for an experiment illustrating each basic step. Have the students enter their plans in their electronic portfolios.	b. Use the Planning an Experiment Rubric to evaluate student performance.

Competency 3: Apply standard agricultural and natural resources safety practices. (DOK 1, AN)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Apply safety standards in the workplace. (CCR7,CCR8, CCR9, CS1, CS4, T1, T2, T6)	a. Invite a safety specialist to present a safety demonstration to the class regarding the importance of safety and standard safety precautions used in the workplace. Have students take notes during the presentation and transcribe them into their electronic journals or notebooks. Follow the presentation with a class discussion to make sure that all students identified the major points.	a. Evaluate the students' electronic notebooks or journals to make sure that all major points are covered.
b. Apply safety standards in the agricultural classroom and laboratory. (CCR7, CCR8, CCR9, CS2, CS4, T6)	b. Provide students with written guidelines for safety in the ANR classroom and laboratory, including the use of personal safety equipment. Identify the location of safety equipment and discuss procedures for dealing with accidents, injuries, and spills.	b. Use a written test to determine the students' initial understanding of the safety standards that apply to the classroom and laboratory. Students will be constantly observed while in the laboratory area and periodically evaluated regarding the use of safety rules and equipment using the Laboratory Safety Rubric.
c. Interpret information on a material safety data sheet (MSDS). (CCR7, CCR8, CCR9, CS1, CS2, CS4, T6)	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.	c. Use Interpret a Hazardous Material Safety Data Sheet Assignment 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	d. Have students draw a diagram of the ANR laboratory showing the location of all safety devices and equipment. Have students identify each tool by its correct name and classify it as being a layout tool, cutting tool, boring tool, driving tool, turning tool, or holding tool.	d. Evaluate the drawing for accuracy and completeness. Use the quiz in the module to evaluate understanding of general safety equipment and color codes. Monitor

kits, emergency exits, and so forth. (CCR1, CCR2, CCR3, CS1, CS2, CS4, T6)		tool activity for content and accuracy.
e. Apply safety precautions related to dress and personal-protection devices and select procedures for dealing with the different classes of fires. (CCR7, CCR8, CCR9, CS1, CS2, CS4, T6)	e. Have students create a role-play to demonstrate safety procedures.	e. Evaluate the role-play using the Role-play Rubric.

Performance Task

Cheeseburger Curiosity

Unit 1

Have each student or group of students break down each part of a cheeseburger (loaded, or with everything on it) and identify the agricultural ingredients. Tell where each ingredient comes from or its place of origin. Begin with the growing, harvesting, processing, and consumption of each ingredient. Students will record individual findings in their journals and one student from each group will present one of the ingredients to the class. The class will discuss accuracy of findings and will record findings in their journals. Evaluate journal activity using the Journal rubric found in Appendix A.

Attachments for Performance Task

None

Unit Resources

Books:

Cooper, E. L., & Burton, L. D. (2009). *Agriscience: Fundamentals and application* (5rd ed.). Albany, NY: Delmar.

Newman, M. E., & Wills, W. J. (1998). *Agribusiness management and entrepreneurship*. Upper Saddle River, NJ: Pearson Prentice Hall.

Web sites:

FFA. (n.d.). Retrieved September 28, 2011, from www.ffa.org

For additional references, activities, and Web resources, please refer to the Mississippi Agriculture Education B.R.I.D.G.E. Web site: http://rcu.blackboard.com (available only to registered users).

Mississippi Department of Agriculture and Commerce. (2011). *Mississippi agriculture overview*. Retrieved June 8, 2011, from http://www.mdac.state.ms.us

United States Department of Agriculture. (2011). *National agricultural statistics service (NASS).* Retrieved June 8, 2011, from http://www.nass.usda.gov/

Other:

Farm Safety of Kids, Inc. (2010). *Farm safety 4 just kids*. Retrieved June 8, 2010, from http://www.fs4jk.org/services.htm

National FFA Organization. (2011). *FFA proficiency award and degree* [Computer software]. Indianapolis, IN: Author.

National FFA Organization. (2011). SAE (Work-based learning): Providing hands-on experience and career exploration. In *A guide to local program success* [Computer software]. Indianapolis, IN: Author.

National FFA Organization. (2011). *LifeKnowledge-Real lessons for real life content* [Computer software]. Indianapolis, IN: Author.

Unit 2: Leadership and Human Relations

Understandings and Goals

Enduring Understandings
In this unit, the student will:

- 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.
- The FFA is an integral part of the Agricultural and Environmental Science and Technology program, promoting leadership, human relations, and technical skill attainment and providing recognition for accomplishments.
- Leadership is the ability to influence people to accomplish the goals and objectives of an organization.
- Leadership skills can be learned.
- Work ethics and values are essential for success in all career fields.

Essential Questions

- What are the necessary life and career skills for success in the modern world?
- What is the role of the FFA in the ANR program?
- What is leadership?
- What are the traits of successful leaders?
- What is the role of work ethics and values in establishing and building a successful career?

Vocabulary

Identify and review the unit vocabulary. Definitions will be located in Appendix B.

FFA
Human relations
Leadership
Parliamentary procedure
Work ethics

Suggested Learning Experiences

Competency 1: Develop life and career skills for success in the 21st century. (DOK 3)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Identify, describe, and apply essential life and career skills. (CCR7, CCL1, CCL2, CCR8, CCR9, CS12, CS13, CS14, CS15, CS16)	a. Provide students with the listing of 21st Century Life and Career Skills 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) graded on their ability to demonstrate these skills.	a. Use 21st Century Life and Career Skills Rubric for assessing students' ability to demonstrate the essential life and career skills.
b. Apply the concepts of team building and team member participation. (CCSL3, CS12, CS13, CS14, CS15, CS16)	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 ANR program. Provide students with a copy of the rubric that will be used periodically to evaluate their team-building and participation skills.	b. Use the rubric for Assessing Team Building and Participation Skills to periodically evaluate the team-building and participation skills of all students.
c. Demonstrate basic parliamentary procedures. (CCL1, CS12, CS13, CS14, CS15, CS16)	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.	c. Use the Scorecard for Assessing Parliamentary Procedures Skills to evaluate parliamentary procedure skills of students.

Competency 2: Explore the role of the FFA in promoting leadership, personal development, and human relations skills. (DOK 1)		
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. (CCR1, CCR2, CCR3, CS12, CS13, CS14, CS15, CS16)	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.	a. Monitor discussion to ensure that all students are participating and attentive.
b. Identify career-related values and ethics promoted through the FFA. (CCR4, CCR5, CS12, CS13, CS14,	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	b. Evaluate the summaries in the electronic journals for completeness and accuracy.

CS15, CS16, T1, T2, T5, T6)	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.	
c. Identify benefits of FFA membership. (CCR1, CCR2, CCR3, CS1, CS2, CS3, CS4, CS5, T1, T2, T5, T6)	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.	c. Evaluate the students' electronic notebooks or journals for completeness and accuracy.
d. Select FFA activities that promote personal development and leadership skills. (CCR4, CCR5, CS1, CS2, CS3, CS4, CS5, T2, T5, T6)	d. Have students search the FFA Web site (http://www.ffa.org) 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.	d. Have students peer review and comment on the completed attachment, Select a Personal/ Leadership Activity Assignment .

Competency 3: Examine the concept of leadership. (DOK 1)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Explain the role of effective leadership. (CCSL1, CCSL2, CS12, CS13, CS14, CS15, CS16, T2, T6)	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.	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. (CCR1, CCR2, CCR3, CS12, CS13, CS14, CS15, CS16)	b. Provide the students with a survey instrument that lists major traits and characteristics of successful leaders. (See the Leadership Characteristics Survey) 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.	b. Have students peer review other students' surveys and offer comments and recommendations on improvement practices. (Leadership Characteristics Survey)

Competency 4: Describe the role of work ethics and values in establishing and building a successful career. (DOK 1)		
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. (CCR4, CCR5, CS1, CS2, CS3, CS4, CS5, T2, T6)	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.	a. Evaluate electronic notebooks/ journals for accuracy and completeness.
b. Practice work ethics and values in the agriscience classroom and laboratory. (CS1, CS2, CS3, CS4, CS5)	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.	b. Use the Sample Rubric for Evaluating Work Ethics and Values to evaluate student work ethics and values periodically, or add

		indicators of work ethics and values to other rubrics used in the course.

Performance Task

The Future President

You are the FFA president and need to present to a group of junior-high students on the FFA. Prepare a 2-3 min speech on the benefits of FFA. Prepare the speech according to the FFA guidelines for speeches (impromptu, extemporaneous, etc.) The class will peer review the speech and discuss clarity and content.

Attachments for Performance Task

None

Unit Resources

Books:

Burton, L. (2010). *Agriscience fundamentals and applications* (5th ed.). Albany, NY: Delmar.

Morgan, E., Lee, J., & Wilson, E. (2009). *Agriscience explorations*. Upper Saddle River, NJ: Prentice Hall.

National FFA Organization. (2010). *Official FFA manual*. Indianapolis, IN: Author.

Stewart, M., Lee, J., Hunter, S., Schell, B., Fraze, S., & Terry, R. (2004). *Developing leadership and communications skills* (2nd ed.). Upper Saddle River, NJ: Prentice Hall.

Web sites:

National FFA Organization. (2011). *Welcome to LifeKnowledge*. Retrieved June 8, 2011, from http://www.ffa.org/index.cfm?method=c_aged.LifeKnowledge_index

National FFA Organization. (2011). *Local program success guide*. Retrieved June 8, 2011, from http://www.ffa.org/documents/lps_guide.pdf

Unit 3: Experiential Learning (SAE)

Understandings and Goals

Enduring Understandings
In this unit, the student will:

- Planning is a continuous process in business.
- Plans must be reviewed and updated on a regular basis.
- Records must be maintained and updated on a regular and timely basis to accurately reflect progress.
- Records should be summarized to give a snapshot of operations on a regular basis that can be used to make decisions.

Essential Questions

- What are my goals and plans for an SAE in the coming year?
- How do I update and maintain the records of my experiential learning program?
- How do I summarize and analyze my experiential learning records?

Vocabulary

Identify and review the unit vocabulary. Definitions will be located in Appendix B.

Asset
Cash
Inventory
Liability
Loss
Net worth
Non-cash expense
Profit
SAEP

Suggested Learning Experiences

Competency 1: Plan and implement an experiential learning program. (DOK 3, AB)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Update and revise long-range and short-term goals of the experiential-learning program. (CCW4, CCW10, CS1, CS2, CS4, T1, T3, T4, T6)	a. Students can do a scavenger hunt activity using Experiential Learning Scavenger Hunt. 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.	a. Evaluate using the Experiential Learning Scavenger Hunt activity.
b. Update, revise, and implement the experiential-learning plan/training agreement for the coming year. (CCW4, CCW10, CS4, CS5, CS6, CS7, T2, T3, T4, T6)	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 Experiential Learning Goals and Plans as a guide.	b. Use an experiential-learning planning rubric and record-keeping rubric to evaluate the students' goals. (See the Experiential Learning Goals and Plans.)

Competency 2: Maintain records and documentation of experiential learning activities, projects, and enterprises. (DOK 3, AB)		
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. (CCW4, CCW10, CS12, CS13, CS14, CS15, CS16, T3, T4, T6)	a. Review requirements for record keeping for the different types of experiential learning. Have students maintain and update their records electronically throughout the year.	a. Use the Rubric for Experiential Learning Planning and Record Keeping to evaluate the students' goals.
b. Prepare an annual summary report. (CCW4, CCW10, CS12, CS13, CS14, CS15, CS16, T3, T4, T6)	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.	b. Use the Rubric for Experiential Learning Planning and Record Keeping to evaluate the students' summaries.

Performance Task

The SAE "CEO"

The student will assume the role as CEO of a Supervised Agriculture Experience (SAE). As the CEO, you are responsible for developing an SAE project and keeping records throughout the year. Students will complete

applications and apply for state degree/proficiency awards. Applications can be retrieved from the FFA Web site. Once the forms are completed they are to be submitted to the FFA organization. The SAE project will be graded using the Activity Performance Task Rubric found in Appendix A.

Attachments for Performance Task

None

Unit Resources

Books:

Burton, L. (2010). *Agriscience fundamentals and applications* (5th ed.). Albany, NY: Delmar.

National FFA Organization. (2011). Lesson 126: Taking my trip. In *LifeKnowledge: Real lessons for real life* [CD-ROM software]. Indianapolis, IN: Author.

National FFA Organization. (2011). *SAE ideas*. Indianapolis, IN: Author.

National FFA Organization. (2011). *SAE handbook* [CD-ROM edition]. Indianapolis, IN: Author.

Web sites:

National FFA Organization. (n.d.). *Introduction to SAE* [PowerPoint presentation]. Retrieved June 9, 2011, from http://www.ffa.org/documents/sae_tch_intro.zip

National FFA Organization. (n.d.). *SAE best practices guide*. Retrieved June 9, 2011, from http://www.ffa.org/documents/sae_bp.pdf

National FFA Organization. (n.d.). *Supervised agricultural experience.* Retrieved June 9, 2011, from http://www.ffa.org/index.cfm?method=c_programs.SAE

Unit 4: Science of Animals

Understandings and Goals

Enduring Understandings

In this unit, the student will learn:

- 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 is 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.
- The basic building block of an animal's body is the cell.
- Through the process of mitosis, cells divide and reproduce to produce an animal.
- 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.
- Reproduction begins with the creation of an embryo. Mammalian embryos develop inside the mothers' bodies. Avian embryos develop outside of the mothers' bodies.
- 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.
- Six different classes of nutrients are needed by an animal for optimum growth and development.
- A variety of feedstuffs is used in developing animal rations.
- Many traits and characteristics of an animal are passed to the animal through the genetic makeup of the animal's parents.
- 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.
- Selective breeding is a process by which desirable characteristics are increased and undesirable characteristics are decreased.

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?
- What are the functions of the different parts of a cell?
- How does mitosis allow cells to divide and reproduce?
- What are the components and functions of the major systems of an animal's body?
- How is the reproduction process in mammals and birds similar yet different?
- How does the digestive process differ from one species of animal to another?
- What are the six essential nutrients, and how are they used for growth and development?
- What are the most commonly used feedstuffs for animal rations, and with which species is each associated?
- How are traits passed from the parent to the offspring?
- Why does an egg or sperm cell contain only half of the parent's chromosomes?
- What is the process of selective breeding?

Vocabulary

Identify and review the unit vocabulary. Definitions will be located in Appendix B.

Animal rights
Animal welfare
Artificial insemination
Digestive system
Embryo transfer
Genetics
Heredity
Marketing
Meiosis
Mitosis
Nutrient
Processing
Production
Roughages
Ruminant

Suggested Learning Experiences

Competency 1: Explore the animal agriculture industry and enterprises. (DOK 2, AS)		
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, goats, and sheep). (CCR1, CCR2, CCR3, CCR4, CCR5, CS1, CS2, CS4, T1,T3, T6, BIOI5, ZO1)	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 Domesticated Animals Benefits assignment in this unit for an example of a chart.) Have students save the chart in their electronic journals.	a. Evaluate the charts for completeness and accuracy. (See the Domesticated Animals Benefits assignment).
b. Explore the production, processing, and marketing of major animal enterprises (beef and dairy cattle, horse, swine, poultry, goats, and sheep). (CCR1, CCR2, CCR3, CCR4, CCR5, CCR7, CCR8, CCR9, CS1, CS2, CS4, T1,T3, T6 BIOI5, ZO1)	b. Have the students research specific production, processing, and marketing practices dealing with beef and dairy cattle, horse, swine, poultry, goats, and sheep alternative animal production practices. Have students prepare a presentation related to each enterprise and record their answers in their electronic journals.	b. Evaluate the presentation using the Presentation Rubric. 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. (CCR7, CCR8, CCR9, CS1, CS2, CS4, CS5, T1, T3, T6, BIOI5, ZO1)	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. The letter should report in factual terms the advantages and benefits of these practices.	c. Evaluate using the Evaluating a Response to a Letter of Concern Rubric to evaluate the students' mastery.

Competency 2: Investigate the anatomy and physiology of animals. (DOK 2, AS)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Diagram the major components of an animal cell and list their functions. (CCR1, CCR2, CCR3, CS1, CS2, CS3, CS4, CS5, T2, T6, BIOI2, BIOI3, BIOII2, ZO2, ZO3)	a. Have the students draw a typical animal cell showing its major parts and describing each part's function or purpose.	a. Evaluate student drawings for accuracy and completeness.
b. Explain animal growth and reproduction by cell mitosis and meiosis. (CCR1, CCR2, CCR3, CCR4, CCR5, CCR7, CCR8, CCR9, CS1, CS2, CS4, T1, T3, T6, BIOI2, BIOI3, BIOII2, ZO2, ZO3)	b. Have the students draw diagrams of the process of meiosis and scan them into their electronic notebooks. Using the Internet, have students research and view the process of mitosis and meiosis. Have them record their observations in their electronic journals.	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	c. Have students make a table that identifies each body	c. Evaluate the students'

anatomical and physiological features of cows, sheep, swine, goats, horse, and poultry including respiration, digestion, and reproductive processes. (CCR7, CCR8, CCR9, CS1, CS2, CS4, T1, T3, T6, BIOI2, BIOI3, BIOII2, ZO2, ZO3)	system and its components and explains its function and purpose.	work on the Major Animal Body Systems, Components, and Functions and Anatomical Comparison Assignment.
d. Compare the reproduction process in cows, sheep, swine, goats, horse, and poultry. (CCR1, CCR2, CCR3, CCR7, CCR8, CCR9, CS4, CS5, CS6, CS7, T1, T3, T6, BIOI2, BIOI3, BIOII2, ZO2, ZO3)	d. Divide the students into pairs. Each group will research three groups of the animals (cows, sheep, swine, goats, horse, and poultry). Each group will present findings to class, include puberty, estrus cycle, gestation period, and number of births.	d. Evaluate using the Presentation rubric.

Competency 3: Describe important elements of digestion and nutrition in animals. (DOK 1, AS)

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Compare and contrast the digestive systems and processes in cows and sheep, horse, swine, and poultry. (CCW1,CCW2, CCW3,CCW7, CS1, CS2, CS4, T1, T2, T4, ZO2, ZO3)	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 compare and contrast the different systems related to ration development and nutritional needs.	a. Evaluate the charts for accuracy and completeness.
b. Associate each of the six major classes of nutrients with their roles and functions. (CCR1, CCR2, CCR3, CCR7, CCR8, CCR9, CS1, CS2, CS4, T1, T2, T4, ZO2, ZO3)	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.	b. Evaluate the students' notebooks or journals for completeness, accuracy, and grammar.
c. Classify and discuss the use of feedstuffs as roughages, concentrates, and processed feeds. Roughage Examples: Hay, cottonseed hulls, and silage Concentrate Examples: Corn, soybeans, and oats (CCR7, CCR8, CCR9, CCW5, CCW6, CS1, CS2, CS4, T1, T2, T4, ZO2, ZO3)	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. 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

Competency 4: Examine the role of genetics and breeding in animal production. (DOK 1, AS)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Explain basic concepts of heredity and genetics. (CCR1, CCR2, CCR3, CCR7,CCR8, CCR9, CS1, CS2, CS4, T1, T3, T5, BIOI2, BIOI4, BIOI5, BIOII3, G1, G2, G3, ZO3)	a. Have students read content on Animal Genetics from the text and complete the Worksheet on Basic Principles of Heredity and Genetics.	a. Evaluate student performance on the assignment on basic principles of heredity and genetics. (See Worksheet on Basic Principles of Heredity and Genetics)
b. Describe the processes of selective breeding including artificial insemination and embryo transfer. (CCR1, CCR2, CCR3,CCW6, CS1, CS2, CS4, T1, T3, T5, BIOI2, BIOI4, BIOI5, BIOII3, G1, G2, G3, ZO3)	b. Divide students into groups. Have the students research the processes of selective breeding including artificial insemination and embryo transfer. Create a presentation discussing the economic importance and impact of these processes. Each group will present the findings to the class.	b. Evaluate student responses to questions.

Performance Task

Choice of Livestock

As a livestock buyer for a local farm, you are going to a livestock auction to purchase registered livestock. You need to make decisions on which breed of livestock to purchase. You will present the pros and cons of each breed of livestock using visual and oral presentation methods to the ranch owners (rest of the class). The presentation will be evaluated using the Presentation Rubric found in Appendix A.

Attachments for Performance Task

None

Unit Resources

Books:

Burton, L. (2010). *Agriscience fundamentals and applications* (5th ed.). Albany, NY: Delmar.

Gillespie, J. R. (2010). *Modern livestock and poultry production* (8th ed.). Albany, NY: Delmar.

Herren, R. (2007). *The science of animal agriculture* (3rd ed.). Albany, NY: Delmar.

Herren, R. (2007). *The science of animal agriculture lab manual* (3rd ed.). Albany, NY: Delmar.

Web sites:

Burditt, L., Buchanan, D., & Fitch, J. (2011). Breeds of livestock. Retrieved September 26, 2011, from Oklahoma State University Department of Animal Science Web site: http://www.ansi.okstate.edu/breeds/

Mississippi State University. (2005). MSU cares: Livestock. Retrieved September 8, 2011, from http://msucares.com/livestock/index.html

Oska, C. (2005). Animal science. Retrieved September 26, 2011, from http://www.glenrosearkansasffa.com/

Unit 5: Science of Plants

Understandings and Goals

Enduring Understandings

In this unit, the student will:

- 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.
- 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.
- Plant growth takes place through the processes of cell division, elongation, and differentiation.
- Seeds are formed through a process of pollination in which pollen grains from the stamen fertilize ova in the pistil.
- Each part of a seed plays an important role in the development of the young plant.
- Seed germination is affected by a number of factors including temperature, moisture, light, and oxygen.
- Plants require regular care for optimum growth and development.
- Plants can be formed through asexual means such as cutting, layering, separation and division, tissue culture, and grafting.
- *Life cycle* is defined as the length of time over which a plant grows to maturity and is able to reproduce itself.
- The scientific classification of plants allows each animal to receive a specific formal name and shows relationships between and among different species.
- Sixteen essential nutrients are necessary in varying amounts for optimum growth and development in plants.
- The control of insects, diseases, and weeds in field crops is a major concern to producers because these pests reduce yields and cause losses.

Essential Questions

- How do the major parts of a flowering plant function together to cause the plant to grow, reproduce, and produce food?
- How do the processes of respiration, photosynthesis, and transpiration work together in causing a plant to grow and reproduce?
- How does a plant grow from a single cell to a complete plant?
- What factors affect the process of seed formation?
- How do the different parts of a seed contribute to plant growth and development?
- How can seed germination rates be improved?
- What types of care are needed for optimum plant growth?
- What are the differences between asexual and sexual reproduction in plants?
- What are the three most common life cycles in plants?
- What is the scientific classification system, and why is it needed?
- What are the essential nutrients required for optimum plant growth and development?
- What are the different types of field-crop pests, and how does each type cause damage or loss to the crop?
- What types of pest control methods exist, and what are their advantages and disadvantages?
- How can producers develop the optimum plan for controlling pests in field crops?

Vocabulary

Identify and review the unit vocabulary. Definitions will be located in Appendix B.

Annual
Asexual reproduction
Biennial
Chlorophyll
Fertilizer
Flowers
Fungicides
Germinate
Herbicides
Insecticides
Leaf
Macronutrients
Micronutrients
Perennial
Photosynthesis
Phototropism
Propagation
Respiration
Roots
Sexual reproduction
Stems
Terminal bud
Transpiration

Suggested Learning Experiences

Competency 1: Explore the anatomy and physiology of a plant. (DOK 2, AP)		
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). (CCR4, CCR5, CS1, CS2, CS3, CS4, CS5, T1, T2,T3, T6, BO1, BO2, BO3, BO4, BIOI1, BIOI2, BIOI4, CHI4)	a. Have the students prepare a chart showing the major parts of a flowering plant and describing each part's structure and function. Have students scan their charts and enter into their electronic journals.	a. Evaluate using the Chart of Plant Parts and Functions Rubric.
b. Compare the process of respiration, photosynthesis, and transpiration. (CCR7, CCR8, CCR9, CS1, CS2, CS3, CS4, CS5, T1, T2,T3, T6, BO 1, BO2, BO3, BO4, BIOI1, BIOI2, BIOI4, CHI4)	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 Chart for Comparing Photosynthesis, Respiration, and Transpiration).	b. Evaluate charts for accuracy and completeness. (See Chart for Comparing Photosynthesis, Respiration, and Transpiration).
c. Examine the process of plant growth to include cell division, cell elongation, and cell differentiation. (CCR1, CCR2, CCR3, CCR7, CCR8, CCR9, CS1, CS2, CS3, CS4, CS5, T1, T2,T3, T6, BO1, BO2, BO3, BO4, BIOI1, BIOI2, BIOI4, CHI4)	c. Have students research and read content related to plant growth and development and cell division, elongation, and differentiation. Have the students summarize their findings in their electronic journals.	c. Evaluate students' electronic journals for accuracy and completeness.

Competency 2: Investigate common methods of plant reproduction. (DOK 1, AP, AO)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Analyze the process of seed formation to include pollination and fertilization. (CCR1, CCR2, CCR3, CCR7, CCR8, CCR9, CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, BIOI1, BIOI4, BO3, BO5)	a. Have students research and read content related to seed formation. Have students summarize their findings in their journals.	a. Evaluate electronic journals for accuracy and completeness.
b. Identify the parts of a seed and associate each part with its function. (CCR1, CCR2, CCR3, CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, BIOI1, BIOI4, BO3, B5)	b. Have students research and read content related to parts of the seed. 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.	b. Evaluate students' drawings and descriptions for accuracy and completeness.
c. Describe and apply factors essential to seed	c. Have students research and read content related to seed germination. Have students answer the questions	c. Evaluate students' assignments for accuracy

germination. (CCR4, CCR5, CS1, CS2, CS3, CS4, CS5, BIOI1, BIOI4, BO3, BO5)	on germination in the assignment Seed Germination. Have students conduct germination tests under different temperature, light, oxygen, and moisture conditions and note differences.	and completeness.
d. Observe and record data related to plant growth and reproduction. (CCW4, CCW10, CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, BIOI1, BIOI4, BO3, BO5)	d. The students will plant rye grass seeds. Have students plant, thin, and care for plants. Have students record data from their experiments using Plant Growth Chart.	d. Evaluate student assignments for accuracy and completeness. (See Plant Growth Chart)
e. Identify the five methods of asexual reproduction. (CCR4, CCR5, CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, BIOI1, BIOI4, BO3, BO5)	e. Through illustrations, students will identify the following methods of asexual reproduction: • Cutting • Layering • Separation and division • Tissue culture • Grafting	e. Evaluate students' understanding through a paper and pencil test.

Competency 3: Apply classification methods to plants. (DOK 1, AP)

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Classify plants based on life cycle. (CCR4, CCR5, CS1, CS2, CS4, T1, T2, T3, T6, BIOII5, BO3)	a. Have students compile a list of plants from their local community based on life cycle (annual, biennial, and perennial.	a. Class will discuss the plant lists.
b. Examine the use of the binomial nomenclature (genus and species) classification system in horticulture. (CCR7, CCR8, CCR9, CS1, CS2, CS4, T1, T2, T3, T6, BIOII5, BO3)	b. 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.	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. (DOK 1, AP)

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Differentiate between the major plant nutrients (macronutrients) and the minor nutrients (micronutrients). (CCR7, CCR8, CCR9, CS1, CS2, CS3, CS4, CS5, T3, T6, BIOI2, CHI1, BO4)	a. Have students construct and complete a chart showing all 16 of the essential plant nutrients and classifying them as macronutrients and micronutrients. (See Plant Nutrient Chart.) 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.	a. Evaluate the charts for accuracy and completeness. (See Plant Nutrient Chart.)
b. Identify the chemical symbols of the 16 essential plant nutrients. (CCR4, CCR5, CS1, CS2, CS3, CS4, CS5, T3, T6, BIOI2, CHI1, BO4)	b. Have students construct and complete a chart showing all 16 of the essential plant nutrients and classifying them as macronutrient and micronutrients. (See Plant Nutrient Chart.) 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.	b. Evaluate the charts for accuracy and completeness. (See Plant Nutrient Chart.)

Competency 5: Explore basic concepts of pest management to include insect damage, weed damage, and diseases. (DOK 1, AP)		
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. (CCR4, CCR5, CS1, CS2, CS3, CS4, CS5, T2, T6, BIOI6, BIOII4, ZO2, ZO3, ZO4)	a. Have students construct a table that identifies the three major types of plant pests (insects, weeds, and diseases) and summarizes the ways in which each type causes damage or loss to crops.	a. Evaluate charts for accuracy and completeness. (See Plant Pests and the Damage They Cause Assignment)
b. Compare the different types of pest control measures. (CCR1, CCR2, CCR3, CS1, CS2, CS3, CS4, CS5, T2, T6, BIOI6, BIOII4, ZO2, ZO3, ZO4)	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. Evaluate the IPM plan for content and clarity.

Performance Task

Horticulturist 101

You are a horticulturist in a local community and have been invited to speak at the local garden club. Prepare a presentation on planting and maintaining a small vegetable garden. You should include details such as site selection criterion, types of plants, fertilizer requirements, irrigation methods, length of growing season, and methods of pest control.

Attachments for Performance Task

Evaluate using the Presentation Rubric in attachment Appendix A.

Unit Resources

Books:

Burton, L. (2010). *Agriscience fundamentals and applications* (5th ed.). Albany, NY: Delmar.

Cooper, E. L., & Burton, L. D. (2009). *Agriscience: Fundamentals and application* (5th ed.). Albany, NY: Delmar.

EduSelf Multimedia. (2010). *Better plants and gardens* [CD-ROM]. Englewood, NJ: Author.

Reiley, H. E., & Shry, C. (2011). *Introductory horticulture* (8th ed.). Albany, NY: Delmar.

Web sites:

Horticulture. (n.d.).Retrieved September 10, 2011, from http://www.hortmag.com/

Unit 6: Soil Science

Understandings and Goals

Enduring Understandings
In this unit, the student will:

- Soil is the most important natural resource that must be protected and conserved.
- Soil is a naturally occurring substance that is formed over centuries through chemical and physical weathering processes.
- *Soil texture* refers to the amount of sand, silt, and clay particles that are present in the soil. Native soils are composed of different layers of materials.
- One important concept of soil conservation is that land can be classified according to its highest productive use.
- Factors that determine the highest productive use of a given plot of land include soil texture, slope, fertility, erosion potential, and internal drainage.
- An accurate soil test is important in determining the need for additional fertilizer and other soil amendments.
- As the pH of a soil changes, the availability of existing nutrients in the soil changes.

Essential Questions

- Why is soil an important natural resource?
- How is soil formed?
- How do I determine the texture of a soil?
- What are the different layers of the soil profile?
- What is the meaning of the term *highest productive use*?
- What factors determine the highest productive use of a plot of land?
- How do I obtain a representative sample of soil from a given area for testing purposes?
- How does the pH of a soil affect its productivity and fertility?
- How do I correct deficiencies in soil fertility?

Vocabulary

Identify and review the unit vocabulary. Definitions will be located in Appendix B.

Erosion
Land capability class
Leach
Microbes
Organic matter
Permeable
pH
Soil
Soil profile
Texture
Tillable

Suggested Learning Experiences

Competency 1: Demonstrate an understanding of the impact of soil as a natural resource. (DOK2, AE, AN)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Associate the definition of soil with its importance. (CCR1, CCR2, CCR3, CCL4, CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, CHI 1, E 4, E 5, ES 3, GE1, GE2)	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.	a. 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. (CCR4, CCR5, CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, CHI1, E4, E5, ES3, GE1, GE2)	b. Summarize the important concepts associated with each of the factors associated with soil formation and place these in the electronic journals.	b. Evaluate the students' journals for accuracy and completeness.
c. Classify the texture of a soil. (CCR4, CCR5, CCW4, CCW10CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, CHI1, E4, E5, ES3, GE1, GE2)	c. Have students research the texture of soil. Have students answer the questions in the Summarize section of the activity and record their answers in their electronic journals.	c. Evaluate the students' journals for accuracy and completeness.
d. Identify the different layers of a typical soil profile and describe their importance. (CCR4, CCR5, CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, CHI1, E4, E5, ES3, GE1, GE2)	d. Have the students make a drawing of a soil profile. Have students record their answers to the questions in the Summarize section of the activity in their electronic journals.	d. Evaluate the students' journals for accuracy and completeness.

Competency 2: Investigate the use of the land capability classification system. (DOK 1, AN, AE)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Describe the concepts of land classification and highest productive use. (CCR1, CCR2, CCR3, CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, E5, ES3)	a. In their electronic journals, have students summarize the important concepts regarding land classification and highest productive use.	a. Evaluate the students' electronic journal entries for accuracy and completeness.
b. Identify and describe factors that contribute to land capability. (CCR4, CCR5, CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, E5, ES3)	b. Have students research and read content related to land capability. 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 Land Capability Classification Chart.)	b. Evaluate the students' electronic journal entries for accuracy and completeness. (See Land Capability Classification Chart.)

Competency 3: Investigate the chemical properties of soils. (DOK 2, AP, AN, AE)		
Suggested Performance	**Suggested Teaching Strategies**	**Suggested Assessment**

Indicators		Strategies
a. Develop a soil testing plan for a given field or area. (CCR7, CCR8, CCR9, CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, CHI5)	a. 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.	a. Use the Checklist for Evaluating a Sketch of a Land Plot 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. (CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, CHI5)	b. Have the students 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.	b. Use the Checklist for Soil Sample Collection and Preparation to evaluate the students' ability to collect and process a soil sample.
c. Describe how soil pH affects productivity of a soil. (CCW4, CCW10, CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, CHI5)	c. Have the students read the section in the text 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.	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. (CCR1, CCR2, CCR3, CCR4, CCR5, CCR7, CCR8, CCR9, CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, CHI5)	d. Using a 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.	d. Observe students using the soil kit to make sure they are following procedures. Evaluate their recommendations for accuracy.

Performance Task

It's a Dirty Job-SOIL

Collect a soil sample and complete the information sheet needed for the MSU Soil testing center.

Your neighbor is having trouble growing grass in one of their 15 food plots. The grass is not growing as much as it is in other plots. He has asked you for your assistance. Using a soil survey report, analyze the needs of your neighbor's food plot. What would be your recommendation to improve the food plot? Compare your recommendations to that of the MSU lab. Evaluate the activity by comparing the student's recommendations to the MSU lab recommendations.

Attachments for Performance Task

None

Unit Resources

Books:

Cooper, E. L., & Burton, L. D. (2009). *Agriscience: Fundamentals and application* (5th ed.). Albany, NY: Delmar.

Burton, L. (2010). *Agriscience fundamentals and applications* (5th ed.). Albany, NY: Delmar.

Camp, W. G., & Daugherty, T. B. (2008). *Managing our natural resources* (4th ed.). Albany, NY: Delmar.

CEV Video. (n.d.). *Land judging made easy* [DVD]. Lubbock, TX: Author.

Crouse, K. (2008). *Instructions on land judging in Mississippi*. Mississippi State, MS: Mississippi State University Extension Service.

Crouse, K., & McCarty, W. (2010). *Soil testing for the farmer*. Mississippi State, MS: Mississippi State University Extension Service.

Discovery Education. (n.d.). *Conservation of natural resources* [CD-ROM]. Silver Spring, MD: Author.

Fickle, J. (2001). *Mississippi forests and forestry*. Jackson, MS: Mississippi Forestry Foundation.

Holland, I. I., & Rolf, G. L. (2003). *Forests and forestry* (6th ed.). Lebanon, IN: Pearson.

Irwin, K. M. (2004). *Science of forestry management.* Winterville, GA: AAVIM.

Plaster, E. J. (2008). *Soil science and management*. Clifton Park, NJ: Thomson Delmar.

Reiley, H. E., & Shry, C. (2011). *Introductory horticulture* (8th ed.) Albany, NY: Delmar.

Web sites:

Mississippi State Cooperative Extension Service. (n.d.). Forestry for beginners. Retrieved September 8, 2011, from http://msucares.com/forestry/topics/beginning-forestry.html

National Geographic Society. (2010). *Alternative energy* [Digital video]. Retrieved September 15, 2011, from http://video.nationalgeographic.com/video/player/environment/energy-environment/alternative-energy.html?fs=science.nationalgeographic.com

Unit 7: Agricultural Lab Operations and Safety

Understandings and Goals

Enduring Understandings
In this unit, the student will learn:

- Safety is an integral part of daily life.
- Rules and regulations are essential to a safe work environment.
- Safe use and proper choice of tools is important to safely complete a welding job.
- Understanding common safety violations and the consequences of committing unsafe acts is important in the workplace.
- Typical applications of oxy-fuel welding and brazing are important.
- Safety procedures must be followed in oxy-fuel cutting.
- Identifying and correctly using personal protective devices is imperative in the welding craft.
- Welders should be able to identify and correct welding safety issues in the work environment.
- Welders should be able to exhibit a working knowledge of striking and extinguishing an arc using SMAW, GTAW, and GMAW practices.
- Welders should be able to distinguish among horizontal, vertical, and overhead welding positions using SMAW, GTAW, and GMAW.

Essential Questions

- What would happen if there were no rules and regulations?
- Why do we have safety rules and regulations?
- How do fires happen, and how do you extinguish a fire?
- What happens when you choose the improper tool for the job or use a tool in an incorrect manner?
- What is the difference between oxy-fuel and oxy-acetylene?
- How and where is oxy-fuel used in the welding area? Why do welders wear protective clothing?
- Why worry about electrical safety in welding?
- Why is it harder to strike an arc on low power supply current settings?
- How can you finish the weld without leaving a crater in the end of the bead?

Vocabulary

Identify and review the unit vocabulary. Definitions will be located in Appendix B.

Amps
Arc
Backfire
Conductor
Electricity
Electrode
Exhaust
Flashback
Ignition
Insulator
Neutral flame
Ohms
Regulator
Resistance
Rpm
Short circuit
Stroke
Tensile
Tip cleaner
Volts
Watts

Suggested Learning Experiences

Competency 1: Identify safety procedures and safety devices for the agricultural workplace. (DOK 1, AT)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Describe procedures for maintaining a clean and safe workplace environment and the use of all protective devices. (CCR4, CCR5, CS1, CS4, CS12, CS13, CS14, CS15, CS16)	a. Students will create safety posters illustrating these rules to be posted in the laboratory areas.	a. Evaluate using the Poster Rubric.
b. Demonstrate rules for hand/power tools including basic operation, danger point, observer safety, and electrical safety. (CCR4, CCR5, CS1, CS4)	b. Students will design and perform a role-play or skit. The students will demonstrate and discuss rules for safe use of hand and power tools including basic operation, danger points, and observe safety procedures.	b. Evaluate using the Role play-Skit Rubric.
c. Explain the relationship between volts, amps, and watts. Demonstrate use of the voltmeter, amp meter, pliers, screwdriver, wire cutters, and wire strippers. Discuss the causes of electrical accidents including short circuits, overloads, improper insulation, and presence of moisture. (CCR1, CCR2, CCR3, CCR7, CCR8, CCR9, CS1, CS4, PS2, PHYI5)	c. Have students use the Internet or classroom resources to gain a basic understanding of the assigned electrical task. Have students write the mathematical calculations and sketch the drawing that represents the task in their journals. Students can use classroom tools or a graphing calculator and presentation equipment to enter data related to various voltages and currents. They should graph the resulting resistances to demonstrate the relationships between volts, amps, and watts and record information in their journals.	c. Journals will be peer reviewed.
d. Demonstrate procedures for preventing electrical accidents such as use of proper tools, proper working environment, and disconnecting of power when working on circuits (lockout-tagout), breakers, fuses, ground fault connector interrupters, control switches, proper grounding, and safety	d. Students complete a laboratory project to wire a simple circuit.	d. Evaluate using the Job Sheet/Performance Rubric.

devices. (CCR4, CCR5, CS1, CS4, PS2, PHYI5),		

Competency 2: Identify common equipment, tools, and safety procedures and perform the various welding processes. (DOK 1, AT)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Identify major types of welders including the shield metal arc welding (SMAW), gas metal arc welding (GMAW), and gas tungsten arc welding (GTAW). (CCR4, CCR5, CS1, CS4, PS2, PHYI5)	a. Use a video or PowerPoint presentation to identify the different types of welders and the tools and equipment used in welding.	a. Evaluate using a written test on welding equipment and tool identification.
b. Describe and identify different welding supplies used in welding: low hydrogen, mild steel and alloy welding electrodes and the types of gases involved in the SMAW process. (CCR7, CCR8, CCR9, CS1, CS4, PS2, PHYI5)	b. Invite a representative from the welding industry to discuss welding supplies and equipment needed in welding. Have students summarize the presentation in their electronic journals.	b. Evaluate the Guest Speaker Evaluation Form and evaluate each journal using the Journal rubric.
c. Perform welding techniques including start, stop, and restart, pad construction, flat butt construction, beads, T, lap, corner, edge, and butt utilizing the appropriate welding process (SMAW, GMAW, and/or GTAW). (CS1, CS4) (GTAW- NOT ON CPAS)	c. Demonstrate the procedures for the following using the appropriate welding process(es) (SMAW, GMAW, and/or GTAW): • Start, stop, and restart • pad construction • flat butt construction • beads • T • lap • corner • edge • butt	c. Evaluate using the Activity Performance Rubric.

Competency 3: Apply safety procedures and perform tasks using oxyacetylene equipment. (DOK 1, AT)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Identify, discuss, and demonstrate parts of the oxyacetylene welding and cutting equipment. (CCR1, CCR2, CCR3, CCR4, CCR5, CS1, CS4, PS2, PHYI5) (Safety procedures will be addressed through the oxyacetylene content)	a. Scavenger Hunt – Students will be given a list of oxy cutting equipment. Students will search a given area and find items on the list. Students will describe each item to the class (function and approximate cost).	a. Evaluate the scavenger hunt by using the Scavenger Hunt Questionnaire. Knowledge areas in which students appear lost or weak will be reviewed. Have students redo the exercise if they are weak in knowledge in those areas.
b. Identify the different	b. Students will demonstrate the adjustments needed	b. Evaluate using the

types of oxyacetylene flames and the applications of each to include neutral, oxidizing, and carburizing. (CCR1, CCR2, CCR3, CCR7, CCR8, CCR9, CS1, CS4, PS2, PHYI5)	to create each type of flame. Discuss the different types of oxyacetylene flames and their applications.	Activity Performance Rubric.
c. Assemble and operate oxyacetylene welding and cutting equipment. Set up equipment for cutting operations to include selecting the proper tip and setting regulator pressures. Practice the "pushing the puddle" procedure for heat control in welding. (CS1, CS4, PS2, PHYI5)	c. Students will demonstrate and discuss the procedures for setting up oxyacetylene equipment including selecting and attaching the proper tip and adjusting pressure regulators. • Demonstrate the practice of "pushing the puddle" on a mild steel plate to control heat of the base metal. • Demonstrate the practice for making a cut in mild steel.	c. Evaluate using the Activity Performance Rubric.

Competency 4: Examine the major parts and function of a small engine. (DOK 1, AT) NOT ON CPAS		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Identify the major systems of a small gasoline engine to include ignition, air intake, lubrication, power train, cooling, exhaust, and fuel systems. Identification will include the purpose or function of each component. (CCR1, CCR2, CCR3, CS1, CS4)	a. Use a videotape or PowerPoint presentation to identify and illustrate the major systems of a small gasoline engine, including their function or purpose.	a. Give a written test on major parts and functions of a small engine.
b. Identify and demonstrate the use of hand tools and diagnostic instruments. (CS1, CS4)	b. Set up a display of the different common and specialty tools and instruments used in small engine service and repair. Discuss the safe and proper use of each tool or instrument. Have students make a drawing of each tool and note its use in their notebook/journal.	b. Peer review the journal.
c. Explore two- and four-cycle engines. (CCR1, CCR2, CCR3, CCR4, CCR5, CCR7, CCR8, CCR9, CS1, CS4)	c. Have the student draw diagrams and write a paragraph tracing the events of a four-cycle and two-cycle engine and identify different characteristics of each type in their notebooks/journals. Item to address: • Trace events in the intake, compression, power, and exhaust strokes of a two- and four-cycle small engine. • Compare differences in two- and four-stroke cycle engines to indicate absence or presence of	c. Evaluate using the Journal Rubric. Evaluate using the Activity Performance Rubric.

	oil sump, mixed fuel, and labeling indicating stroke type. • Perform preventive maintenance and troubleshooting on a small engine. • Service a crankcase breather. • Diagnose ignition concerns. Provide students with an operator's manual for a given engine. Have them follow manufacturer's recommendations in servicing the different systems on the engine. Provide students with a checklist for diagnosing problems in a small engine. Provide them with different scenarios and have them identify what they would do to troubleshoot an engine with a specific problem. Evaluate using the Performance rubric.	

Performance Task

Welding Fabricator

You have been asked to design and build a shop project. The buyer (Instructor) will give you the basic idea for the project. As the designer you will design the project and present the project to the buyer. Once the buyer approves the project, you will build the item and present it to the buyer for final approval. The presentation must include a bill of material, material list, and a sketch/blueprint of the item. Evaluate the presentation using the Presentation Rubric found in Appendix A.

Attachments for Performance Task

None

Unit Resources

Books:

Burkybile, C., Johnson, D., Lee, J., & Shelhamer, C. (2005). *Agricultural power & technology.* Upper Saddle River, NJ: Pearson.

Herren, R. (2010). *Agricultural mechanics: Fundamentals & applications.* Clifton Park, NJ: Delmar/Cengage.

Phipps, L., Miller, G., & Lee, J. (2004). *Introduction to agricultural mechanics*. Upper Saddle River, NJ: Pearson.

Web sites:

Mississippi FFA Association. (2011). *Mississippi FFA career development event rules and regulations*. Retrieved on June 9, 2011 from http://www.mde.k12.ms.us/vocational/FFA/

Peavy, V. (n.d.). *Tractor Safety, Maintenance, and Operation*. Retrieved on June 11, 2011 from http://www.gaaged.org/

Spurlin, J. (n.d.). *Troubleshooting Small Engines*. Retrieved June 11, 2011 from http://www.gaaged.org/

Understanding Simple Machines. (n.d.). (PowerPoint). Retrieved June 11, 2011 from http://www.gaaged.org/

United States Department of Agriculture. (n.d.). *A history of American agriculture: Farm machinery and technology*. Retrieved June 11, 2011 from http://www.agclassroom.org

Other:

CEV Video. (n.d.). *CEV Pathway: Power, Structural & Technical Systems Pathway* [DVD]. Lubbock, TX: Author.

Unit 8: Orientation/Careers/Leadership

Understandings and Goals

Enduring Understandings
In this unit, the student will:

- 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.
- The FFA is an integral part of the Agricultural and Environmental Science and Technology program, promoting leadership, human relations, and technical skill attainment and providing recognition for accomplishments.
- Leadership is the ability to influence people to accomplish the goals and objectives of an organization.
- Leadership skills can be learned.
- Work ethics and values are essential for success in all career fields.

Essential Questions

- What are the necessary life and career skills for success in the modern world?
- What is the role of the FFA in the ANR program?
- What is leadership?
- What are the traits of successful leaders?
- What is the role of work ethics and values in establishing and building a successful career?

Vocabulary

Identify and review the unit vocabulary. Definitions will be located in Appendix B.

FFA
Human relations
Leadership
Parliamentary procedure
Work ethics

Suggested Learning Experiences

Competency 1: Review safety rules and behavior. (DOK 1)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Identify safety rules and behavior for the classroom. (CCR7, CCR8, CCR9, CS1, CS2, CS3, CS4, CS5, T2, T6)	a. Identify and discuss with the students basic safety rules and behavior for the classroom, shop, and laboratory areas using handouts, PowerPoint presentations, demonstrations, and/or videos. (Note: Instruction in safety is an ongoing process throughout the school year. Safety will be stressed and monitored on a daily basis.)	a. Give a written test on safety practices. (The teacher may use the Farm Bureau safety test found on B.R.I.D.G.E. Agriculture Education Blackboard site.)
b. Identify safety rules and behavior for the shop and laboratory areas. (CCR7, CCR8, CCR9, CS1, CS5)	b. Students will participate in safety role-play to support safety rule understanding.	b. Assessment of safety will be included as part of the assessment of all shop and laboratory activities.

Competency 2: Select careers in agriculture and natural resources. (DOK 1)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Compare the careers available in agriculture and natural resources. (CCR7, CCR8, CCR9, CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6)	a. The teacher will review opportunities available in the following agriculture and natural resource areas: Agriculture Production, Agriculture Mechanics, Agriculture Processing, Forestry, Horticulture, Agriculture Business, Aquaculture, and Natural Resources. Have students identify one area that is of interest to them and identify an expert within this area. Students will create a portfolio in their journals with ongoing information and communication with the expert to include important characteristics of their occupations including factors such as educational requirements, working conditions, career ladders, etc. Tasks to be completed: • Resume • Letter of Application	a. Evaluate using the Journal Rubric. Evaluate the resume using the Resume Assessment Rubric. Evaluate the Letter of Application using the Letter of Application Rubric.

Competency 3: Develop an individual FFA activity plan. (DOK 1)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Identify FFA activities and programs that contribute to career advancement and individual achievement. (CCR7,CCR8, CCR9, CS12, CS13, CS14,	a. Have students use the FFA Manual, Student Handbook, PowerPoint presentations, FFA organization web site (www.ffa.org), Local Program Success Guide, and LifeKnowledge lesson handouts and worksheets to identify and describe the different FFA events, programs, and degrees and explore how each	a. Evaluate using the Presentation Rubric.

CS15, CS16)	contributes to career advancement and individual achievement. Students will create a PowerPoint presentation.	
b. Select and document FFA activities and programs that contribute to personal development. (CCW4, CCW10, CS1, CS12, CS13, CS14, CS15, CS16)	b. Have each student select FFA activities, events, and/or award programs to participate in the coming year(s). Have students keep an ongoing journal of preparation for FFA activities as part of their supervised experience program.	b. Evaluate using the Journal Rubric.

Competency 4: Develop and present a 3-5 min multimedia presentation on an agriculture or natural resource topic. (DOK 1)

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Discuss guidelines for preparing a successful presentation: preparation, resource development, writing skills, and presentation skills. (CCW4, CCW10, CCSL4, CCSL5, CCSL6, CS9, CS10, CS11)	a. Discuss and demonstrate presentation techniques and guidelines with the students. Show videos of examples of speeches and have students evaluate the speaker and topic using the FFA scorecard. Have students research, prepare, and deliver a 3-5 min speech on their selected occupation.	a. Students and teacher will evaluate the speeches using the scorecard found in the Mississippi FFA Contest Handbook. Evaluate using the FFA Prepared Public Speaking Scorecard found in FFA materials.

Competency 5: Apply the principles of leadership and personal development. (DOK 1)

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify and demonstrate the principles of leadership and personal development. (CCR7, CCR8, CCR9, CS1, CS4, CS16)	a. Discuss with the students characteristics of a good leader. Using a chart, PowerPoint presentation, or video, identify and describe the characteristics of a good leader. Have students demonstrate leadership by taking turns in a supervisory role in the classroom, shop, and/or laboratory.	a. Give a written test on principles of leadership and personal development.

Competency 6: Maintain Supervised Agricultural Experience records. (DOK 1)

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Maintain records as they relate to SAE activities. (CCW4, CCW10, CS1, CS4, CS13)	a. Review procedures for maintaining records of SAE activities. Students will maintain records of SAE activities throughout the year using an approved record book. Items to include: • Records of income and expenses related to SAE activities • Skills learned through SAE • SAE supplementary projects (improvement projects, community service projects, etc.)	a. Give a written test on SAE records. Make monthly or quarterly checks of students' record books.

Performance Task

My First Real Job

As a prospective employee, you will prepare a letter of application and a resume. You will choose a time and date for your interview. The interviewer will be a representative from agriculture companies.

Attachments for Performance Task

None

Unit Resources

Refer to Unit 1 for resource information

Unit 9: Science of the Agricultural Environment

Understandings and Goals

Enduring Understandings

- The atmosphere is a combination of gases, water vapor, and other materials that sustains life on earth.
- The atmosphere can be divided into distinguishable layers with each layer playing a different function.
- The relationship between the weather and the environment is complex.
- Climates can be defined using scientific factors such as latitude, longitude, and temperature.
- The movement of the earth in orbit plays a major role in how weather patterns develop.
- Weather maps are used to predict and analyze the weather.
- Air quality is affected by the amount of foreign material in the air.
- Global pollution occurs through the movement of air.
- Air pollution comes from many sources.
- Air pollution can have a negative effect on the environment.
- Air pollution levels can be detected in the air around you.

Essential Questions

- What is the atmosphere made of?
- What are the various layers of the atmosphere?
- How do the weather and the environment impact each other?
- How are climates defined?
- How does the movement of the earth affect weather fronts?
- What environmental factors are considered when analyzing the weather?
- How is air quality defined?
- How does global pollution occur?
- What causes air pollution?
- What are the effects of air pollution on the environment?
- How can air pollution be detected?

Vocabulary

Identify and review the unit vocabulary. Definitions will be located in Appendix B.

Alternative energy
Conservation
Decomposer
Domestic species
Ecosystem
Effluent
Exhaustible resources
Industrial solid waste
Inexhaustible natural resources
Renewable natural resources

Suggested Learning Experiences

Competency 1: Examine the relationship of the atmosphere to the earth's environment. (DOK 1, AN)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Define *atmosphere* and describe its contents. (CCR7, CCR8, CCR9, CS2, T3, CH14, ES1, ES2, ES3)	a. Identify atmosphere and describe the air, moisture, and particulates in it.	a. Evaluate using a pencil and paper test.
b. Diagram and describe the structure of the atmosphere. (CCR7, CCR8, CCR9, CS1, CS2, CS4, T1, T2, T3, CH14, ES1, ES2, ES3)	b. Have students draw and label the structure of the atmosphere. Identify the layers and describe their location, characteristics, and special functions.	b. Evaluate the diagram of the atmosphere using the Checklist for Evaluating the Diagram of the Atmosphere..

Competency 2: Use weather and climate information in making decisions about the environment. (DOK 2, AE)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Distinguish between weather and environment. (CCR7, CCR8, CCR9, CS2, T4, ES1, ES2, ES3)	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.	a. Evaluate using a pencil and paper test.
b. Explore the relationship of latitude, longitude, and altitude to climate. (CCR7, CCR8, CCR9, CS1, CS2, T3, T6, ES1, ES2, ES3)	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 the longitude and latitude of cities and classify them as being in the temperate and tropical regions.	b. Grade the assignment to locate longitude and latitude.

Competency 3: Assess air quality and identify sources of air pollution. (DOK 2, AN,AE)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Define air quality and relate quality to pollution and air-quality standards. (CCR1, CCR2, CCR3, CS2, T2, T3, T4, ES1, ES2, ES3)	a. Define air quality, air pollution, and air-quality standards. Show the relationship between each.	a. Instructors can use the Environmental Science Weather Test or another pencil and paper test.
b. Explain the movement of air and global pollution. (CCR1, CCR2, CCR3, CS2, T3, ES1, ES2, ES3)	b. Explain the relationship of air movement and pollution globally. Explain how weather fronts play a role in the movement.	b. Instructors can use the Environmental Science Weather Test or another pencil and paper test.
c. Describe the major kinds and sources of air	c. Describe gases, particulate matter, and metal materials as they relate to air pollution. Assign students	c. Use the Air Pollution Presentation Rubric to

pollution. (CCR4, CCR5, CS1, CS2, CS3, T2, T5, T6, ES1, ES2, ES3)	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.	assess student mastery.
d. Identify the effects of air pollution on the earth's environment. (CCR7, CCR8, CCR9, CS3, T2, T3, ES1, ES2, ES3)	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.	d. Use the Detecting Air Pollution Activity Presentation Rubric to assess student mastery.

Competency 4: Explore concepts and practices related to wildlife conservation and management. (DOK 1, AN, AE)

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Create a diagram illustrating the interrelationships among the soil, plants, animals, and humans. (CCR7, CCR8, CCR9, CS1, CS2, CS3, CS4, CS5, T2, T6, ES1, ES2, ES3)	a. Discuss the interrelationships among soil, plants, animals, and humans. Have students prepare a diagram illustrating these relationships.	a. Give a written test on concepts and practices of wildlife conservation and management.
b. Discuss the concept of a food web. (CCSL4, CS1, CS2, CS3, CS4, CS5, T2, T6, ES1, ES2, ES3)	b. Have students prepare a KWL diagram showing a food web for a given species.	b. Evaluate using the KWL diagram.
c. Identify and discuss conservation and management of wildlife. (CCR7, CCR8, CCR9, CS1, CS2, CS3, CS4, CS5, T2, T6, ES1, ES2, ES3)	c. Divide the students into groups. Each group will design a visual presentation discussing the different approaches to wildlife conservation and management.	c. Evaluate using the Group Presentation Rubric.
d. Research a given species of wildlife to determine habitat and management practices. (CCR7, CCR8, CCR9, CS1, CS2, CS3, CS4, CS5, T2, T6, ES1, ES2, ES3)	d. Assign a given species of wildlife to each student. Have the student research and compile a report on habitat and management practices. Have students present the findings to the class.	d. Evaluate using the Written Report Rubric. Evaluate the presentation using the Presentation Rubric.

Performance Task

Performance Task Title

As a consultant for a natural resource group, you have been asked to prepare and present a PowerPoint presentation to a group of elementary students. The topic will be exhaustible/inexhaustible and renewable/nonrenewable resources. The presentation should last about 15 to 20 min. Evaluate the presentation using the Presentation Rubric found in Appendix A.

Attachments for Performance Task

None

Unit Resources

Books:

Burton, L. (2010). *Agriscience fundamentals and applications* (5th ed.). Albany, NY: Delmar.

Camp, W. G., & Daugherty, T. B. (2008). *Managing our natural resources* (4th ed.). Albany, NY: Delmar.

CEV Video. (n.d.). *Land judging made easy* [DVD]. Lubbock, TX: Author.

Crouse, K. (2008). *Instructions on land judging in Mississippi*. Mississippi State, MS: Mississippi State University Extension Service.

Crouse, K., & McCarty, W. (2010). *Soil testing for the farmer*. Mississippi State, MS: Mississippi State University Extension Service.

Discovery Education. (n.d.). *Conservation of natural resources* [CD-ROM]. Silver Spring, MD: Author.

Fickle, J. (2001). *Mississippi forests and forestry*. Jackson, MS: Mississippi Forestry Foundation.

Holland, I. I., & Rolf, G. L. (2003). *Forests and forestry* (6th ed.). Lebanon, IN: Pearson.

Irwin, K. M. (2004). *Science of forestry management*. Winterville, GA: AAVIM.

Plaster, E. J. (2008). *Soil science and management*. Clifton Park, NJ: Thomson Delmar.

Web sites:

Mississippi State Cooperative Extension Service. (n.d.). Forestry for beginners. Retrieved June 8, 2011, from http://msucares.com/forestry/topics/beginning-forestry.html

Society of American Foresters. (2010). *About forestry*. Retrieved June 8, 2011, from http://www.safnet.org/about/index.cfm

Unit 10: Water Quality Management

Understandings and Goals

Enduring Understandings
In this unit, the student will:

- The availability of water is dependent on its physical state.
- Water is classified based upon its salt content.
- Water is essential for all forms of life and is used for many purposes.
- Water comes from sources below and on the surface of the earth.
- The amount of water on the earth never changes.
- Flowing bodies of water have different characteristics than non-flowing bodies of water.
- Water pollution originates from both known and unknown sources of contamination.
- Water quality can be monitored by regularly testing the water for certain chemical indicators.
- Potable water can be consumed by humans.
- Wastewater is produced by agricultural, industrial, and residential sources.
- Wastewater can be hazardous to humans, animals, and the environment.
- There are various methods and treatments for wastewater management that prevent it from being a hazard to the environment.

Essential Questions

- What is the chemical and physical makeup of water?
- How does the salt content of water affect its usefulness?
- Why is water so important?
- What is the difference between surface and groundwater?
- How does the water cycle work?
- What is the difference between flowing and non-flowing bodies of water?
- What causes water pollution?
- How do you test for the quality of water?
- What is potable water?
- Where does wastewater come from?
- What makes wastewater so hazardous?
- How is wastewater treated and handled?

Vocabulary

Identify and review the unit vocabulary. Definitions will be located in Appendix B.

Nonpoint source pollution
Pathogens
Point source pollution
Potable water
Stream
Stream flow
Stream hydrology

Suggested Learning Experiences

Competency 1: Explore concepts of water usage and quality. (DOK 1, AN)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Describe the nature and states of water. (CCR4, CCR5, CCR7, CCR8, CCR9, CS1, CS2, CS3, CS4, CS5, T2, T3, T4,AQ1, AQ2, AQ3, AQ4, ES3)	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.	a. Use a pencil and paper test to evaluate students' understanding.
b. Compare the classifications of water. (CCR7, CCR8, CCR9, CS2, T2, T3, AQ1, AQ2, AQ3, AQ4, ES3)	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 species that live in each classification and give a general physical description of the type of species. Students will present their findings to the class.	b. Use the Fish Research Group Project Rubric to assess students' mastery.
c. Identify important uses of water. (CCR7, CCR8, CCR9, CS2, CS4, T2, T3, T4,AQ1, AQ2, AQ3, AQ4, ES3)	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, estimating the amount they used, and identifying ways in which water could be conserved. Students can use the Student Water Use Diary for this activity.	c. Have students peer review their daily diaries and comment on additional ways in which water could be conserved. (See Student Water Use Diary Checklist.)
d. Identify sources of water. (CCR7, CCR8, CCR9, CS1, CS2, T3, AQ1, AQ2, AQ3, AQ4, ES3)	d. Describe the two major sources of water (surface and groundwater). Explain the path water follows throughout a watershed. Assign students to conduct a reflective essay explaining their understanding of the differences between groundwater and surface water.	d. Use the Reflective Writing Rubric on the Differences between Ground Water and Surface Water to evaluate the reflective writing exercise on student understanding of ground and surface water sources.

Competency 2: Describe important water management practices. (DOK 2, AN)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a Diagram and describe the water cycle. (CCR7, CCR8, CCR9, CS1, CS2, CS3, CS4, CS5, T2, T6, AQ1, AQ2, AQ3, AQ4, ES1, ES2, ES3)	a. Provide the students a diagram of the water cycle, identify each part, and explain its role in the cycle.	a. Evaulate students' understanding using a pencil and paper test.
b. Compare natural water bodies of flowing and non-flowing sources. (CCR7, CCR8, CCR9, CS1, CS4, T2, T6, AQ1, AQ2, AQ3, AQ4, ES1, ES2, ES3)	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.	b. Evaluate students' understanding using a pencil and paper test.
c. Identify common causes of water pollution	c. Identify common kinds of water pollutants (sediment and suspended particles, pathogens, organic wastes,	c. Grade student observation chart.

and distinguish between point and nonpoint sources of pollution. (CCR7, CCR8, CCR9, CS1, CS2, T3, AQ1, AQ2, AQ3, AQ4, ES1, ES2, ES3)	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 the pollution.	
d. Monitor the water quality in a selected body of flowing water. (CCR7, CCR8, CCR9, CS1, CS2, CS4, T2, T3, T4, AQ1, AQ2, AQ3, AQ4, ES1, ES2, ES3)	d. Use a water quality 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.	d. Use the Stream Monitoring Activity Performance Rubric to assess student mastery.
e. Describe and analyze the qualities of potable water. (CCR7, CCR8, CCR9, CS1, CS2, CS4, T2, T3, T6, AQ1, AQ2, AQ3, AQ4, ES1, ES2, ES3)	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.	e. Use the Water Quality Testing Laboratory Rubric to assess student mastery.

Competency 3: Describe how wastewater is treated to maintain water quality. (DOK 1, AN)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Identify and describe the sources and types of wastewater. (CCW4, CCW10, CS1, CS2, T3, AQ3, ES3)	a. Ask students to list and classify different sources of wastewater (homes and businesses, manufacturing, agricultural, storm run off). From their list, develop a working definition for wastewater and classify each source as being spent, domestic, or sewage.	a. Grade list and student definition of wastewater.
b. Identify and describe hazards that may be present in water. (CCW4, CCW10, CS1, CS2, T3, AQ3, ES3)	b. Identify and describe common hazards associated with wastewater to include toxic waste, organic matter, infectious agents, and temperature.	b. Evaluate using a pencil and paper test.
c Describe methods and processes in wastewater treatment. (CCW8, CCW9, CS1, CS2, CS3, CS4, CS5, T2, T6, AQ3, ES3)	c. Take a field trip to a local wastewater treatment plant and view the processes that occur in the treatment of wastewater 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.	c. Use the Field Trip to Wastewater Treatment Plant Participation Checklist for the field trip or use the Guest Speaker Evaluation Form. Evaluate student electronic blog or journal for accuracy and completeness.

Performance Task

At One with Nature

As a wildlife specialist, you have been requested to conduct a wildlife survey of a given area. The survey should include, but not be limited to, the following items: habitat, available food, species that inhabit the area, and environmental impact. Present your findings to the class while in the given area. The class will explore the area to

validate and add to the findings as they relate to habitat, available food, species that inhabit the area, and environmental impact. Evaluate the presentation using the Presentation Rubric found in Appendix A.

Attachments for Performance Task

None

Unit Resources

Books:

Parker, R. (2011). *Aquaculture science*. Albany, New York: Delmar.

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.

Web sites:

Adopt-a-Stream Foundation. *Welcome to the adopt-a-stream foundation.* Retrieved September 11, 2011, from http://streamkeeper.org/

Mississippi Wildlife Federation. *Adopt a stream*. Retrieved September 1, 2011, from http://www.mswildlife.org/AAS/

Other:

CEV Video. (n.d.). *CEV pathway: Natural resources & environmental systems pathway* [DVD]. Lubbock, TX: Author.

For additional references, activities, and web resources, please refer to: Mississippi Agriculture Education B.R.I.D.G.E. Web site: http://rcu.blackboard.com (Available only to registered users).

Unit 11: Science of Forestry and the Environment

Understandings and Goals

Enduring Understandings
In this unit, the student will:

- A 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.
- 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.
- The number and size of the growth rings in a tree are indicators of the tree's age and annual growth rate.
- 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.
- 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 seedlings include proper depth of plants, proper placement of the root system, and proper soil compaction. 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.
- 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.
- Prevention of forest fires is preferable to control of fires. Prevention is achieved through a number of methods including prescribed burning and burn bans.
- 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.
- Reforestation is a major factor in the sustained use of forest land.

Essential Questions

- How do the layers of a forest function to protect and enhance the ecosystem?
- What are the most economically important tree species in Mississippi, and how are products from these species used?
- How can the number and size of the growth rings of a tree be used to determine age and growth rate of the tree?
- How is an estimate of the volume of pulp and sawlog timber established?
- What procedures are used in planting young trees for reforestation?
- How do forest products affect our lives?
- How do forests promote biodiversity?
- What are some ways that forest fires can be prevented?
- How does fire cause damage to the forest and the environment in general?
- Why is reforestation important, and how is it accomplished?

Vocabulary

Identify and review the unit vocabulary. Definitions will be located in Appendix B.

Annual Ring

Arboriculture
Board foot
Clear
Conifers
Deciduous
Evergreen
Hardwood
Lumber
Pulpwood
Seedling
Silviculture
Softwood

Suggested Learning Experiences

Competency 1: Examine basic principles of forest dendrology and mensuration. (DOK 1, AN)		
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. (CCR7, CCR8, CCR9, CCW8, CCW9, CS1, CS2, CS4, T1, T6, BIOI3, BIOII4, BO1, BO4, ES1, ES2, ES3)	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.	a. Use the Picture Assessment Rubric to assess student mastery.
b. Identify locally important tree species by common name, type, physical characteristics, and use. (CCR7, CCR8, CCR9, CS1, CS2, CS4, T1, T6, BIOI3, BIOII4, BO1, BO4, ES1, ES2, ES3) Examples: • Pine (slash, loblolly, longleaf, shortleaf) • Oak (red, pin, white, water) • Ash (green, white) • Hickory (bitternut, red, shagbark, mockernut)	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, Mississippi Tree Identification, found at 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 for this activity. Examples: • Pine (slash, loblolly, longleaf, shortleaf) • Oak (red, pin, white, water) • Ash (green, white) • Hickory (bitternut, red, shagbark, mockernut)	b. Evaluate chart for accuracy and completeness.
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. (CCR7, CCR8, CCR9, CS1, CS2, CS4, T1, T6, BIOI3, BIOII4, BO1, BO4, ES1, ES2, ES3)	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.	c. Evaluate student activity sheet for accuracy and completeness.
d. Demonstrate proper procedures for planting trees. (CCR7, CCR8, CCR9, CS2, CS4, T6, BIOI3, BIOII4, BO1, BO4, ES1, ES2, ES3)	d. Have students read about planting trees based on the information on trees and shrubs. After demonstrating the procedure, have students apply their knowledge by planting a tree on the school campus.	d. Use the Tree Planting Checklist to assess student mastery.

Competency 2: Discuss the relationship of forestry to environmental quality and economic development. (DOK 2, AN)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Identify consumer goods derived from forest locally. (CCR1, CCR2, CCR3, CS1, CS3, CS4, T1, T6, BIOI3, BIOII5, BO2, BO5, ES1, ES2, ES3)	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.	a. Evaluate using the Guest Speaker Rubric.
b. Describe the relationships between biodiversity and forests. (CCR4, CCR5, CS2, CS4, T2, T6, BIOI3, BIOII5, BO2, BO5, ES1, ES2, ES3)	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.	b. Evaluate the presentation using the Presentation Rubric.
c. Investigate methods for forest fire prevention. (CCR7, CCR8, CCR9, CCW8, CCW9, CS2, CS4, T2, T6, BIOI3, BIOII5, BO2, BO5, ES1, ES2, ES3)	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 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.	c. Use the Fire Prevention Poster Rubric to assess student mastery.
d. Discuss the different damages caused by forest fires. (CCR4, CCR5, CS2, CS4, T2, T6, BIOI3, BIOII5, BO2, BO5, ES1, ES2, ES3)	d. Have students search the Internet and other resources to locate examples of damage caused by forest fires. 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.	d. Evaluate using the Journal Rubric.
e. Discuss the methods and importance of reforestation. (CS2, CS4, T2, T6, BIOI3, BIOII5, BO2, BO 5, ES1, ES2, ES3)	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.	e. Evaluate using a paper and pencil test.

Performance Task

Run Forester, Run

As the local Forester, you have received a request from a local grower. The local grower wants you to give an assessment of a given area. Topics that must be addressed are:

- Ecosystems
- Fire prevention
- Species found on property
- Age of species
- Potential markets

Each forester in the class will have a written report for the local grower. Evaluate the written report using the Written Rubric found in Appendix A.

Attachments for Performance Task

None

Unit Resources

Books:

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.

Burton, L. D. and Cooper, E. L. (2007). *Agriscience: Fundamental & applications* (4th ed.). Clifton Park, NY: Delmar.

Herren, R. V. (2007). *The science of agriculture: A biological approach* (3rd ed.). Clifton Park, NY: Delmar.

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.

Web sites:

For additional references, activities, and web resources, please refer to: Mississippi Agriculture Education B.R.I.D.G.E. Web site: rcu.blackboard.com/ (Available only to registered users).

Mississippi State University Extension Service. *Mississippi tree identification*. Retrieved October 14, 2011, from http://msucares.com/pubs/publications/p2330.pdf

Other:

CEV Video. (n.d.). *CEV pathway: Natural resources & environmental systems pathway* [DVD]. Lubbock, TX: Author.

Unit 12:Wildlife and the Environment

Understandings and Goals

Enduring Understandings
In this unit, the student will:

- Mississippi is home to a diverse number of aquatic and terrestrial wildlife species.
- All wildlife species require a habitat that provides food, water, shelter, and space for each species to survive and repopulate.
- Wildlife species play an important role in human life and in maintaining our environment.
- Wildlife habitat must be protected, managed, and improved so that this important national resource can be conserved, sustained, and renewed.
- Like any renewable natural resource, wildlife must be protected and conserved to maintain sustainability of each species.
- Because of declining populations, some wildlife species are now protected by being classified as protected, threatened, or endangered.
- Habitat management and hunting regulations, such as limiting hunting seasons and imposing bag limits, are major tools in the conservation and protection of wildlife.

Essential Questions

- What are the major species of wildlife in my community?
- What habitat does my community offer to different wildlife species?
- What are ways in which wildlife benefit humankind and the environment in general?
- How can habitat for wildlife be managed and improved?
- Why are wildlife conservation and protection policies and programs needed?
- What wildlife species are now considered to be nuisance, protected, threatened, endangered, or extinct? What is the difference between these categories?
- What are the major tools and practices for conserving, protecting, and managing wildlife?

Vocabulary

Identify and review the unit vocabulary. Definitions will be located in Appendix B.

Commensalism
Mutualism
Parasitism
Predator
Prey
Vertebrae
Wetlands
Wildlife

Suggested Learning Experiences

Competency 1: Examine the relationships of wildlife well-being and environmental quality. (DOK 2, AN)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Identify the wildlife species found in the local area, and classify each as terrestrial or aquatic. (CCR7, CCR8, CCR9, CS2, CS4, AQ3, AQ4, BIOI3, ES2, ES3, ZO2, ZO3)	a. Introduce the unit by asking students to compare domesticated animals and wildlife animals. Have students brainstorm as many animals as possible and classify wildlife that are found locally as terrestrial or aquatic. 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.	a. Check student notebooks for accuracy and completeness.
b. Assess local wildlife habitat. (CCR4, CCR5, CCR7, CCR8, CCR9, CS2, CS4, AQ3, AQ4, BIOI3, ES2, ES3, ZO2, ZO3)	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.	b. Use the Written Report Rubric, the Poster Assessment Rubric, and the Oral Report Rubric to assess student mastery.
c. Investigate the importance of wildlife to the environment and human well-being. (CCR7, CCR8, CCR9, CS2, CS4, AQ3, AQ4, BIOI3, ES2, ES3, ZO2, ZO3)	c. Explain the benefits of wildlife to the environment and humans through consumptive and non-consumptive uses. 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.	c. Evaluate student performance using a written test.
d. Recommend procedures for improving habitat for wildlife. (CCR7, CCR8, CCR9, CCSL1, CCSL2, CS1, CS2, CS4, CS5, T2, T6, AQ3, AQ4, BIOI3, ES2, ES3, ZO2, ZO3)	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.	d. Use the Group Work Assessment Rubric to assess student mastery.

Competency 2: Investigate approaches in protecting and managing wildlife species. (DOK 1, AN)		
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. (CCR7, CCR8, CCR9, CS1, CS4, ES3, ZO3)	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,	a. Use the Group Work Assessment Rubric to assess student mastery.

	and have students transcribe them into their electronic notebooks or journals.	
b. Classify wildlife species based on threats to their continued existence. . (CCR1, CCR2, CCR3, CS1, CS4, T2, T6, ES3, ZO3)	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.	b. Evaluate student performance using a written test.
c. Describe practices in conservation, protection, and management of wildlife. (CCR4, CCR5, CS1, CS4, T6, ES3, ZO3)	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.	c. Evaluate student performance using a written test and/or the Guest Speaker Evaluation and Summary Form to assess student mastery.

Performance Task

Performance Task Title

As a wildlife consultant, you have been asked to conduct a wildlife survey of a given area. A few of the criteria are to identify the wildlife, habitat, and food availability. Prepare a PowerPoint to present your findings to a civic group (class). The group will ask questions related to the topic. Evaluate the presentation using the Presentation Rubric found in Appendix A.

Attachments for Performance Task

None

Unit Resources

Books:

Burton, D. (2009). *Fish and wildlife: Principles of zoology and ecology.* Florence, KY: Cengage Learning.

Deal, K. (2010). *Wildlife and natural resource management.* Florence, KY: Cengage Learning.

Stutzenbaker, C. D., Scheil, B. J., Swan, M. K., Lee, J. S., & Mattics, J. D. (2003). *Wildlife management: Science and technology* (2nd ed.). Old Tappan, NJ: Pearson/Prentice-Hall.

Web sites:

Mississippi Department of Wildlife, Fisheries, and Parks. (2011). MDWPF wildlife home page. Retrieved November 14, 2011, from www.mdwfp.com

Mississippi Museum of Natural Science. (2011). *Endangered species of Mississippi*. Retrieved November 14, 2011, from http://museum.mdwfp.com/downloads/science/endangered_species_packet.pdf

For additional references, activities, and web resources, please refer to: Mississippi Agriculture Education B.R.I.D.G.E. Web site: http://rcu.blackboard.com/ (Available only to registered users).

Other:

CEV Video. (n.d.). *CEV pathway: Natural resources & environmental systems pathway* [DVD]. Lubbock, TX: Author.

Unit 13: Environmental Stewardship

Understandings and Goals

Enduring Understandings

In this unit, the student will:

- Sustainable agriculture is a process for producing agricultural products economically and efficiently while maintaining the quality of life and the environment and conserving natural resources.
- Practices that promote sustainable agriculture include reduced tillage, integrated pest management programs, precision agriculture practices, fertilizer management, and protection of the soil.
- Many local, state, and federal agencies play an important role in protecting and maintaining the environment by providing education and assistance to producers, monitoring production practices, and assisting in environmental cleanup projects.
- Public laws and policies have been enacted to monitor and protect environmental quality and promote the conservation of natural resources.
- Solid waste comes 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.
- Solid waste can be disposed of by recycling, composting, incineration, or burial in a sanitary landfill.
- Recycling is the most environmentally friendly way of disposing of solid waste, but it is not practical for many forms of waste.
- A recycling program must include methods for collecting, sorting, storing, and disposal/sale of products.
- Composting is another environmentally-friendly disposal method for non-hazardous organic materials (grass clippings, tree limbs, etc.).
- Hazardous waste is any product that has the potential for harming human health or the environment in general.
- Hazardous waste materials may cause harm by being ignited, reacting with other materials, corroding other materials, or posing a health hazard to humans and animals.
- 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.

Essential Questions

- What is the difference between traditional agriculture production and sustainable agriculture?
- What are some key practices associated with sustainable agriculture, and how do they promote sustainability?
- What are some roles of government agencies and other organizations in protecting the environment and conserving natural resources?
- How do public laws and government policies protect the environment and promote the conservation of natural resources?
- What is solid waste, and how does it cause damage?
- How can solid waste be disposed?
- What is recycling?
- What is composting?
- What is hazardous waste, and how does it cause harm?
- Where can I obtain information about hazardous materials?

Vocabulary

Identify and review the unit vocabulary. Definitions will be located in Appendix B.

Composting
E.P.A.
Hazardous waste
Humus
MSDS
N.R.C.S.
Sustainable agriculture

Suggested Learning Experiences

Competency 1: Discuss concepts of sustainable agriculture. (DOK 1, AN, AP)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Describe the nature and importance of sustainable agriculture (renewable/nonrenewable resources). (CCR4, CCR5, CS1, CS2, T3, T6, ES2, ES3, SP2)	a. Introduce the lesson by a short talk on the concept of sustainability. Have students read content on sustainable agriculture. 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.	a. Evaluate using a paper and pencil test.
b. Identify and select practices that promote sustainability in agriculture, forestry, and natural resources. (CCR4, CCR5, CS1, CS2, CS4, T3, T6, ES2, ES3, SP2)	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 them if possible. Take photographs to depict findings.	b. Use the Written Report Rubric or the Oral Report Rubric to assess student mastery.

Competency 2: Explore the services of agencies and organizations that protect and maintain the environment. (DOK 1, AE)		
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. (CCR1, CCR2, CCR3, CS1, CS2, CS4, T3, T6, ES2)	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 Environmental and Natural Resources Agencies worksheet for this activity.	a. Evaluate student assignment for accuracy and completeness.
b. Investigate public laws and policies related to environmental quality and natural resource conservation. (CCR7, CCR8, CCR9, CCW8, CCW9, CS1, CS2, CS4, T3, T6, ES2)	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 Did You Know session with the class. The findings should be summarized and presented in written or oral reports.	b. Use the Written Report Rubric or the Oral Report Rubric to assess student mastery.

Competency 3: Use appropriate procedures for management and disposal of solid waste. (DOK 1, AE)		
Suggested Performance	**Suggested Teaching Strategies**	**Suggested Assessment**

Indicators		Strategies
a. Identify sources of solid waste. (CCR7, CCR8, CCR9, CS1, CS2, CS4, T3, T6, ES3)	a. Have students read content related to solid waste. 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 Guest Speaker rubric.	a. Evaluate using the Guest Speaker rubric.
b. Identify common hazards associated with improperly managed wastes. (CCR7, CCR8, CCR9, CS1, CS2, CS4, T3, T6, ES3)	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.	b. Evaluate student understanding using a written test.
c. Explain how solid waste materials should be managed and disposed. (CCW4, CCW10, CS1, CS2, CS4, T3, T6, ES3)	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 Advantages and Disadvantages of Waste Disposal Methods.	c. Use the Student Electronic Notebook rubric to assess student mastery.
d. Develop a plan for recycling. (CCR1, CCR2, CCR3, CCR7, CCR8, CCR9, CS1, CS2, CS4, T3, T6, ES3)	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 sale/disposal of recycled materials. (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.)	d. Use the Recycling Program Rubric to assess student mastery.
e. Explain the use of residential, agricultural, and industrial composting. (CCR7, CCR8, CCR9, CS1, CS2, CS4, T3, T6, ES3)	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 Connecticut School Composting Manual.) The results of composting can be used in school landscaping projects.	e. Use the School Composting Plan Rubric to assess student mastery.

Competency 4: Select appropriate procedures for managing hazardous waste materials. (DOK 1, AE)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Explore the meaning of hazardous waste. (CCR7, CCR8, CCR9, S1, CS2, CS4, T3, T6, ES3)	a. Have students recall the different sources of waste (domestic, commercial, medical, municipal, industrial, construction and demolition, transportation, and agricultural) 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	a. Students will be evaluated by a paper and pencil test.

	disposed of 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.	
b. Classify hazardous waste materials. (CCR7, CCR8, CCR9, CS1, CS2, CS4, T3, T6, ES3)	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. Discuss and illustrate the different classes of hazardous materials (ignitibility, reactivity, corrosivity, and toxicity).	b. Evaluate student understanding using a paper and pencil test.
c. Discover information about hazardous materials. (CCR7, CCR8, CCR9, CS1, CS2, CS4, T3, T6, ES3)	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 material 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 Hazardous Materials Discovery Assignment for this activity. After reviewing the assignments for accuracy and completeness, post to the class' Blackboard site.	c. Evaluate student assignments for accuracy and completeness.

Performance Task

Environmental Stewardship Information

You have been asked by a local civic group to research and prepare a one-page report regarding environmental stewardship in a local community. Your task is to identify and select practices that promote sustainability in agriculture, forestry, and natural resources. Present findings to the class. Evaluate the presentation using the Presentation Rubric found in Appendix A.

Attachments for Performance Task

None

Unit Resources

Books:

Arams, K. (2006). *Holt environmental science*. Austin, TX: Holt, Rinehart, and Winston.

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.

Web sites:

For additional references, activities, and web resources, please refer to: Mississippi Agriculture Education B.R.I.D.G.E. Web site: http://rcu.blackboard.com (Available only to registered users).

MSDSsearch. *MSDSSEARCH: The national MSDS repository*. Retrieved October 21, 2011, from http://www.msdssearch.com

MacLennan, M. *CGRER netsurfing: Environmental agencies/organizations*. Retrieved October 21, 2011, from http://www.cgrer.uiowa.edu/servers/servers_envorgs.html

Natural Resources Defense Council. *NRDC: Environmental laws and treaties.* Retrieved October 21, 2011, from http://www.nrdc.org/reference/laws.asp

Other:

CEV Video. (n.d.). *CEV pathway: Natural resources & environmental systems pathway* [DVD]. Lubbock, TX: Author.

Unit 14: Construction/Agricultural Equipment Operation and Maintenance

Understandings and Goals

Enduring Understandings
In this unit, the student will:

- Proper management and maintenance of equipment extends the life of the machine, reduces failures and operating costs, and increases safety for operators.
- An important part of machinery management is the documentation of maintenance and repairs to the machine.
- Work orders for machinery maintenance and repair should detail the parts and supplies used and the amount of labor required.
- Preventive maintenance programs are designed to extend equipment life, reduce repair costs, and provide for better safety for operators.
- 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.
- The owner's manual is the primary reference for planning and performing preventive maintenance on a regular schedule.
- Daily maintenance of equipment includes checking engine oil and transmission/hydraulic levels, checking tires, checking coolant levels, and visually inspecting the machine.
- 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.
- The most common types of arc welders are the SMAW (stick), GMAW (MIG), and GTAW (TIG). Each type has its strengths and limitations and can be used for several different types of welding.
- Welding accessories that must be used in arc welding include electrode holders, grounding clamps, wire brushes, chipping hammers, and work clamps and guides.
- 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.
- 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.
- Welds are classified as to type (fillet or groove), joint (butt, corner, edge, lap, and T), and position (flat, vertical horizontal, and overhead).
- 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.
- Mixtures of oxygen and acetylene gases are potentially explosive, and proper safety procedures and personal protection are necessary for safe operation.
- The major parts of an oxyacetylene cutting unit are the cylinders, regulators, hoses, torch body, and cutting attachment.
- There is a set procedure for safely setting up, igniting, and shutting down an oxyacetylene torch unit that must be followed at all times.
- There are three different types of flames that can be generated by an oxyacetylene torch: oxidizing, neutral, and carbonizing.
- 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.

Essential Questions

- Why are machinery management and maintenance important?
- How are records of maintenance and repairs kept for a machine?
- How is a work order for machinery maintenance and repair completed?
- What are the purpose and goals of preventive maintenance?
- What safety procedures should be followed in performing preventive maintenance?
- What information can be found in an owner's manual regarding preventive maintenance?
- What items should be checked on a machine on a daily basis?
- What personal protection devices are necessary for safely using an arc welder?
- What safety procedures are necessary for safely using an arc welder?
- What are the most common types of arc welding machines, and where are they used?
- What accessories are used in arc welding, and what is their purpose?
- What factors must be taken into account in selecting a specific electrode for a job?
- What factors must be considered in setting up an arc welding machine for a specific job?
- What are the different weld types, joints, and positions?
- What factors must be taken into consideration in making a weld?
- What safety and personal protection procedures are necessary for oxyacetylene torch operation?
- What are the major parts of an oxyacetylene cutting unit?
- What is the procedure for setting up, igniting, and shutting down an oxyacetylene torch?
- What are the characteristics of the three different types of flames that can be generated by an oxyacetylene torch?
- What is the procedure for making a cut in mild steel with an oxyacetylene cutting torch?

Vocabulary

Identify and review the unit vocabulary. Definitions will be located in Appendix B.

Cutting Terms

Regulator
Neutral flame
Tip cleaner
Backfire
Flashback
Arc
Electrode
Ground clamp
Tensile strength

Electrical Terms

Short circuit
Electricity
Conductor
Resistance
Insulator
Volts
Amps
Watts
Ohms

Suggested Learning Experiences

Competency 1: Inspect, maintain, and repair agricultural equipment. (DOK 2, AT)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Describe procedures for inspecting coolant, engine oil, tire pressure, hydraulic fluid, gear oil, and air filters. (CCR7, CCR8, CCR9, CS1, CS4,PHI3)	a. Provide students with copies of owner maintenance manuals and procedures. Have students identify key maintenance procedures.	a. Give a written test on inspecting and maintaining agricultural equipment.
b. Perform operation and maintenance checks on agricultural equipment according to manufacturer's specifications. (CCR7, CCR8, CCR9, CS1, CS4, PHI3)	b. Students will perform routine owner equipment checks and maintenance procedures.	b. Evaluate using the Performing Routine Equipment Maintenance and Repair Tasks Rubric.
c. Assess parts to repair or replace parts based on manufacturer's specifications and observation. (CS1, CS4, PHI3)	c. Demonstrate the procedure for checking parts for wear or damage using manufacturer's specifications.	c. Give a written test on procedures for checking parts.
d. Perform maintenance for required parts, reassemble, adjust, and test. (CCR7, CCR8, CCR9, CS1, CS4, PHI3)	d. Have students inspect, repair, and/or replace parts as necessary. Students will be provided hands-on opportunities to inspect and identify procedures for maintaining agricultural equipment.	d. Evaluate using the Performing Routine Equipment Maintenance and Repair Tasks Rubric.

Competency 2: Perform reconditioning of agricultural machinery and equipment. (DOK 2, AT)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Recondition agricultural machinery and equipment. (CCR7, CCR8, CCR9, CS1, CS4, CS5, CS6, CS7, PHI3)	a. Using a PowerPoint or other visual presentation, discuss the procedures for reconditioning and repairing equipment and machinery.	a. Give a written test on reconditioning equipment.
b. Paint agricultural machinery and equipment. (CCR7, CCR8, CCR9, CS1, CS4, CS5, CS6, CS7, PHI3)	b. Students will work in teams to recondition equipment and machinery.	b. Evaluate using the Activity Performance Rubric.

Competency 3: Perform welds with shielded metal arc welding (SMAW) equipment. (DOK 2, AT)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Fabricate a single v-groove butt welding in	a. Review safety rules and procedures for welding. Students will perform an exercise for the appropriate	a. Give a written test on shielded metal arc welding.

the horizontal position. (CCR7, CCR8, CCR9, CS1, CS4, CS5, CS6, CS7, PHI 3)	welding position.	
b. Fabricate a single v-groove butt weld in the vertical up position. (CCR7, CCR8, CCR9, CS1, CS4, CS5, CS6, CS7, PHI3)	b. Discuss and demonstrate procedures of each welding position with the use of practical exercises, PowerPoint presentations, overheads, and print information. Students will perform an exercise for the appropriate welding position.	b. Evaluate using the Advanced Welding and Cutting Techniques Rubric.

Competency 4: Perform welds with gas metal arc welding (GMAW) equipment. (DOK 2, AT)

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Fabricate a single v-groove butt weld in the horizontal position. (CCR7, CCR8, CCR9, CS1, CS4, CS5, CS6, CS7, PHI3)	a. Review safety rules and procedures for oxyacetylene operations. Students will perform an exercise for each welding position.	a. Give a written test on oxyacetylene welding procedures.
b. Fabricate a single v-groove butt weld in the vertical up position. (CCR7, CCR8, CCR9, CS1, CS4, CS5, CS6, CS7,PHI3)	b. Discuss and demonstrate procedures of each welding position with the use of practical exercises, a PowerPoint presentation, overheads, and print information. Students will perform an exercise for the appropriate welding position.	b. Evaluate using the Activity Performance Rubric.

Competency 5: Cut metal with plasma arc cutter. (DOK 1, AT)

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify safety rules and practices associated with a plasma arc cutter. (CCR7, CCR8, CCR9, CS1, CS4, PHI3)	a. Provide students with a list of safety rules and practices associated with a plasma arc cutter.	a. Give a written test on safety, setup, and operation of plasma arc cutters.
b. Plasma cutter operation and usage. (CCR7, CCR8, CCR9, CS1, CS4, CS5, CS6, CS7, PHI3)	b. Students will • identify the parts of the plasma arc cutter and their functions. • set up and operate a plasma arc cutter to make cuts in steel. • demonstrate the setup and operation of the plasma arc cutter to the students.	b. Evaluate using the Activity Performance Rubric.

Competency 6: Select and demonstrate proper equipment for a specific construction job and develop a bill of materials for a specific job. (DOK 1, AB)

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Assess tool usage and material estimating for a specific task. (CCR7, CCR8, CCR9, CS4, CS5, CS6, CS7, T2, T6)	a. Provide the students with scenarios of actual repair jobs. Have them select and properly use appropriate tools and equipment. Students will create and submit a bill of materials for the specific job. (Safety will be reinforced during every task.)	a. Evaluate using the Activity Performance Rubric.

Performance Task

Performance Task Title

You are the owner of a local repair shop. A customer has brought you a sketch of an item that they need repaired or manufactured. You are to review the sketch, provide a bill of materials, cost of job (materials and labor), and an estimated time of completion. When the customer has approved the job, you are to repair or manufacture the item according to the sketch, bill of materials, and within the allotted time.
Note: Instructor will provide the student with sketch. Project may be completed over several classes.
Evaluate this activity using the Activity Performance Rubric found in Appendix A.

Attachments for Performance Task

None

Unit Resources

Books:

Herren, R. (2009). *Agriculture mechanics: Fundamentals and applications* (5th ed.). Albany, NY: Delmar.

Phipps, L. J., Miller, G. M., & Lee, J. S. (2004). *Introduction to agricultural mechanics* (2nd ed.). Upper Saddle River, NJ: Pearson Prentice Hall.

Unit 15: Agricultural Business Management and Processes

Understandings and Goals

Enduring Understandings
In this unit, the student will:

- Knowing what entrepreneurship means is necessary for a business.
- Society needs people who are willing to start business ventures.
- Each component of a business plan is important.
- There are many sources for funding a business venture.
- Having a plan for a business layout is needed when starting a business.
- The functions of management are important to a business's success.
- All companies have levels of management.
- The types of business ownership used in society today are sole proprietorship, partnership, and corporation.
- Businesses are regulated by government in many ways.
- Risk management is important in a business setting.
- Insurance is very important in reducing business risk.
- Insurance is a necessary means of protecting against loss.
- Insurance coverage is obtained through an insurance company or agent.
- An insurance agent will assist in the process of settling a loss.
- Speculative business risk should be identified for any business.
- GIS can be integrated into a variety of disciplines for solving problems.

Essential Questions

- What does entrepreneurship mean?
- What are some business ventures that you might be interested in?
- What are the components of a business plan?
- What are some sources for funding a business?
- Why is your business layout so important?
- What are the seven functions of marketing?
- What are the functions of management?
- What are the levels of management?
- What must one do to prepare to own a business?
- What are the three types of business ownership?
- How are businesses regulated by the government?
- How can a business maintain or control risk?
- Why is insurance important to a business?
- What is insurance, and why do we need it?
- How would you obtain insurance coverage?
- What is the process of settling an insurance loss?
- How can GIS be used to solve problems in agriculture?

Vocabulary

Identify and review the unit vocabulary. Definitions will be located in Appendix B.

Capital
Cooperative
Corporation
Depreciation
GPS
Health Insurance
Income
Interest
Life Insurance
Negligent
Partnership
Principle
Profit
Retail
Sole proprietor
Supply
Wholesale

Suggested Learning Experiences

Competency 1: Explore basic principles of agricultural economics and marketing. (DOK 1, AB)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Describe and contrast the types of business organizations. (CCR1, CCR2, CCR3, CS1, CS2, CS3, CS4, CS5, CS12, CS13, CS14, CS15, CS16, T2, T6)	a. Discuss and contrast the different types of business organizations with the students. Provide examples of different organizations.	a. Monitor classroom discussion.
b. Identify factors that influence pricing including the law of supply and demand and consumer characteristics. (CCR1, CCR2, CCR3, CS1, CS2, CS3, CS4, CS5, CS12, CS13, CS14, CS15, CS16, T2, T6)	b. Discuss and illustrate the law of supply and demand. Have students work in groups to apply this law to different scenarios regarding agricultural products.	b. Evaluate using the Group Presentation rubric.
c. Differentiate between wholesale and retail marketing. (CCR7, CCR8, CCR9, CS1, CS2, CS3, CS4, CS5, CS12, CS13, CS14, CS15, CS16, T2, T6)	c. Have students identify wholesale and retail businesses in their area. Students will debate the pros and cons of each. Have students view Web sites of local banks and compile a list of other services including checking and savings accounts. Have students compare different institutions' accounts, fees, and services. Students will present their findings to the class.	c. Monitor classroom discussion. Evaluate using the Presentation Rubric.

Competency 2: Discuss principles and practices of an agricultural business. (DOK 1, AB)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Compare sources of agricultural credit, discuss the importance of a personal and business credit rating and the factors that affect the credit rating. (CCR7, CCR8, CCR9, CS1, CS2, CS3, CS4, CS5, CS12, CS13, CS14, CS15, CS16, T2, T6)	a. Invite a representative of a bank or agricultural financial agency to speak to the class on sources of credit and other financial services. Have students summarize the presentation in their journals. Follow up with a discussion to make sure that all students have noted the important points. Have students research credit ratings and summarize the factors associated with credit ratings. Have students summarize their findings, including information on the importance of a strong credit rating.	a. Evaluate using the Journal Rubric.
b. Discuss other banking services for agriculture. (CCR1, CCR2, CCR3,CS1, CS2, CS3, CS4, CS5, CS12, CS13, CS14, CS15, CS16, T2, T6)	b. Have students view Web sites of local banks and compile a list of other services including checking and savings accounts. Have students compare different institutions' accounts, fees, and services.	b. Evaluate using classroom discussion. Monitor class to be sure all students participate.

c. Discuss taxes and insurance as related to agriculture business. (CCR4, CCR5, CS1, CS2, CS3, CS4, CS5, CS12, CS13, CS14, CS15, CS16, T2, T6)	c. Divide the students into groups. Each group will create an agricultural business model. Items to include: • Describe the forms and practices associated with income tax preparation. • Identify insurance needs for an agricultural business. • Discuss essential elements of a contract and other common business agreements and laws. • Discuss principles of property acquisition and transfer. • Apply legal land descriptions. • Discuss principles and practices related to land surveys.	c. Evaluate using the Group Presentation Rubric.

Competency 3: Explore the principles and applications of precision-farming operations. (DOK 2, AT)		
Suggested Performance Indicators	**Suggested Teaching Strategies**	**Suggested Assessment Strategies**
a. Identify components of an agricultural GIS system. (CCR1, CCR2, CCR3, CS1, CS2, CS3, CS4, CS5, CS6, CS7, CS12, CS13, CS14, CS15, CS16, T2, T6)	a. Use a video or PowerPoint presentation to identify the use of GIS/GPS and precision-farming techniques. Have students summarize the presentation in their electronic journals.	a. Evaluate journals using the Journal Rubric.
b. Explore the principles and applications of precision-farming operations. (CCR1, CCR2, CCR3, CS1, CS2, CS3, CS4, CS5, CS12, CS13, CS14, CS15, CS16, T2, T6)	b. Have students design an application GIS project. The project will be related to a local problem or situation. Students will present the project to the class for peer review and critique.	b. Monitor peer review.

Performance Task

Starting an Agricultural Business

The performance task will be to design an agricultural business using the topics covered in class. The class will be divided into different student groups. The teacher will assign different agricultural business topics to each group. Each group will research and apply each topic to the proposed agri-business. Each group will present their agricultural business model to the class for questions and defense. Evaluate the presentation using the Group Presentation Rubric found in Appendix A.

Attachments for Performance Task

None

Unit Resources

Books:

Brasse, T. (2006). *Precision agriculture*. Albany, NY: Delmar.

Elliot, J. (2008). *Agribusiness: Decisions and dollars*. Albany, NY: Delmar.

Ess, D. R., Shoup, W. B., & Butler, J. N. (2003). *The precision-farming guide for agriculturists*. Moline, IL: Deere and Company.

Steward, J., Jobes, R., Casey, J. E., & Purcell, W. D. (2004). *Farm and ranch business management* (5th ed.). Moline, IL: Deere and Company.

Web sites:

United States Internal Revenue Service. (2011). *Publication 225: Farmer's tax guide*. Retrieved August 22, 2011, from http://www.irs.gov/publications/p225/index.html

Student Competency Profile

Student's 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 it 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 ANR		
	1.	Examine the nature of the agriculture and natural resources industry. (DOK1, AB, AS, AO, AE, AF, AN, AP, AT)
	2.	Examine the relationships between the pure sciences, agriculture, and agriscience. (DOK 1, AN)
	3.	Apply standard agricultural and natural resources safety practices. (DOK 1, AN)
Unit 2: Leadership and Human Relations		
	1.	Develop life and career skills for success in the 21st century. (DOK 3)
	2.	Explore the role of the FFA in promoting leadership, personal development, and human relations skills. (DOK 1)
	3.	Examine the concept of leadership. (DOK 1)
	4.	Describe the role of work ethics and values in establishing and building a successful career. (DOK 1)
Unit 3: Experiential Learning (SAE)		
	1.	Plan and implement an experiential learning program. (DOK 3, AB)
	2.	Maintain records and documentation of experiential learning activities, projects, and enterprises. (DOK 3, AB)
Unit 4: Science of Animals		
	1.	Explore the animal agriculture industry and enterprises. (DOK 2, AS)
	2.	Investigate the anatomy and physiology of animals. (DOK 2, AS)
	3.	Describe important elements of digestion and nutrition in animals. (DOK 1, AS)
	4.	Examine the role of genetics and breeding in animal production. (DOK 1, AS)
Unit 5: Science of Plants		
	1.	Explore the anatomy and physiology of a plant. (DOK 2, AP)
	2.	Investigate common methods of plant reproduction. (DOK 1, AP, AO)
	3.	Apply classification methods to plants. (DOK 1, AP)
	4.	Apply principles of plant nutrition. (DOK 1, AP)
	5.	Explore basic concepts of pest management to include insect damage, weed damage, and diseases. (DOK 1, AP)
Unit 6: Soil Science		
	1.	Demonstrate an understanding of the impact of soil as a natural resource. (DOK2, AE, AN)

	2.	Investigate the use of the land capability classification system. (DOK 1, AN, AE)
	3.	Investigate the chemical properties of soils. (DOK 2, AP, AN, AE)
Unit 7: Agricultural Lab Operations and Safety		
	1.	Identify safety procedures and safety devices for the agricultural workplace. (DOK 1, AT)
	2.	Identify common equipment, tools, and safety procedures and perform the various welding processes. (DOK 1, AT)
	3.	Apply safety procedures and perform tasks using oxyacetylene equipment. (DOK 1, AT)
	4.	Examine the major parts and functions of a small engine. (DOK 1, AT) NOT ON CPAS
Unit 8: Orientation/Careers/Leadership		
	1.	Review safety rules and behavior. (DOK 1)
	2.	Select careers in agricultural and natural resources. (DOK 1)
	3.	Develop an individual FFA activity plan. (DOK 1)
	4.	Develop and present a 3-5 min multi-media presentation on an agriculture or natural resource topic. (DOK 1)
	5.	Apply the principles of leadership and personal development. (DOK 1)
	6.	Maintain Supervised Agricultural Experience records. (DOK 1)
Unit 9: Science of the Agricultural Environment		
	1.	Examine the relationship of the atmosphere to the earth's environment. (DOK 1, AN)
	2.	Use weather and climate information in making decisions about the environment. (DOK 2, AE)
	3.	Assess air quality and identify sources of air pollution. (DOK 2, AN,AE)
	4.	Explore concepts and practices related to wildlife conservation and management. (DOK 1, AN, AE)
Unit 10: Water Quality Management		
	1.	Explore concepts of water usage and quality. (DOK 1, AN)
	2.	Describe important water-management practices. (DOK 2, AN)
	3.	Describe how wastewater is treated to maintain water quality. (DOK 1, AN)
Unit 11: Science of Forestry and the Environment		
	1.	Examine basic principles of forest dendrology and mensuration. (DOK 1, AN)
	2.	Discuss the relationship of forestry to environmental quality and economic development. (DOK 2, AN)
Unit 12: Wildlife and the Environment		
	1.	Examine the relationships of wildlife well-being and environmental quality. (DOK 2, AN)
	2.	Investigate approaches in protecting and managing wildlife species. (DOK 1, AN)
Unit 13: Environmental Stewardship		
	1.	Discuss concepts of sustainable agriculture. (DOK 1, AN, AP)
	2.	Explore the services of agencies and organizations that protect and maintain the environment. (DOK 1, AE)
	3.	Use appropriate procedures for management and disposal of solid waste. (DOK 1, AE)

	4.	Select appropriate procedures for managing hazardous waste materials. (DOK 1, AE)
Unit 14: Construction/Agricultural Equipment Operation and Maintenance		
	1.	Inspect, maintain, and repair agricultural equipment. (DOK 2, AT)
	2.	Perform reconditioning of agricultural machinery and equipment. (DOK 2, AT)
	3.	Perform welds with shielded metal arc welding (SMAW) equipment. (DOK 2, AT)
	4.	Perform welds with gas metal arc welding (GMAW) equipment. (DOK 2, AT)
	5.	Cut metal with plasma arc cutter. (DOK 1, AT)
	6.	Select and demonstrate proper equipment for a specific construction job and develop a bill of materials for a specific job. (DOK 1, AB)
Unit 15: Agricultural Business Management and Processes		
	1.	Explore basic principles of agricultural economics and marketing. (DOK 1, AB)
	2.	Discuss principles and practices of an agricultural business. (DOK 1, AB)
	3.	Explore the principles and applications of precision-farming operations. (DOK 2, AT)

Appendix A: Activities and Rubrics

An alphabetized list of activities and rubrics follows.

Name: _____

Date: _____

Period: _____

Advanced Welding and Cutting Tasks Rubric

Rate the ability of the student to perform maintenance and repair tasks shown below using the following scale:

4 Proficient – Can perform consistently and independently with proficiency of an incumbent worker.
3 Intermediate – Can perform the task but may require further practice to become as proficient as an incumbent worker.
2 Introductory – Can perform the task but some coaching and further training is required.
1 Limited – Can perform the task with extensive coaching. Further training and practice is required.

Task	**Rating**
Fabricate a single v-groove butt weld in the horizontal position using SMAW equipment	
Fabricate a single v-groove butt weld in the vertical up position using SMAW equipment	
Fabricate a single v-groove butt weld in the horizontal position using GMAW equipment	
Fabricate a single v-groove butt weld in the vertical up position using GMAW equipment	
Set up a plasma arc cutter	
Make cuts in mild steel using a plasma arc cutter	

Name: _____

Date: _____

Period: _____

Air Pollution Presentation Rubric

	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	

Name: _____

Date: _____

Period: _____

Activity Performance Rubric

Task to Be Performed_____

	Possible Points	Points Awarded
Safety Personal safety (glasses, clothing, etc.) Safe use of tool Safely performs the task	25	
Performance of the task Follows the task instructions Performs the task efficiently Performs the task satisfactorily	50	
Lab maintenance Area cleanup (clean and tidy) Area organization (before, during, and after the task)	25	
Total	100	

Comments for Deductions:

Name: _____

Date: _____

Period: _____

Agriculture Natural Resources Areas Graphic Rubric

	Superior 4	Very Good 3	Acceptable 2	Needs Improvement 1	Score
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: _____

Agriculture Timeline Graphic Rubric

The student did the following:	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 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: _____

21st Century Life and Career Skills

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 relating 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

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 skill 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 and Self-Direction		
Social and Cross-Cultural Skills		
Productivity and Accountability		
Leadership and Responsibility		
	TOTAL SCORE	

Name: _____

Date: _____

Period: _____

Chart for Comparing Photosynthesis, Respiration, and Transpiration

For each process, identify or describe the following:

	Photosynthesis	Respiration	Transpiration
Inputs			
Outputs			
Lighting			
Contributing Factors			
Primary Difference			

Name: _____

Date: _____

Period: _____

Checklist for Evaluating the Diagram of the Atmosphere

_____ 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 _____ %

Name: _____

Date: _____

Period: _____

Checklist for Evaluating a Sketch of a Land Plot

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

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 packaged 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: _____

Detecting Air Pollution Activity Performance Rubric

	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:

Name: _____

Date: _____

Period: _____

Domesticated Animals' Benefits

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.

Class of Animal	Species	Benefits

Name: _____

Date: _____

Period: _____

Environmental Science Weather Test

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 the:
    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=5/9 (F-32) **F=9/5 (C+32)**

6. Convert 36 degrees Fahrenheit to Celsius.

7. Convert 105 degrees Celsius to Fahrenheit.

Name: _____

Date: _____

Period: _____

Experiential Learning Goals and Plans

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, etc. 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: _____

Evaluating Student Chart on Plant Parts and Functions

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: _____

Experiential Learning Scavenger Hunt

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: _____

Field Trip to Wastewater Treatment Plant Participation Checklist

___ 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.

Name: _____

Date: _____

Period: _____

Fish Research Group Project Rubric

CATEGORY	4-Exceptional	3-Admirable	2-Acceptable	1-Amateur	SCORE
Group Participation	All students participated in the activity.	Three-fourths of the students participated in the activity.	One-half 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 half 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 performed roles effectively.	Each student was assigned a role, but roles were not clearly defined or consistently followed.	Students were assigned roles, but roles were not consistently followed.	No effort was made to assign roles to group members.	
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:	

Name: _____

Date: _____

Period: _____

Group Work Assessment Rubric

	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	

Name: _____

Date: _____

Period: _____

Guest Speaker Evaluation Form

Name of Speaker: _____

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: _____

Interpret a Hazardous Material Safety Data Sheet Assignment

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: _____

Journal Rubric

	Exemplary 4 Points	Accomplished 3 Points	Developing 2 Points	Beginning 1 Point	Score
Writing Quality	There is a strong writing style and ability to express concepts learned. Spelling, grammar, syntax, and so forth are excellent.	There is a good writing style and ability to express concepts learned. Grammar, syntax, spelling, and so forth are very good.	There is a writing style that conveys meaning adequately. There are 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 description of the activity is recorded. All major points are documented.	Very good description of the activity is recorded. Most major points are documented.	Good description of the activity is recorded. Some major points have been omitted.	Limited description of the activity is recorded. Very few major points are documented.	
Insight and Understanding	Definite insights into the implications of the activity are recorded. Awareness of the complexity of issues and situations is present.	Some insight into the issue or situation is recorded. Some sense of complexity is present.	Insight is present from a more simplistic standpoint.	Only limited insight into the issue or situation is recorded.	
Application	Content of the activity is connected to the student's personal life and goals.	Content of the activity is connected to the field of service.	Content of the activity is related to life in general.	Only limited connections are made.	
				Total Score	

Comments:

Name: _____

Date: _____

Period: _____

Job Sheet/Performance Rubric

	Exemplary 4 Points	Accomplished 3 Points	Developing 2 Points	Beginning 1 Point	Score
Safety	Student follows all safety regulations without prompting.	Student follows all safety regulations but may require limited reminders or prompting.	Student follows all or nearly all safety regulations but requires significant reminders.	Student does not follow most safety regulations.	
Guidelines	Student properly diagnoses problem according to manufacturer guidelines and specifications within manufacturer-specified time limits.	Student properly diagnoses problem according to manufacturer guidelines and specifications but may take additional time.	Student properly diagnoses problem according to manufacturer guidelines and specifications with limited assistance.	Student's work is not performed to manufacturer guidelines and specifications.	
Diagnosis	Student quickly and accurately diagnoses problems and accurately determines causes of malfunction based on information obtained from resources.	Student accurately diagnoses problems and accurately determines causes of malfunction based on information obtained from resources.	Student diagnoses problem with limited assistance. With limited assistance, student determines causes of malfunction based on information obtained from resources.	Student is unable to diagnose problem.	
Customer Information	Job Sheet includes all customer information, lists all requested repairs, and contains correct calculations with no items missing.	Job Sheet includes customer information, lists requested repairs, and contains correct calculations but may include up to	Job Sheet includes customer information, lists requested repairs, and contains correct calculations but may include up to	Job Sheet includes customer information, lists requested repairs, and contains correct calculations but may include up to	

		two errors or omissions.	three errors or omissions.	four errors or omissions.	
Written Information	Written report is accurate and complete and demonstrates thorough understanding of systems, how they operate, safety procedures, and importance of manufacturer recommendations.	Written report is accurate and complete and demonstrates solid understanding of systems, how they operate, safety procedures, and importance of manufacturer recommendations.	Written report is mostly accurate and complete and demonstrates understanding of types of systems, how they operate, safety procedures, and importance of manufacturer recommendations.	Written report is inaccurate and/or incomplete or indicates limited to no understanding of types of systems, how they operate, safety procedures, and importance of manufacturer recommendations.	
Total Score					

KWL Chart: Teacher Instructions

Purposes

To help students access prior knowledge through brainstorming
To identify areas of student interest or concern
To aid the teacher in planning lessons as well as checking for understanding
To track student learning throughout the unit
To identify areas for further student research/study

Process

Use this strategy prior to, during, or at the close of any unit of study. The process can be done individually, in small groups, or as a class activity.
Post the charts or have students record their information in groups.
During the brainstorming phase, emphasize getting lots of ideas rather than debating or discussing the ideas as they are generated. Debates, clarifications, and discussions of ideas occur once the brainstorming is over. Do not clarify any confusion or react in any way other than to record the data. Conflicting data may be recorded.
During the lesson or unit of study, misconception, confusion, or curiosity should be addressed.

Name: _____

Date: _____

Period: _____

KWL Chart

KNOW	WHAT TO KNOW	WHAT I LEARNED

Name: _____

Date: _____

Period: _____

Laboratory Safety Rubric

	Scoring Criteria			
The student does the following:	**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				
Subtotal for safety equipment				
Maintains clean facility				
Performs safety inspections				
Keeps traffic area free of debris				
Stores materials properly				
Subtotal for facility cleanliness				
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				
Subtotal for appropriate behaviors				
Observes safety signage				

Interprets color coding				
Understands safety symbols				
Observes safety zones				
Locates fire extinguishers				
Locates first-aid supplies				
Subtotal for safety signage				
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				
Subtotal for tool selection				
Exercises caution with hazardous chemicals				
Observes label precautions				
Handles chemicals properly				
Provides adequate ventilation				
Subtotal for chemical safety				
Summative Total				

Adapted from Rubric Toolkit for Agricultural Science and Technology, Texas A&M University Instructional Materials Service

Notes:

Name: _____

Date: _____

Period: _____

Land Capability Classification Chart

Identify the distinguishing factors for each of the eight land capability classes.

Land Capability Class	Soil	Slope	Erosion Potential	Internal Drainage	Highest Productive Use
I					
II					
III					
IV					
V					
VI					
VII					
VIII					

Name: _____

Date: _____

Period: _____

Leadership Characteristics Survey

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 to 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: _____

Letter of Application Rubric

	Excellent 4 Points	Proficient 3 Points	Needs Improvement 2 points	Unsatisfactory 1 Point	Score
Layout/Design	Creatively designed and easily read; excellent business letter	Attractive and easy to read; good business letter	Appears busy or boring and is difficult to read; needs improvement	Unattractive or inappropriate and very difficult to read; not acceptable	
Information, Style, Audience, and Tone	Accurate and complete information; very well written and presented	Well written and interesting to read	Some information provided but is limited or inaccurate	Poorly written, inaccurate, or incomplete	
Accurate Parts	Complete with all required parts	Some elements may be missing.	Most elements are missing or out of place.	Did not use proper form for a letter	
Grammar, Punctuation, and Wording	Excellent presentation, style, grammar, and punctuation	Fair presentation, style, grammar, and punctuation	Missing information and inaccurate punctuation and/or grammar	Poor grammar, punctuation, and wording	
Following Directions and Guidelines	Always on task and always followed directions	Followed directions with some guidance	Required a good bit of extra guidance	Did not follow directions and did not ask for extra help	
				Total Score	

Name: _____

Date: _____

Period: _____

Letter of Concern Regarding Production Practices

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 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: _____

Letter of Concern Rubric

	Scoring Criteria			
	Excellent 4	**Good 3**	**Needs Improvement 2**	**Unacceptable 1**
Information and Content	Letter is 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

Complete the following table using the information found in your module and in the textbook.

Name of System	Major Components	Major Functions

Name: _____

Date: _____

Period: _____

Oral Report Rubric

	Scoring Criteria			
The student does the following:	**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: _____

Performing Routine Equipment Maintenance and Repair Tasks Rubric

Rate the ability of the student to perform maintenance and repair tasks shown below using the following scale:

4 Proficient – Can perform consistently and independently with proficiency of an incumbent worker
3 Intermediate – Can perform the task but may require further practice to become as proficient as an incumbent worker
2 Introductory – Can perform the task but some coaching and further training is required
1 Limited – Can perform the task with extensive coaching; further training and practice is required

Task	Rating
Check engine oil level and condition	
Check coolant level and concentration	
Check hydraulic/transmission fluid and condition	
Check pleated paper air filter	
Check oil bath air filter	
Assess machinery parts for wear or breakage	
Recondition agricultural machinery	

Name: _____

Date: _____

Period: _____

Picture Assessment Rubric

	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: _____

Presentation Rubric

Date_____

Criteria	1	2	3	4	Score
Presentation	Unorganized; does not flow; hard to follow; does not account for the knowledge of the audience; bland; no use of color or graphics	Ideas are organized, but presentation requires further explanation to follow; some use of color and graphics; obvious improvement needed	Appropriately organized; some improvement needed to clearly understand the topic; appropriate use of graphics	Presentation flows easily and can be understood easily by the audience; good use of color and graphics; all required information is present	
Cleanliness	Unorganized experimentation; poor lab skills; messy and unorganized report; lacks direction	Ideas are organized, but presentation requires further explanation to follow; poor lab skills; obvious improvement needed	Appropriately organized; some improvement needed to clearly understand the topic; only a few errors in lab skills	Report flows easily and is easily understood; good lab skills; all required information is present	
Knowledge of the Topic	Little to no understanding of the project; shows lack of interest and research; unable to answer questions on the topic	Basic understanding of the task; very little interest (too easy); unable to sufficiently answer questions	Adequate understanding of the task; appropriate information for the audience; could be further studied	Questions answered easily; information appropriate for the audience; shows interest and good investment of time	
Thoroughness	No understanding of the science involved; did not include all topics	Poor understanding of the science; one reference; only a couple of topics researched	Decent explanation of the science; two references; most topics present	Effective explanation of science; all topics present	
Accuracy	Incorrect facts throughout the presentation; no data inclusion	One or two correct facts, but primarily poor information; poor representation of data	A few incorrect facts, but effective overall presentation; should improve representation of data	Complete factual information; good overall presentation and representation of data	
Total					

Teacher comments:

Name: _____

Date: _____

Period: _____

Planning an Experiment Rubric

	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
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 measurable 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, or 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: _____

Plant Growth

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: _____

Plant Nutrient Chart

For each essential nutrient, enter the element name, the chemical symbol, type, and deficiency symptoms.

Element Name	Chemical Symbol	Type	Deficiency Symptoms

(O=Organic, P = Primary, S = Secondary, M = Micronutrient)

Name: _____

Date: _____

Period: _____

Plant Pests and the Damage They Cause

Type of pest	Damage or loss caused by each type

Name: _____

Date: _____

Period: _____

Poster Assessment Rubric

	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 are 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 are 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	

Name: _____

Date: _____

Period: _____

Reflective Writing Rubric on the Differences between Groundwater and Surface Water

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.	There are 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 groundwater and surface water.	The writing contains at least two accurate descriptions of groundwater and surface water.	The writing contains at least one accurate example of groundwater and surface water.	The writing contains no examples or descriptions of groundwater 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 groundwater.	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 groundwater.	The writing seemed to be a collection of unrelated sentences. The student did not grasp the concept of the difference between surface and groundwater.

Name: _____

Date: _____

Period: _____

Relationship of Pure Sciences to Agricultural Sciences Assignment

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

Applied Agricultural Science	Biology	Chemistry	Physics	Mathematics
Entomology				
Soil Science				
Silviculture				
Horticulture				
Animal Nutrition				
Agricultural Mechanization				
Plant Pathology				
Animal Genetics				
Environmental Science				

Name: _____

Date: _____

Period: _____

Recycling Program Rubric

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 educational 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: _____

Resume Assessment Rubric

	Excellent 25 Points	Well Done 20 Points	Meets Standards 15 Points	Beginning 10 Points	No Evidence 0 Points	Score
Format	Resume contains name, address, objective, education, experience, and references; all words spelled correctly	Contains at least six of the criteria; no more than two spelling errors	Contains at least five of the criteria; no more than four spelling errors	Contains minimal information; more than four spelling errors	Assignment not submitted	
Education	Education includes schools attended, graduation dates, diploma/degree awarded, and major field of study.	Education includes three of the criteria.	Education includes two of the criteria.	Education includes one of the criteria.	Assignment not submitted	
Experience	Experience includes internships, entry-level jobs, and current position.	Experience includes two of the criteria.	Experience includes one of the criteria.	Experience includes current position only.	Assignment not submitted	
Factual	Contains factual names and dates and is believable	Contains fairly believable names and dates	Resume has unrealistic dates or names.	Resume is unrealistic and contains conflicting information.	Assignment not submitted	
					Total Score	

Name: _____

Date: _____

Period: _____

Role-Play or Skit Rubric for Shop/Lab Safety Activity

	Exemplary 4 Points	**Accomplished 3 Points**	**Developing 2 Points**	**Beginning 1 Point**	**Score**
Accuracy	All safety information was accurate.	Almost all safety information was accurate.	Most safety information was accurate.	Very little safety 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 might have contributed.	Little or no character development; student did not contribute much at all.	
Knowledge Gained	Used more than 4 safety examples, showed considerable creativity, and can clarify details	Used three to four safety examples and showed considerable creativity	Used two to three safety examples	Used one safety example	
Content	Safety content used was appropriate to the workplace, and student can explain why.	Safety content used was appropriate to the workplace.	Safety content used was slightly appropriate to the workplace.	Safety content used was not appropriate to the workplace.	
Required Elements	Included more information than required	Included all required information	Included most required information	Included less information than required	
				Total Score	

Comments:

Name: _____

Date: _____

Period: _____

Rubric for Assessing Team-Building and Participation Skills

	Scoring Criteria			
The student does the following:	**Excellent 4**	**Good 3**	**Needs Improvement 2**	**Unacceptable 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 on 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: _____

Rubric for Experiential Learning Planning and Record Keeping

	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: _____

Sample Rubric for Evaluating Work Ethics and Values

	Scoring Criteria			
Behavior/Skill	**Excellent 4**	**Good 3**	**Needs Improvement 2**	**Unacceptable 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 good work ethic)				
Demonstrates a concern for others				
Remains on task and allows others to remain on task				
Takes initiative as appropriate				

Name: _____

Date: _____

Period: _____

Scavenger Hunt Questionnaire

Respond to the following:

1. What is the name of the component?

2. What is the purpose of the component?

3. Where is the component located on a vehicle?

4. Where can the component be purchased?

5. What is the cost of the component?

6. When should the component be repaired or replaced?

7. What is the cost of labor to replace or repair the component?

Name: _____

Date: _____

Period: _____

School Composting Plan Rubric

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 students 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: _____

Select a Personal/Leadership Activity Assignment

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: _____

Scorecard for Assessing Parliamentary Procedure Skills

Sample Scorecard for Parliamentary Procedure Demonstration

	Points Allowed	Points Earned
Required motion 5	**5**	
Discussion (maximum of 5 debates @ 2 pts each) 10	**10**	
Additional motion (includes main or alternate main motion) 5	**5**	
Chair 10	**10**	
Ability to preside 5	**5**	
Leadership 10	**10**	
Team's general effect 15	**15**	
Conclusions reached by team	**10**	
(team's use of motions and discussion support disposal of the main motion) 10		
Team effect	**10**	
(degree to which discussion was convincing, logical, realistic, orderly, and efficient) 10		
Team's voice, poise, expression, and appearance 5	**5**	
Completeness and accuracy 5	**5**	
Format 5	**5**	
Grammar, style, and legibility 5	**5**	
SUBTOTAL 100	**100**	
Deductions for parliamentary mistakes	**5–20**	
(5 pts for a minor mistake; up to 20 points for a major mistake) pts/minor mistake		
Deductions for omitting assigned motion 10	**10**	
TOTAL		

Adapted from FFA CDE Handbook

Name: _____

Date: _____

Period: _____

Stream Monitoring Activity Performance Rubric

	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**	
Laboratory Maintenance • Properly handles the Ecology Kit tools and equipment • Understands 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: _____

Student Electronic Notebook Rubric

	Scoring Criteria			
The student did the following:	**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: _____

Student Water Use Diary

Date	Use of water	Amount used

Identify five ways in which you could conserve water.

1. _____

2. _____

3. _____

4. _____

5. _____

Name: _____

Date: _____

Period: _____

Tree Planting Checklist

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: _____

Water Quality Testing Laboratory Rubric

	Scoring Criteria			
The student/team does the following:	**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				
Subtotal for skill performance				
Demonstrates overall effectiveness				
Completes laboratory report				
Observes all safety practices				
Maintains appropriate dress				
Maintains personal grooming				
Subtotal for overall effectiveness				
Summative Total				

Name: _____

Date: _____

Period: _____

Worksheet on Basic Principles of Heredity and Genetics

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 produces 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: _____

Written Report Rubric

	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	

Appendix B: Glossary

Unit 1
Agriculture – the science of growing and raising livestock and crops
Agriscience – the application of scientific principles and new technologies in agriculture
Hazardous material – material that can cause injury or death
MSDS – Material Safety Data Sheet; provides safety data on hazardous materials
Natural resources – resources provided by nature
Renewable natural resource – resources provided by nature that can replace and renew themselves
Scientific method – a procedure for investigating problems of a scientific nature

Unit 2
FFA – The National FFA Organization
Human relations – the study of group behavior for the purpose of improving relationships
Leadership – the act of leading, guiding, or directing
Parliamentary procedure – a body of rules and procedures used when a group is assembled for a meeting
Work ethics – a belief in the importance of work

Unit 3
Asset – adds value to operation, something you own
Cash – expense; liabilities you spend money on
Inventory – record of property and goods you own
Liability – takes value away from an expense
Loss – liabilities larger than assets
Net worth – liabilities minus assets
Non-cash expense – no money changes hands, trade services or barter
Profit – assets minus liabilities
SAEP – an educational program conducted under simulated or real-life conditions by which a student can obtain a start toward placement in a chosen occupation

Unit 4
Animal rights – the rights of animals to be treated humanely
Animal welfare – the well-being of an animal
Artificial Insemination – a process of impregnating the female whereby sperm is placed in the female reproductive organs by means other than sexual intercourse
Digestive System – a system that breaks food into components small enough that they can be absorbed by the body
Embryo Transfer – a process of placing embryos into the female to cause pregnancy
Genetics – the genetic composition of an organism as it relates to heredity
Heredity – the total of genetic characteristics
Marketing – process of selling goods or services
Meiosis – a process of chromosomes' reduction in gamete-producing cells
Mitosis – a cell-dividing process in which 2 nuclei have the same number of chromosomes
Nutrient – a substance that gives nutrition
Processing – a process or treatment that changes an item into a consumable or a refined product for another process
Production – making goods usable
Roughages – food that is high in fiber
Ruminant – chewing and re-chewing what has been swallowed

Unit 5

Annual – a plant with a life cycle that is completed in one growing season
Asexual reproduction – propagation utilizing a part or parts of one plant to produce others
Biennial – a plant that takes two growing seasons to complete its life cycle
Chlorophyll – green pigment in leaves
Fertilizer – material that supplies nutrients for plants
Flowers – reproductive part of the plant
Fungicides – a material used to destroy fungi
Germinate – a seed sprouting or starting to grow
Herbicides – a chemical for killing weeds
Insecticides – a material used to kill insects
Leaf – plant part consisting of a stipule, petiole and blade
Macronutrients – elements used in relatively large quantities
Micronutrients – elements used in very small quantities
Perennial – a plant that lives for more than two growing seasons
Photosynthesis – a process in which chlorophyll in green plants enables those plants to utilize light to manufacture sugar from CO_2 and H_2O
Phototropism – a process by which a plant leaf is capable of adjusting its angle of exposure to the sun
Propagation – process of increasing the number of a species
Respiration – a process in which energy and CO_2 are released due to digestion or the breakdown of plant tissues during periods of darkness
Roots – the part of the plant needed to anchor the plant to the ground
Sexual Reproduction – growing plants from seed
Stems – supports leaves and conducts flow of H_2O nutrients
Terminal bud – bud at the end of a twig or branch
Transpiration – a process by which a plant looses water vapor

Unit 6

Erosion – wearing away of the soil
Land capability class – classification that describes the best use of land
Leach – contents of soil removed downward into the soil by water
Microbes – microscopic plants or animals
Organic Matter – dead plant or animal matter
Permeable – permitting movement of material down into the soil
pH – degree of acidity or alkalinity
Soil – top layer of the soil
Soil profile – cross-section view of the soil
Texture – refers to the size and proportion of soil particles
Tillable – land or soil that is workable with tools or equipment

Unit 7

Regulator – a device that keeps pressure at a set level or controls the rate of flow of a gas or liquid
Neutral flame – flame with a balance of oxygen and acetylene
Tip cleaner – tool used to remove dirt or metal residue from a hole in tip of torch
Backfire – a loud snap or popping noise heard from torch when the flame blows out
Flashback – burning inside an oxy-fuel torch that causes the torch to squeal or hiss
Arc – flow of current across a narrow gap
Electrode – welding rod coated with flux and used with an electric welder
Tensile – the amount of tension or pull a weld can withstand
Electricity – form of energy that can produce light, heat, magnetism and chemical changes
Conductor – any material that will allow electrons to move through it
Resistance – any tendency of a material to prevent electrical flow
Insulator – material that provides great resistance to the flow of electricity

Volts – a measure of electrical pressure
Amps – a measure of rate of flow of current in a conductor
Watts – a measure of energy available or work that can be done using 1 ampere at 1 volt
Ohms – a measure of the resistance of a material to the flow of electrical current
Ignition – spark igniting an air fuel mixture
Exhaust – burned gases removed by the motion of the piston
Rpm – revolutions per minute
Stroke – the movement of the piston from the top to the bottom or the bottom to the top

Unit 8
FFA – The National FFA Organization
Human relations – the study of group behavior for the purpose of improving relationships
Leadership - the act of leading, guiding, or directing.
Parliamentary procedure – a body of rules and procedures used when a group is assembled for a meeting
Work ethics – a belief in the importance of work

Unit 9
Alternative energy – energy or fuel from new renewable or nonpolluting sources that are not widely used
Conservation – using natural resources wisely
Decomposer – an organism, such as a mushroom and bacterium, that breaks down the bodies of dead plants and animals
Domestic species – a species that is stronger or has some advantage over another species
Ecosystem – all the parts of a particular environment
Effluent – The water that flows from a treatment facility or factory into a stream, lake, or ocean
Exhaustible resources – a natural resource that cannot be increased; there are fixed quantities (coal, oil, etc.)
Industrial solid waste – waste from manufacturing
Inexhaustible resources – natural resources with a seemingly endless supply (wind, solar, etc.)
Renewable natural resources – a resource that can be replaced when it is used (air, soil, and wildlife)

Unit 10
Nonpoint source pollution – Pollution from sources that cannot be directly traced to any single point of discharge
Pathogens – living or non-living things that cause disease
Point source pollution – pollution that can be traced to a specific point of discharge
Potable water – water that is safe for humans to use for drinking or cooking
Stream – a flowing body of water
Stream flow – the volume and velocity of water movement in a stream
Stream hydrology – the study of flowing water and its environment

Unit 11
Annual Ring - the layer of wood produced by a single year's growth of a woody plant
Arboriculture – the cultivation of trees and bushes for study, ornamentation, or profit
Board Foot – a unit of volume for measuring lumber, equal to the volume of a board that is 1-ft square and 1-in. thick
Clear – cut to cut down and remove all of the trees from a forest or other area of land
Conifers – any tree that has thin leaves, needles, and produces cones; many types are evergreen; pines, firs, junipers, larches, spruces, and yews are conifers
Deciduous – describes trees and bushes that shed their leaves in the fall
Evergreen – describes a tree or bush that retains its foliage throughout the year
Hardwood – wood from a broad-leaved tree as opposed to from a conifer
Lumber – trees that have been sawed and prepared for use in building, woodworking, or cabinetmaking
Pulpwood – a soft wood that is used to make paper, (e.g., aspen, pine, or spruce)
Seedling – a young developing plant that has been grown from a seed
Silviculture – the study, cultivation, and management of forest trees

Softwood – the open-grained wood of a pine, cedar, or other coniferous tree

Unit 12

Wildlife – wild animals, birds, and other living things, sometimes including vegetation, living in a natural undomesticated state
Vertebrae – bone in spinal column
Predator – carnivorous animal that hunts, kills, and eats other animals in order to survive, or any other organism that behaves in a similar manner
Prey – an animal or animals caught, killed, and eaten by another animal as food
Parasitism – symbiosis in which one organism lives as a parasite in or on another organism
Mutualism – relationship between two organisms of different species that benefits both and harms neither
Commensalism – the relationship between organisms of two different species in which one derives food or other benefits from the association while the other remains unharmed and unaffected
Wetlands – a marsh, swamp, or other area of land where the soil near the surface is saturated or covered with water, especially one that forms a habitat for wildlife

Unit 13

Sustainable agriculture – exploiting natural resources without destroying the ecological balance of an area
E.P.A. – Environmental Protection Agency; a government agency charged with protecting the environment and human health
N.R.C.S – Natural Resources Conservation Service; government agency charged with conservation of soil and water resources in the United States
Composting – a mixture of decayed plants and other organic matter used by gardeners for enriching soil
Hazardous waste – waste that poses substantial or potential threats to public health or the environment
MSDS – Material Safety Data Sheet; accompanies chemicals to inform the user of the properties
Humus – dark brown organic component of soil that is derived from decomposed plant and animal remains and animal excrement

Unit 14

Regulator – a device that keeps pressure at a set level or controls the rate of flow of a gas or liquid
Neutral flame – flame with a balance of oxygen and acetylene
Tip cleaner – tool used to remove dirt or metal residue from a hole in tip of torch
Backfire – a loud snap or popping noise heard from torch when the flame blows out
Flashback – burning inside an oxy-fuel torch that causes the torch to squeal or hiss
Arc – flow of current across a narrow gap
Electrode – welding rod coated with flux and used with an electric welder
Tensile – the amount of tension or pull a weld can withstand
Electricity – form of energy that can produce light, heat, magnetism, and chemical changes
Conductor – any material that will allow electrons to move through it
Resistance – any tendency of a material to prevent electrical flow
Insulator – material that provides great resistance to the flow of electricity
Volts – a measure of electrical pressure
Amps – a measure of rate of flow of current in a conductor
Watts – a measure of energy available or work that can be done using 1 ampere at 1 volt
Ohms – a measure of the resistance of a material to the flow of electrical current

Unit 15

Corporation – a company recognized by law as a single body with its own powers and liabilities, separate from those of the individual members
Partnership – the relationship between two or more people or organizations that are involved in the same activity
Sole proprietor – an individual who is the sole owner of a business that is neither a partnership nor a company
Wholesale – the business of buying goods in large quantities and selling them, especially to retailers for resale

Retail – the selling of goods directly to customers, (e.g., in stores)
Supply – to give, sell, or make available something that is wanted or needed by somebody or something
Interest – a charge made for a loan or credit facility, or a payment made by a bank or other financial institution for the use of money deposited in an account
Principle – finance relating to the initial amount of money that was invested or borrowed
Capital – money that can be used to produce further wealth
Depreciation – the amount or percentage by which something decreases in value over time, usually 1 year
Profit – the excess of income over expenditure, especially in business
Income Tax – a tax paid on money made from employment, business, or capita
Life insurance – a plan under which regular payments are made to a company during somebody's lifetime, and in return the company pays a specific sum to the person's beneficiaries after the person's death
Health Insurance – insurance to cover the costs or losses incurred if an insured person falls ill
Contract – a formal or legally binding agreement
Negligent – guilty of failing to provide a proper or reasonable level of care
GPS – Global Positioning System; a satellite-based navigation system that precisely identifies points on the earth

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Appendix C: Pathway Content Standards

AGRICULTURE, FOOD, AND NATURAL RESOURCES (AFNR) PATHWAY
CONTENT STANDARDS AND PERFORMANCE ELEMENTS

Crosswalk for Agriculture and Natural Resources

	Units	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10
AFNR											
AB -AGRIBUSINESS SYSTEMS		X	X						X		
AS -ANIMAL SYSTEMS		X			X				X		
AO -BIOTECHNOLOGY		X				X			X		
AE -ENVIRONMENTAL SERVICE SYSTEMS		X					X		X	X	
AF -FOOD PRODUCTS AND PROCESSING SYSTEMS		X							X		
AN -NATURAL RESOURCE SYSTEMS		X					X		X	X	X
AP -PLANT SYSTEMS		X				X			X		
AT -POWER, STRUCTURAL, AND TECHNICAL SYSTEMS		X						X	X		
		Unit 11	Unit 12	Unit 13	Unit 14	Unit 15					
AB -AGRIBUSINESS SYSTEMS					X	X					
AS -ANIMAL SYSTEMS											
AO -BIOTECHNOLOGY											
AE -ENVIRONMENTAL SERVICE SYSTEMS											
AF -FOOD PRODUCTS AND PROCESSING SYSTEMS											
AN -NATURAL RESOURCE SYSTEMS		X	X	X							
AP -PLANT SYSTEMS				X							
AT -POWER, STRUCTURAL, AND TECHNICAL SYSTEMS					X	X					

AT - POWER, STRUCTURAL, AND TECHNICAL SYSTEMS
AP - PLANT SYSTEMS
AN - NATURAL RESOURCE SYSTEMS
AF - FOOD PRODUCTS AND PROCESSING SYSTEMS
AE - ENVIRONMENTAL SERVICE SYSTEMS
AO - BIOTECHNOLOGY
AS - ANIMAL SYSTEMS
AB - AGRIBUSINESS SYSTEMS

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AB - 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.

AS - 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.

AO - 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.

AE - 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.

AF - 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.

AN - 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.

AP - 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.

AT - 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 D: 21st Century Skills[1]

21st Century Crosswalk for Agriculture and Natural Resources											
	Units	**Unit 1**	**Unit 2**	**Unit 3**	**Unit 4**	**Unit 5**	**Unit 6**	**Unit 7**	**Unit 8**	**Unit 9**	**Unit 10**
21st Century Standards											
CS1		X	X	X	X	X	X	X	X	X	X
CS2		X	X	X	X	X	X	X	X	X	X
CS3		X	X		X	X	X		X	X	X
CS4		X	X	X	X	X	X	X	X	X	X
CS5		X	X	X	X	X	X		X	X	X
CS6				X	X						
CS7					X						
CS8					X						
CS9					X						
CS10											
CS11											
CS12			X	X				X	X		
CS13			X	X				X	X		
CS14			X	X				X	X		
CS15			X	X				X	X		
CS16			X	X				X	X		
		Unit 11	**Unit 12**	**Unit 13**	**Unit 14**	**Unit 15**					
CS1		X	X	X	X	X					
CS2		X	X	X		X					
CS3		X				X					
CS4		X	X	X	X	X					
CS5		X	X		X	X					
CS6					X						
CS7					X						
CS8											
CS9											
CS10											
CS11											
CS12						X					
CS13						X					
CS14						X					
CS15						X					
CS16						X					

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

[1] *21st century skills.* (n.d.). Washington, DC: Partnership for 21st Century Skills.

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 toward 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 E: Common Core Standards

Common Core Crosswalk for Agriculture and Natural Resources

	Units	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10
Common Core Standards											
CCR1		X	X		X		X	X		X	
CCR2		X	X		X		X	X		X	
CCR3		X	X		X		X	X		X	
CCR4		X	X		X	X	X	X		X	X
CCR5		X	X		X	X	X	X		X	X
CCR6		X			X						X
CCR7		X	X		X	X	X	X	X	X	X
CCR8		X			X	X	X	X	X	X	X
CCR9		X			X	X	X	X	X	X	X
CCR10											
CCW1											
CCW2											
CCW3											
CCW4				X			X		X		X
CCW5											
CCW6					X						
CCW7											
CCW8											X
CCW9											X
CCW10				X		X			X		X
CCSL1			X								
CCSL2			X								
CCSL3			X								
CCSL4									X		
CCSL5									X		
CCSL6											
CCL1											
CCL2											
CCL3											
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CCM1											
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	Units	**Unit 11**	**Unit 12**	**Unit 13**	**Unit 14**	**Unit 15**					
Common Core Standards											
CCR1		X	X	X		X					
CCR2		X	X	X		X					
CCR3		X	X	X		X					
CCR4		X	X	X		X					
CCR5		X	X	X		X					
CCR6											
CCR7		X	X	X	X	X					
CCR8		X	X	X	X	X					
CCR9		X	X	X	X	X					
CCR10											
CCW1											
CCW2											
CCW3											
CCW4				X							
CCW5											
CCW6											
CCW7											
CCW8		X		X							
CCW9		X									
CCW10				X							
CCSL1			X								
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English Language Arts (6-12)

College and Career Readiness Anchor Standards for *Reading*

Key Ideas and Details

CCR1: Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

CCR2: Determine central ideas or themes of a text, and analyze their development; summarize the key supporting details and ideas.

CCR3: Analyze how and why individuals, events, and ideas develop and interact over the course of a text.

Craft and Structure

CCR4: Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.

CCR5: Analyze the structure of texts, including how specific sentences, paragraphs, and larger portions of the text (e.g., a section, chapter, scene, or stanza) relate to each other and the whole.

CCR6: Assess how point of view or purpose shapes the content and style of a text.

Integration of Knowledge and Ideas

CCR7: Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.

CCR8: Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.

CCR9: Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take.

Range of Reading and Level of Text Complexity

CCR10: Read and comprehend complex literary and informational texts independently and proficiently. Mathematics (High School)

College and Career Readiness Anchor Standards for *Writing*

Text Types and Purposes

CCW1: Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
CCW2: Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

CCW3: Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.

Production and Distribution of Writing

CCW4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CCW5: Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.

CCW6: Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

Research to Build and Present Knowledge

CCW7: Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.

CCW8: Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.

CCW9: Draw evidence from literary or informational texts to support analysis, reflection, and research.

Range of Writing

CCW10: Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

College and Career Readiness Anchor Standards for *Speaking and Listening*

Comprehension and Collaboration

CCSL1: Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

CCSL2: Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

CCSL3: Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric.

Presentation of Knowledge and Ideas

CCSL4: Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

CCSL5: Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.

CCSL6: Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.

College and Career Readiness Anchor Standards for *Language*

Conventions of Standard English

CCL1: Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

CCL2: Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

Knowledge of Language

CCL3: Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.

Vocabulary Acquisition and Use

CCL4: Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate.

CCL5: Demonstrate understanding of figurative language, word relationships, and nuances in word meanings.

CCL6: Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

Mathematics (High School)

Number and Quantity

The Real Number System

CCM1: Extend the properties of exponents to rational exponents.

CCM2: Use properties of rational and irrational numbers.

Quantities

CCM3: Reason quantitatively and use units to solve problems.

The Complex Number System

CCM4: Perform arithmetic operations with complex numbers.

CCM5: Represent complex numbers and their operations on the complex plane.

CCM6: Use complex numbers in polynomial identities and equations.

Vector and Matrix Quantities

CCM7: Represent and model with vector quantities.

CCM8: Perform operations on vectors.

CCM9: Perform operations on matrices and use matrices in applications.

Algebra

Interpret the structure of expressions

CCM10: Write expressions in equivalent forms to solve problems.

Arithmetic with Polynomials and Rational Expressions

CCM11: Perform arithmetic operations on polynomials.

CCM12: Understand the relationship between zeros and factors of polynomials.

CCM13: Use polynomial identities to solve problems.

CCM14: Rewrite rational expressions.

Creating Equations

CCM15: Create equations that describe numbers or relationships.

Reasoning with Equations and Inequalities

CCM16: Understand solving equations as a process of reasoning, and explain the reasoning.

CCM17: Solve equations and inequalities in one variable.

CCM18: Solve systems of equations.

CCM19: Represent and solve equations and inequalities graphically.

Functions

CCM20: Understand the concept of a function and use function notation.

CCM21: Interpret functions that arise in applications in terms of the context.

CCM22: Analyze functions using different representations.

Building Functions

CCM23: Build a function that models a relationship between two quantities.

CCM24: Build new functions from existing functions.

Linear, Quadratic, and Exponential Models

CCM25: Construct and compare linear, quadratic, and exponential models, and solve problems.

CCM26: Interpret expressions for functions in terms of the situation they model.

Trigonometric Functions

CCM27: Extend the domain of trigonometric functions using the unit circle.

CCM28: Model periodic phenomena with trigonometric functions.

CCM29: Prove and apply trigonometric identities.

Geometry

CCM30: Experiment with transformations in the plane.

CCM31: Understand congruence in terms of rigid motions.

CCM32: Prove geometric theorems.

CCM33: Make geometric constructions.

Similarity, Right Triangles, and Trigonometry

CCM34: Understand similarity in terms of similarity transformations.

CCM35: Prove theorems involving similarity.

CCM36: Define trigonometric ratios, and solve problems involving right triangles.

CCM37: Apply trigonometry to general triangles.

Circles

CCM38: Understand and apply theorems about circles.

CCM39: Find arc lengths and areas of sectors of circles.

Expressing Geometric Properties with Equations

CCM40: Translate between the geometric description and the equation for a conic section.

CCM41: Use coordinates to prove simple geometric theorems algebraically.

Geometric Measurement and Dimension

CCM42: Explain volume formulas, and use them to solve problems.

CCM43: Visualize relationships between two-dimensional and three-dimensional objects.

Modeling with Geometry

CCM44: Apply geometric concepts in modeling situations.

Statistics and Probability

CCM45: Summarize, represent, and interpret data on a single count or measurement variable.

CCM46: Summarize, represent, and interpret data on two categorical and quantitative variables.

CCM47: Interpret linear models.

Making Inferences and Justifying Conclusions

CCM48: Understand and evaluate random processes underlying statistical experiments.

CCM49: Make inferences and justify conclusions from sample surveys, experiments, and observational studies.

Conditional Probability and the Rules of Probability

CCM50: Understand independence and conditional probability and use them to interpret data.

CCM51: Use the rules of probability to compute probabilities of compound events in a uniform probability model.

Using Probability to Make Decisions

CCM52: Calculate expected values, and use them to solve problems.

CCM53: Use probability to evaluate outcomes of decisions.

Appendix F: National Educational Technology Standards for Students (NETS-S)

NETS Crosswalk for Agriculture and Natural Resources											
	Course	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10
NETS Standards											
T1		X	X	X	X	X				X	
T2		X	X		X	X	X		X	X	X
T3		X		X	X	X	X		X	X	X
T4		X		X			X		X	X	
T5			X								X
T6		X	X	x	X	X	X		X	X	X
		Unit 11	Unit 12	Unit 13	Unit 14	Unit 15					
T1		X									
T2		X	X		X	X					
T3				X							
T4											
T5											
T6		X	x	X	X	X					

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.

Appendix G: Mississippi Academic Standards

MISSISSIPPI SCIENCE FRAMEWORK COMPETENCIES

MS Science Standards for Agriculture and Natural Resources

	Course	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10
MS Science Standards											
AQ 1		X									X
AQ 2											X
AQ 3											X
AQ 4											X
BIOI 1		X				X					
BIOI 2		X			X	X					
BIOI 3					X						
BIOI 4					X	X					
BIOI 5					X						
BIOI 6						X					
BIOII 1											
BIOII 2					X						
BIOII 3					X						
BIOII 4						X					
BIOII 5						X					
BO 1		X				X					
BO 2						X					
BO 3						X					
BO 4						X					
BO 5						X					
CHI 1						X	X				
CHI 2											
CHI 3											
CHI 4						X				X	
CHI 5							X				
ORGC 1											
ORGC 2											
ORGC 3											
E1											
E2											
E3							X				
E4							X				
E5							X				
ES 1		X								X	X
ES 2										X	X
ES 3							X			X	X
G 1		X			X		X				
G 2					X		X				
G 3					X						
GE1							X				
GE2							X				
PS 1		X									
PS 2								X			
PS 3											
PS 4											
PS 5											
PHYI 1											
PHYI 2											
PHYI 3											

PHYI 4											
PHYI 5								X			
PHYI 6											
SP 1											
SP 2											
ZO 1		X			X						
ZO 2					X	X					
ZO 3					X	X					
ZO 4						X					
		Unit 11	**Unit 12**	**Unit 13**	**Unit 14**						
AQ 1											
AQ 2											
AQ 3			X								
AQ 4			X								
BIOI 1											
BIOI 2											
BIOI 3		X	X								
BIOI 4											
BIOI 5											
BIOI 6											
BIOII 1											
BIOII 2											
BIOII 3											
BIOII 4		X									
BIOII 5		X									
BO 1		X									
BO 2		X									
BO 3											
BO 4		X									
BO 5		X									
CHI 1											
CHI 2											
CHI 3											
CHI 4											
CHI 5											
ORGC 1											
ORGC 2											
ORGC 3											
E1											
E2											
E3											
E4											
E5											
ES 1		X									
ES 2		X	X	X							
ES 3		X	X	X							
G 1											
G 2											
G 3											
GE1											
GE2											
PS 1											
PS 2											
PS 3											
PS 4											
PS 5											
PHYI 1											
PHYI 2											
PHYI 3					X						

PHYI 4											
PHYI 5											
PHYI 6											
SP 1											
SP 2				X							
ZO 1											
ZO 2			X								
ZO 3			X								
ZO 4											

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. <u>Apply inquiry-based and problem-solving processes and skills to scientific investigations.</u>

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 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. <u>Develop an understanding of physical and chemical properties of water and aquatic environments.</u>

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. <u>Apply an understanding of the diverse organisms found in aquatic environments.</u>

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. <u>Draw conclusions about the relationships between human activity and aquatic organisms.</u>

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. <u>Apply inquiry-based and problem-solving processes and skills to scientific investigations.</u>

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. <u>Describe the biochemical basis of life, and explain how energy flows within and between the living systems.</u>

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. **<u>Demonstrate an understanding of principles that explain the diversity of life and biological evolution.</u>**
   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.

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. 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, 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.

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, 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)

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, 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. <u>Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.</u>

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 20^{th}-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 non-native species. (DOK 2)

5. <u>Develop an understanding of organism classification.</u>

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, Platyhelmenthes, 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. <u>Demonstrate an understanding of plant reproduction.</u>

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. <u>Draw conclusions about the factors that affect the adaptation and survival of plants.</u>

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. <u>Relate an understanding of plant genetics to its uses in modern living.</u>

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 Schrődinger, 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. <u>Develop an understanding of the periodic table.</u>

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. <u>Analyze the relationship between microscopic and macroscopic models of matter.</u>

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. <u>Compare factors associated with acid/base and oxidation/reduction reactions.</u>

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. <u>Apply inquiry-based and problem-solving processes and skills to scientific investigations.</u>

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. <u>Demonstrate an understanding of the properties, structure, and function of organic compounds.</u>

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 nitrides) 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. <u>Discuss the versatility of polymers and the diverse application of organic chemicals.</u>

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. <u>Apply inquiry-based and problem-solving processes and skills to scientific investigations.</u>

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. <u>Develop an understanding of the history and evolution of the universe and earth.</u>

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 led 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. <u>Discuss factors that are used to explain the geological history of earth.</u>

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 geological 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. <u>Demonstrate an understanding of earth systems relating to weather and climate.</u>

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. <u>Apply an understanding of ecological factors to explain relationships between earth systems.</u>

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
   - Multi-cellular 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 relationships 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. <u>Apply inquiry-based and problem-solving processes and skills to scientific investigations.</u>

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. <u>Develop an understanding of the relationship of ecological factors that affect an ecosystem.</u>

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. <u>Analyze the structure and function of DNA and RNA molecules. (L, P)</u>

a. Cite evidence that supports the significance of Mendel's concept of "particulate inheritance" to explain the understanding of heredity. (DOK 1)
b. Apply classic 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. <u>Apply inquiry-based and problem-solving processes and skills to scientific investigations.</u>

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. <u>Develop an understanding of plate tectonics and geochemical and ecological processes that affect earth.</u>

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. <u>Apply inquiry-based and problem-solving processes and skills to scientific investigations.</u>

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. <u>Describe and explain how forces affect motion.</u>

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. <u>Demonstrate an understanding of general properties and characteristics of waves.</u>

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. <u>Develop an understanding of the atom.</u>

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. <u>Investigate and apply principles of physical and chemical changes in matter.</u>

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. <u>Discuss the characteristics and properties of light and sound.</u>

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. <u>Apply an understanding of magnetism, electric fields, and electricity.</u>

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. <u>Analyze and explain concepts of nuclear physics.</u>

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 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. <u>Develop an understanding of levels of organization and animal classification.</u>

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, and locomotion) of the following phyla: Porifera, Cnidarians, Nematoda, Annelida, Platyhelmenthes, 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. <u>Differentiate among animal life cycles, behaviors, adaptations, and relationships.</u>

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 animal 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. <u>Demonstrate an understanding of the principles of animal genetic diversity and evolution.</u>

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., non-random mating, migration, etc.). (DOK 2)
   - Relationship between natural selection and evolution
   - Mutations, crossing over, non-disjunction
   - Non-random 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)