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Part 39: Agriculture Food and Natural Resources, Career Pathways

Science of Agricultural Animals

Science of Agricultural Animals

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The Research and Curriculum Unit, located in Starkville, MS, as part of Mississippi State University, was established to foster educational enhancements and innovations. In keeping with the land grant mission of Mississippi State University, the RCU is dedicated to improving the quality of life for Mississippians. The RCU enhances intellectual and professional development of Mississippi students and educators, while applying knowledge and educational research to the lives of the people of the state. The RCU works within the contexts of curriculum development and revision, research, assessment, professional development, and industrial training.

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Dr. Tom Burnham, State Superintendent
Mr. William Harold Jones, Chair
Mr. Charles McClelland, Vice Chair
Ms. Kami Bumgarner
Mr. Howell “Hal” N. Gage
Dr. O. Wayne Gann
Mr. Claude Hartley
Ms. Martha “Jackie” Murphy
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Dr. Sue Matheson

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Finally, standards in the *Science of Agricultural Animals Curriculum Framework and Supporting Materials* are based on the following:

National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards

The National AFNR Career Cluster Content Standards were developed by the National Council on Agricultural Education to serve as a guide for what students should know or be able to do through a study of agriculture in grades 9–12 and 2-year postsecondary programs. The standards were extensively researched and reviewed by leaders in the agricultural industry, secondary and postsecondary instructors, and university specialists. The standards consist of a pathway content standard for each of the eight career pathways. For each content standard, performance elements representing major topic areas with accompanying performance indicators were developed. Measurements of assessment of the performance elements and performance indicators were developed at the basic, intermediate, and advanced levels. A complete copy of the standards can be accessed at <https://aged.learn.com>. The National AFNR Career Cluster Content Standards are copyrighted to the National Council for Agricultural Education and are used by permission.

Applied Academic Credit Benchmarks

Mississippi Department of Education 2010 Mississippi Science Framework

21st Century Skills and Information and Communication Technologies Literacy Standards

In defining 21st century learning, the Partnership for 21st Century Skills has embraced five content and skill areas that represent the essential knowledge for the 21st century: global awareness; civic engagement; financial, economic, and business literacy; learning skills that encompass problem-solving, critical-thinking, and self-directional skills; and Information and Communication Technology (ICT) literacy.

National Educational Technology Standards for Students

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ACT College Readiness Standards



The College Readiness Standards are sets of statements intended to help students understand what is expected of them in preparation for the ACT. These standards are integrated into teaching and assessment strategies throughout the curriculum framework.

Preface

Secondary vocational–technical education programs in Mississippi are faced with many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing true learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, Mississippi Code of 1972, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, ch. 487, §14; Laws, 1991, ch. 423, §1; Laws, 1992, ch. 519, §4 eff. from and after July 1, 1992; Carl D. Perkins Vocational Education Act IV, 2007; and No Child Left Behind Act of 2001).

Research Synopsis

Agricultural and Environmental Science and Technology Research

The Agricultural Sciences Career Cluster covers the broad field of occupations related to the production and use of plants and animals for food, fiber, aesthetic, and environmental purposes. According to the U.S. Department of Labor, the growing interest in worldwide standardization of agricultural equipment should result in increased employment of agricultural engineers. Job opportunities should also result from the increasing demand for agricultural products, the continued efforts for more efficient agricultural production, and the increasing emphasis on the conservation of resources. The sales of food and fiber products amounted to 5.8 billion dollars in 2005 according to USDA statistics. Additionally, the Mississippi Department of Agriculture and Commerce estimates that 30% of the state's workforce is employed in jobs relating directly or indirectly to agriculture.

Agriculture and Environmental Science and Technology will target careers at the professional and technical levels in agriculture. Students enrolled in these courses should be better prepared to pursue degrees at the community college and 4-year college levels.

Employment Projections

Data for this synopsis were compiled from employment projections prepared by the Mississippi Department of Employment Security and the U. S. Department of Labor. The National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards developed by the National Council for Agricultural Education and scholarly research articles were also reviewed as a guide for the redesign of the Agriculture and Natural Resources Cluster.

Industry Job Data – Employment Projections 2006 to 2016 for Mississippi

Note: Compiled by Mississippi Department of Employment Security and Labor Market Information Department

Animal Breeders	9,770	9,870	100	1.0	165
Agricultural and Food Science Technicians	260	310	50	19.2	10
Agricultural Equipment Operators	1,090	1,190	100	9.2	40
Agricultural Sciences Teachers, Postsecondary	190	240	50	26.3	20
Conservation Scientists	790	890	100	12.7	30
Custodial and Caretaking Supervisors and Workers	46,920	54,110	7,190	15.3	2,320
Environmental Engineers	270	320	50	18.5	10

Environmental Engineering Technicians	50	100	50	100.0	0
Environmental Scientists and Specialists	420	470	50	11.9	10
Environmental Science and Protection Technicians	100	150	50	50.0	5
Farmworkers and Laborers, Crop, Nursery, and Greenhouse	5,160	5,810	650	12.6	225
Farmworkers, Farm and Ranch Animals	1,400	1,550	150	10.7	65
First-Line Supervisors / Managers of Farming, Fishing, and Forestry Workers	1,390	1,540	150	10.8	40
Food Processing Workers	14,920	18,320	3,400	22.8	680
Foresters	470	520	50	10.6	20
Forest and Conservation Technicians	390	440	50	12.8	15
Forest and Conservation Workers	880	980	100	11.4	30
Grounds Maintenance Workers	10,310	11,810	1,500	14.5	375
Logging Equipment Operators	3,910	4,210	300	7.7	100
Purchasing Agents and Buyers, Farm Products	80	130	50	62.5	5
Soil and Plant Scientists	430	480	50	11.6	10
Veterinarians	540	640	100	18.5	25
Veterinary Assistants and Laboratory Animal Caretakers	690	890	200	29.0	35
Veterinary Technologists and Technicians	440	540	100	22.7	15

Note: Data was retrieved from the Mississippi Department of Employment Security (2009).

Occupational Employment and Wage Estimates for Mississippi May 2006

Farmers and Ranchers	2,760	\$17.85	\$43,560.00
Farm Managers and Supervisors	2,640	\$23.23	\$48,360.00
Logging Equipment Operators	3,890	\$14.28	\$30,880.00
Landscaping Supervisors	2,990	\$17.93	\$40,240.00
Landscape Workers	8,560	\$10.22	\$23,010.00
Agricultural Scientists/Technicians	29,680	\$18.33	\$38,555.00

Note: Data was retrieved from the U.S. Bureau of Labor Statistics (2009).

Curriculum Content

In compiling the research for the Agricultural Sciences cluster, face-to-face and telephone interviews were conducted with representatives of agricultural employers and agricultural agencies. The following comments summarize the results of these interviews:

- While opportunities to enter farming on a full-scale commercial enterprise basis are limited, opportunities do exist and are expected to increase as current operators retire and begin to rent their land to companies and individuals. Opportunities are also expected to increase for consultants and technicians who support production enterprises by providing specialized services to producers.
- There was general agreement among all persons interviewed that all students need to better develop skills related to leadership, teamwork, communication, and work ethics, habits, and values. All respondents also indicated that a basic knowledge of economics, record keeping, budgeting, and business decision-making skills will be essential in today's "lean" environment.
- Opportunities for high school graduates in all fields of agriculture are limited to the basic entry-level positions. More abundant opportunities exist for students who have received advanced training at the community college or 4-year college levels.
- All respondents agreed that a common core of knowledge and skills existed across all three major pathways related to the following themes: leadership and personal development; principles of plant science and production; principles of soil science and air and water quality; principles of agricultural power, structures, and technology; and principles of economics and management. A sixth theme, principles of animal science and production, exists for students in the AEST and Agriculture and Natural Resources pathway.
- All respondents agreed that students in all three pathways should be exposed to the process by which agricultural products are grown, managed, harvested, processed, and marketed. As students study this process, they should be also exposed to the different careers that are involved in all segments of the industry.
- The role of federal and state agencies including the USDA, OSHA, FDA, EPA, and so forth should be discussed. Also, the role of agricultural organizations such as the Poultry Association, Nurseryman's Association, and Farm Bureau needs to be investigated.

Results of the survey of employers and agricultural agency representatives show that there are six major themes or topics that apply to a majority of occupations in the agriculture and natural resources area. These themes and their respective pathways are listed below.

Principles of Leadership, Personal Development, and Career Success	X	X	X
Principles of Plant Science and Production	X	X	X
Principles of Animal Science and Production	X	X	
Principles of Soil, Water, and Air Quality, Conservation, and Use	X	X	X
Principles of Agricultural Power, Structures, and Technological Systems	X	X	X
Principles of Management, Economics, and Marketing	X	X	X

Executive Summary

Program Description

Science of Agricultural Animals is an advanced level course for the Agricultural and Environmental Science and Technology Program. The course focuses on the development of skills and knowledge related to the anatomy and physiology, growth and nutrition, breeding and reproduction, evaluation, health, and management of agricultural and other domesticated animals. The course carries 1 Carnegie unit of credit that may count as an elective science credit for high school graduation. Students may also earn an additional ½ Carnegie unit by completing a successful supervised agricultural experience program.

Industry Certification

No national industry recognized certifications are known to exist at this time in the field of Agriscience. Competencies and suggested performance indicators in the *Science of Agricultural Animals* course have been correlated, however to the National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards, which have been reviewed and endorsed at the national level by the National Council on Agricultural Education.

Articulation

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

High School Program	Community College Program	Community College Course
Agricultural & Environmental Science & Tech – Concepts (CIP: 01.9999)	Ag Business & Mgmt Tech(Program CIP: 01.0304 – Field Crops)	AGT 1111 - Survey of Agriculture
Agricultural & Environmental Science & Tech – Environments (CIP: 03.0104)	Ag Business & Mgmt Tech(CIP: 01.0304 – Field Crops)	AGT 1313 - Applied Principles of Plant Production
Agricultural & Environmental Science & Tech – Animals (CIP: 01.0901)	Ag Business & MgmtTech (CIP 01.0302) Agricultural Animal Husbandry/Production)	AGT 1214 - Applied Principles of Animal Production
Agricultural & Environmental Science & Tech – Plants (CIP: 01.1101)	Ag Business & Mgmt Tech(CIP: 01.0304 – Field Crops)	AGT 1313 - Applied Principles of Plant Production
Agricultural & Environmental Science & Tech – Agricultural Mechanization (CIP: 01.0201)	Ag Business & Mgmt Tech(Program CIP: 01.0304 – Field Crops)	AGT 2563 - Agricultural Machinery and Shop Management

Assessment

Students will be assessed using the AEST MS-CPAS2 test. All students will be tested on *Concepts of Agriscience* and the second course that they may take in their chosen path of study. The second course may be one of the following:

- Science of Agricultural Animals
- Science of Agricultural Environment
- Science of Agricultural Mechanization
- Science of Agricultural Plants

The MS-CPAS2 blueprint can be found at <http://info.rcu.msstate.edu/services/curriculum.asp>. If there are questions regarding assessment of this program, please contact the instructional design specialist at the Research and Curriculum Unit at 662.325.2510.

Student Prerequisites

Prior to enrolling in *Science of Agricultural Animals*, a student must have completed *Concepts of Agriscience*. *Science of Agricultural Animals* may be offered to students in grades 10–12. It is recommended that students enrolling in the course possess at least a C average in other science courses and a TABE reading score at the eighth grade level or higher.

Proposed Applied Academic Credit

The academic credit is still pending for this curriculum.

Licensure Requirements

A 992 endorsement is currently required to teach any course in the Agricultural and Environmental Science and Technology Program. In order to receive a 992 endorsement, applicants must do the following:

1. Hold a valid Mississippi Educator License with endorsement #301 – Vocational Agriculture Education Programs or #302 – Agriculture.
2. Possess a baccalaureate degree in an agricultural subject area.
3. Complete the 3-semester-credit-hour course devoted to the teaching of Agricultural and Environmental Science and Technology courses. The course, AIS 6113 - Methods of Teaching Agriscience, is currently offered by Mississippi State University.
4. Enroll immediately in the Vocational Instructor Preparation (VIP) program or the College and Career Readiness Education Program (CCREP).
5. Complete the individualized Professional Development Plan (PDP) requirements of the VIP or CCREP prior to the expiration date of the 3-year vocational license.
6. Successfully complete an MDE-approved computer literacy certification exam.

7. Successfully complete a certification for an online learning workshop, module, or course that is approved by MDE.

Note: If the applicant meets all requirements listed above, that applicant will be issued a (992) endorsement—a 5-year license. If the applicant does not meet **all** requirements, the applicant will be issued a 3-year endorsement (license), and all requirements stated above must be satisfied prior to the ending date of that license.

Professional Learning

The professional learning itinerary for the middle school or individual pathways can be found at <http://redesign.rcu.msstate.edu>. If you have specific questions about the content of each training session provided, please contact the Research and Curriculum Unit at 662.325.2510, and ask for the Professional Learning Specialist.

Course Outlines

Course Description: Science of Agricultural Animals is designed as a one-unit course that offers an in-depth study of the animal industry. This includes both traditional livestock and poultry enterprises as well as companion animals. Emphasis is on production methods used in beef operations, swine, dairy, and poultry. The course also includes equine science, companion and laboratory animal care, and aquaculture. Instruction is undergirded with fundamentals of biological science.

Science of Agricultural Animals (One Carnegie Unit) - Course Code: 991001

1	Introduction to Animal Agriculture*	15
2	Experiential Learning (SAE)*	5
3	Animals as Living Organisms	20
4	Animal Growth and Nutrition	20
5	Animal Reproduction	20
6	Animal Evaluation	20
7	Production Management	10
8	Marketing*	5
9	Companion Animal Care*	5
Total Hours		120

* Note: These units are not tested by MS-CPAS2.

Using This Document

Unit Number and Title

Suggested Time on Task

An estimated number of clock hours of instruction that should be required to teach the competencies and objectives of the unit. A minimum of 140 hours of instruction is required for each Carnegie unit credit. The curriculum framework should account for approximately 75–80% of the time in the course.

Competencies and Suggested Objectives

A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies. The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.

Suggested Teaching Strategies

This section of each unit indicates research-based strategies that can be used to enable students to master each competency. Emphasis has been placed on strategies that reflect active learning methodologies. Teachers should feel free to modify or enhance these suggestions based on needs of their students and resources available in order to provide optimum learning experiences for their students.

Suggested Assessment Strategies

This section indicates research-based strategies that can be used to measure student mastery. Examples of suggested strategies could include rubrics, class participation, reflection, and journaling. Again, teachers should feel free to modify or enhance these suggested assessment strategies based on local needs and resources.

Integrated Academic Topics, 21st Century Skills and Information and Communication Technology Literacy Standards, ACT College Readiness Standards, and Technology Standards for Students

This section identifies related academic topics as required in the Subject Area Testing Program (SATP) in Algebra I, Biology I, English II, and U.S. History from 1877, which are integrated into the content of the unit. Research-based teaching strategies also incorporate ACT College Readiness standards. This section also identifies the 21st Century Skills and Information and Communication Technology Literacy skills. In addition, national technology standards for students associated with the competencies and suggested objectives for the unit are also identified.

References

A list of suggested references is provided for each unit. The list includes some of the primary instructional resources that may be used to teach the competencies and suggested objectives. Again, these resources are suggested, and the list may be modified or enhanced based on needs and abilities of students and on available resources.

Science of Agricultural Animals

Unit 1: Introduction to Animal Agriculture

15 Hours

Competency 1: Investigate the nature of animal agriculture and its associated enterprises. AS.01, AS.02, Z02,

Z04

Suggested Enduring Understandings

1. In addition to providing meat, products from large animals such as cattle, hogs, sheep, and goats are also used to make clothing, medicines, cosmetics, gelatin, and other products that affect almost everyone's daily life.
2. Major animal enterprises in Mississippi include broiler, catfish, beef cow-calf, egg production, swine, and dairy production enterprises.
3. There are many different breeds of cattle, chickens, horses, sheep, goats, and other forms of livestock. A knowledge of a breed's characteristics is useful in making decisions on breed selection and breeding programs.
4. There are many promising careers in the animal industry for people who have the skills and knowledge to succeed.
5. The scientific classification system is used on a global scale to classify animals according to their characteristics.

Suggested Essential Questions

1. How do livestock products affect people's daily lives?
2. What are the major animal enterprises in Mississippi?
3. How does knowing characteristics of different breeds of livestock enhance a producer's ability to select and breed animals?
4. What are some promising careers in animal agriculture, and what skills and knowledge are necessary to enter them?
5. How is the scientific classification used to classify animals?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe the importance of agricultural animals to people. (DOK 1)	a. Prior to teaching this competency, have students read the chapter on <i>The Large Animal Industry</i> in the text (Herren, 2007). Begin by asking students to identify animal products that they use in their daily lives. List products on the LCD projector. As the discussion continues, make sure students understand the role that animals play in providing clothing, medicine, cosmetics, gelatin, and other products as well as providing services related to security, companionship, and service. Have students enter the list of products and services in their electronic notebooks or journals. CS1, CS2, CS4, T6, W4, W5	a. Use a written test to evaluate student understanding.
b. Describe the major	b. Use a teacher-developed PowerPoint	b. Use a written test

animal enterprises in Mississippi. (DOK 1)	presentation to describe the major animal enterprises in Mississippi, including beef cow-calf, dairy, swine, broiler, catfish, and egg production. The presentation should cover the scope and economic impact of the enterprise, production practices, geographic distribution, and marketing practices. CS1, CS2, CS4	to evaluate student understanding.
c. Identify and describe the major types and breeds of livestock and poultry. (DOK 1)	c. Have students search the Internet and other sources to complete an assignment to identify and describe the major breeds of beef and dairy cattle, swine, sheep, goats, and poultry. Students should complete the <i>Breeds of Livestock Assignment (1.1)</i> . CS1, CS2, CS4, T3, T6, W4, W5	c. Use a written test to evaluate student understanding.
d. Explain how taxonomy is used with domesticated animals. (DOK 1)	d. Prior to teaching this competency, have the students read the chapter on <i>The Classification of Agricultural Animals</i> in the text (Herren, 2007). Provide the students with the taxonomy of an animal (ex. Angus cattle belong to the kingdom Animalia, phylum Chordata, subphylum Vertebrata, class Mammalia, family Bovidae, genus Bos, species Taurus). Discuss the meaning of each grouping within the taxonomy and how members of each group share common characteristics. Use the <i>Taxonomy of Common Domestic Animals Assignment (1.6)</i> to have students search the Internet to determine the taxonomy of each species and note which species are more closely related. CS1, CS2, CS4, T3, T4, T6, R1, R2, R5	d. Evaluate student assignment for accuracy and completeness.
e. Identify careers in the agriculture industry and the skills required by employees. (DOK 1)	e. Provide a list of career areas in the animal industry. Have each student select an area of personal interest and prepare a PowerPoint presentation on the area. The presentation should include information on major skill areas, educational requirements, salary, specific skills, and occupational outlook. CS2, CS4, T2, T3, T4, T6, R1, R2, R4, R5, W4, W5	e. Use the <i>PowerPoint Presentation on Animal Careers Rubric (1.5)</i> to evaluate student understanding on this indicator.

Competency 2: Examine consumer concerns and their effect on animal production. AS.01, AS.08

Suggested Enduring Understandings

1. Consumer preferences for nutritionally healthier animal products have led producers to breed animals that can meet these preferences.
2. Concern over food safety has lead producers and processors to implement quality assurance and analysis programs.

Suggested Essential Questions

1. How have consumer food preferences led producers to change?
2. How are safety and quality assurance maintained in food production?
3. How have concerns over disposal of animal wastes led to safer methods of disposal?

3. Concerns over animal wastes have led producers to develop methods for safely disposing of this waste without endangering the environment or people's health.
4. Local, state, and federal agencies are monitoring and assisting producers in protecting food safety and the environment.
4. What government agencies provide assistance to producers regarding food safety and environmental concerns?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Examine how consumer concerns and preferences about food and nutrition have affected animal production enterprises. (DOK 1)	a. Ask students what they understand about fat content in food, cholesterol, steroids, and other additives in food. Use their response to lead a discussion on how consumer concerns and preferences have lead animal producers to change the way animals are fed and managed. Show pictures of the lard-type hog of the early 1900s, and compare them to modern meat type hogs. Discuss the concepts of organic and natural foods and how production practices have changed to deliver these products to the markets. CS1, CS2, CS4	a. Use a written test to evaluate student understanding.
b. Describe the role of quality assurance and safety in meat production today. (DOK 1)	b. Use an article from a recent newspaper or magazine to call attention to concerns over food safety, and discuss how programs such as Hazards Analysis and Critical Control Point (HACCP) and animal identification systems are being used to help prevent and minimize food borne illnesses. CS1, CS2, CS4	b. Use a written test to evaluate student understanding.
c. Investigate concerns about animal waste and its effect on the environment. (DOK 1)	c. Have students indentify animal waste products such as manure, litter and bedding, and dead animals. Lead a discussion about proper disposal methods and how these methods can actually enhance an environment rather than degrade it. Have students write a paragraph that outlines the potential hazards of a specific type animal waste and outlines a method for avoiding these hazards and properly disposing of the material. CS2, CS4, T6, E1, E2, E3, E4, E5, E6, R1, R2, R4, R5, W2, W4, W5	c. Evaluate students' paragraphs for accuracy and completeness.
d. Identify and describe the role and function of government agencies in assisting animal producers in	d. Provide the students with a list of local, state, and national agencies that are associated with food safety and environmental protection. This list could include the local health department, Mississippi Department of Agriculture and Commerce, Mississippi Department of Environmental Safety, U.S. Department of	d. Use a written test to evaluate student understanding.

producing safe food products and protecting the environment. (DOK 1)	Agriculture, U.S. Environmental Protection Agency, and U.S. Food and Drug Administration. Have students do a search on the Internet and use other sources to identify the role and function of these agencies as related to animal production. Lead a classroom discussion to allow students to share their findings. Compile a list of major roles and functions for each agency using the LCD projector, and have students enter into their electronic notebooks or journals. CS2, CS4, T2, T3, T4, T6, R1, R2, R4, R5, W4, W5
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Competency 3: Explore concepts of animal welfare and animal rights. AS.03, AS.06

Suggested Enduring Understandings

1. Animal welfare activists believe that it is right for animals to be raised for human use but not be abused or mistreated.
2. Animal rights activists believe that animals have rights. Some believe that animals are free to make their own choices.
3. There are various animal welfare issues that affect consumers and producers of agriculture animal products. The main issues relate to laboratory research, animal confinement, and animal production.

Suggested Essential Questions

1. What are the sides and their viewpoints in the debate relative to animal welfare in agriculture?
2. What are the main animal welfare issues that are prevalent in today's society?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Define and discuss the concepts of animal welfare and animal rights along with their applications in modern animal enterprises. (DOK 3)	a. Prior to teaching this competency, have the students read the chapter on <i>The Issue of Animal Welfare</i> from the text (Herren, 2007). Introduce the competency by using an article from a current newspaper or magazine that is critical of the way animals are treated in our society. Some of the concepts that should be discussed are the following: • Animal Welfare • Animal Rights Lead a discussion on the two major sides of the animal welfare debate, those who feel that it is right for animals to be raised for human use but not abused or mistreated and those who think animals should have the same rights as humans. Have students compose a paragraph defending one of these positions. CS1, CS2, CS4, T1, T2, T5, T6, E1, E2, E3, E4, E5, E6, R1, R2, R3, R4, R5, W1, W2, W3, W4, W5	a. Use the <i>Animal Welfare Fact Sheet Rubric (1.2)</i> to evaluate the student mastery.

b. Assess animal welfare issues. (DOK 2)	b. Provide students with a list of animal welfare issues such as confinement, transportation, use of antibiotics in feeds, debeaking, dehorning, castration, tail docking, branding, use of animals in laboratory testing, and so forth. Have students research the issue and compile a fact sheet showing the concerns raised over the issue and the reasons why the practice is used and considered humane. CS1, CS2, CS4, T1, T2, T5, T6, E1, E2, E3, E4, E5, E6, R1, R2, R3, R4, R5, W1, W2, W3, W4, W5	b. Use the <i>Animal Welfare Fact Sheet Rubric (1.2)</i> to evaluate the student mastery.
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Standards

AFNR Industry Standards

- AS.01 Examine the components, historical development, global implications, and future trends of the animal systems industry.
- AS.08. Analyze environmental factors associated with animal production.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS3 Social and Cross-Cultural Skills
- CS4 Productivity & Accountability
- CS5 Leadership & Responsibility

Applied Academic Credit Standards

Zoology

- ZO 2 Develop an understanding of levels of organization and animal classification.
- ZO 3 Differentiate among animal life cycles, behaviors, adaptations, and relationships.
- ZO 4 Demonstrate an understanding of the principles of animal genetic diversity and evolution.

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- E1 Topic Development in Terms of Purpose and Focus
- E2 Organization, Unity, and Coherence
- E3 Word Choice in Terms of Style, Tone, Clarity, and Economy
- E4 Sentence Structure and Formation
- E5 Conventions of Usage
- E6 Conventions of Punctuation
- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- W2 Focusing on the Topic
- W4 Organizing Ideas
- W5 Using Language

Suggested References

- Burton, L. (2010). *Agriscience fundamentals and applications* (5th ed.). Albany, NY: Delmar.
- CEV Video. (n.d.). *CEV pathway: Animal systems pathway* [DVD]. Lubbock, TX: Author.
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Science of Agricultural Animals

Unit 2: Experiential Learning (SAE)

5 Hours

Competency 1: Plan and implement an experiential learning program. ABS.02, ABS.04

Suggested Enduring Understandings

1. Planning is a continuous process in business.
2. Plans must be reviewed and updated on a regular basis.

Suggested Essential Questions

1. What are my goals and plans for an SAE in the coming year?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Update and revise long-range and short-term goals of the experiential learning program. (DOK 3)	a. Based on the summary and analysis of the students' previous experiential learning activities, have students reflect and revise or amend their experiential learning long-range and short-term goals for the coming year. The goals should be added to the students' electronic portfolios. CS1, CS2, CS4, T1, T3, T4, T6, W1, W2, W4, W5	a. Use an experiential learning planning rubric and record keeping rubric to evaluate the students' goals. (See the <i>Rubric for Experiential Learning Planning and Record Keeping (2.1).</i>)
b. Update, revise, and implement the experiential learning plan/training agreement for the coming year. (DOK 3)	b. Based on the revised goals, have students update, amend, and revise their experiential learning plan/training agreement to reflect growth in skill and proficiency levels. The updated plan should be added to the students' electronic portfolios. CS1, CS2, CS4, T1, T3, T4, T6, W1, W2, W4, W5	b. Use an experiential learning planning rubric and record keeping rubric to evaluate the students' goals. (See the <i>Rubric for Experiential Learning Planning and Record Keeping (2.1).</i>)

Competency 2: Maintain records and documentation of experiential learning activities, projects, and enterprises. ABS.02, ABS.03, ABS.04, ABS.06

Suggested Enduring Understandings

1. Records must be maintained and updated on a regular and timely basis to accurately reflect progress.
2. Records should be summarized to give a "snapshot" of operations on a regular basis that can be used to make decisions.

Suggested Essential Questions

1. How do I update and maintain the records of my experiential learning program?
2. How do I summarize and analyze my experiential learning records?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Update and maintain records of experiential	a. Review requirements for record keeping for the different types of experiential learning. Have	a. Use the <i>Rubric for Experiential Learning</i>

learning related income, expenses, activities, skills, and supplementary improvement projects. (DOK 3)	students maintain and update their records electronically throughout the year. CS2, CS4, T3, T4, T6, M1, M2, W4	<i>Planning and Record Keeping (2.1)</i> to evaluate the students' goals.
b. Prepare an annual summary report.	b. Review procedures for summarizing records. Have students prepare an annual summary of their experiential learning activities at the end of the school year to include income and expense summary and a net worth statement. CS2, CS4, T3, T4, T6, M1, M2, W4	b. Use the <i>Rubric for Experiential Learning Planning and Record Keeping (2.1)</i> to evaluate the students' summaries.

Standards

AFNR Industry Standards

- ABS.02. Utilize appropriate management planning principles in AFNR business enterprises.
- ABS.03. Utilize record keeping to accomplish AFNR business objectives while complying with laws and regulations.
- ABS.04. Apply generally accepted accounting principles and skills to manage cash budgets, credit budgets, and credit for an AFNR business.
- ABS.05. Assess accomplishment of goals and objectives by an AFNR business.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS4 Productivity & Accountability

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- M1 Basic Operations and Applications
- M2 Probability, Statistics, and Data Analysis
- W1 Expressing Judgments
- W2 Focusing on the Topic
- W4 Organizing Ideas
- W5 Using Language

Suggested References

- Cooper, E., & Burton, L. (2007). *Agriscience: Fundamentals and applications* (4th ed.). Clifton Park, NJ: Thomson Delmar.
- National FFA Organization. (n.d.). *Introduction to SAE* [PowerPoint presentation]. Retrieved June 9, 2010, from http://www.ffa.org/documents/sae_tch_intro.zip
- National FFA Organization. (2004). *Lesson 126: Taking my trip*. In *LifeKnowledge: Real lessons for real life* [CD-ROM software]. Indianapolis, IN: Author.
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Science of Agricultural Animals

Unit 3: Animals as Living Organisms

20 Hours

Competency 1: Examine the characteristics of life and living organisms. AS.02, BIOI 2, BIOI 4, BIOII 2, ZO2, ZO3, ZO4

Suggested Enduring Understandings

1. The animal cell is the basic building block of an animal's body and is composed of cell walls, membranes, a nucleus, cytoplasm, and organelles. Each component plays a role in the growth and reproduction of the cell.
2. As an embryo develops, cells begin to transform themselves into specialized cells through a process called cell differentiation.
3. All animals have a basic life cycle that goes from an egg to a young animal to an adult.
4. All animals share the same common life processes including respiration, digestion, growth, reproduction, movement, excretion, and sensitivity.

Suggested Essential Questions

1. What are the parts of an animal cell, and how do they function within the cell?
2. What is cell differentiation?
3. What is the basic life cycle of an animal, and how does it differ from phyla to phyla?
4. What are the common life processes that are necessary for animal growth and reproduction?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify the parts of an animal cell, and explain their functions. (DOK 1)	a. Have the students read <i>An Owner's Guide to the Cell</i> . Using the information in this document, have students view animal cells through a microscope and draw a typical cell and label its parts. Have students write a one to two sentence description of the role that each part plays in the cell. Have students scan their drawings and enter into their electronic notebooks or journals. CS1, CS2, CS4, T3, T4, T6, R1, R2, R5, W2, W4, W5	a. Evaluate the students' drawings and explanations for accuracy and completeness.
b. Describe the process of cell differentiation in the development of an animal. (DOK 2)	b. Have students view the video and read the information on the <i>Teacher's Domain</i> Web site related to cell differentiation. As students view the video and read the material, have them make written notes and record in their electronic journals or notebooks. Have students transcribe their notes into short essay describing how the process of cell differentiation allows an animal to develop. CS1, CS2, CS4, T3, T4, T6, R1, R2, R5, W2, W4, W5	b. Evaluate the students' essays for completeness and accuracy.
c. Examine the different stages in the life cycle of an	c. Have students search the Internet and other sources and prepare a chart that identifies the different stages of the life cycle of insects, fish,	c. Evaluate the chart for accuracy and completeness.

animal organism.
(DOK 1)

birds, reptiles, and mammals. Have students summarize the commonalities and differences for each category of animal. Students can complete the *Common Life Processes (3.1)* for review.

CS1, CS2, CS4, T3, T4, T6, R1, R2, R5, W2, W4, W5

Competency 2: Examine the anatomy and physiology of animals. AS.02, BIOI 4, ZO2, ZO3

Suggested Enduring Understandings

1. Anatomy refers to the physical makeup of an animal's body structure while physiology refers to the vital processes by which the animal functions.
2. There are four major types of animal tissue: epithelial, connective, muscle, and nervous. Each type performs specific functions within the body.
3. There are 11 different organ systems in an animal (skeletal, muscular, circulatory, respiratory, nervous, urinary, endocrine, digestive, integumentary, immune, and lymphatic) that must function together for animal growth, development, and reproduction.

Suggested Essential Questions

1. What is the definition of anatomy and physiology, and how do the two sciences relate to each other?
2. What are the major types of animal tissue and their functions?
3. What are the different organ systems in an animal body and their functions?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Define the terms anatomy and physiology, and discuss the relationships and differences between the two terms. (DOK 1)	a. Have students read Introduction to Anatomy and Physiology and develop definitions of anatomy and physiology and explore the relationships and differences in the two terms. Include material on the relationships of cells, tissues, and organs within the body. Summarize and discuss findings in class, and have students transcribe the summary into their electronic notebooks or journals. CS1, CS2, CS4, T6, R1, R2, R5, W2, W4, W5	a. Use a written test to evaluate student understanding.
b. Describe the types of animal tissue and the purpose of the tissue. (DOK 1)	b. Using the material from Introduction to Anatomy and Physiology identify, define and discuss the four fundamental tissue types (epithelial, connective, muscle, and nervous). Have students enter major points into their electronic notebooks or journals. CS1, CS2, CS4, T6, R1, R2, R5, W2, W4, W5	b. Use a written test to evaluate student understanding.
c. Name and explain the functions of the organ systems. (DOK 1)	c. Using the material from Introduction to Anatomy and Physiology , identify and discuss the functions of the 11 different organ systems. Have students enter major points into their	c. Use a written test to evaluate student understanding.

Competency 3: Investigate the importance of heredity and genetics. ^{AS.05, BS.03, BIOI5, BIOI6, BIOII3, BIOII4, G1, G2, G3}

Suggested Enduring Understandings

1. An understanding of the definitions and major terms associated with genetics and heredity is necessary to understanding the principles of the science.
2. DNA is a complex protein like substance that contains the genes and chromosomes that control the passage of traits and characteristics from parents to offspring.
3. Passage of traits from parents to offspring is based on the pairing of genes from each parent and can be predicted using a Punnett square.
4. Selective breeding is a process by which animal breeders can improve an existing breed or develop a new breed through careful selection of the best animals for breeding purposes.
5. Biotechnology in animal agriculture involves the use of artificial insemination, embryo transplants, cloning, and genetic engineering.

Suggested Essential Questions

1. What are some of the basic terms associated with genetics, and what are their definitions?
2. What function do DNA and RNA play in the transmission of traits from parent to offspring?
3. How can the passage of a trait from a parent to an offspring be predicted mathematically?
4. What is selective breeding, and how does it improve animal breeds over time?
5. What biotechnology practices are becoming more common in animal agriculture?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Define terms related to genetics and heredity including gene, chromosome, mutations, inherited traits, dominant, recessive, codominant, heterozygous, homozygous, alleles, gametes, genotype, and phenotype. (DOK 1)	a. Introduce the competency by having students bring a picture of one of their parents as a young child. Shuffle the pictures, and post on the bulletin board. Have student try to associate each picture with a student in the class. Explain that genetics and heredity are two reasons we often look like our parents. Have students read the chapter on <i>Animal Genetics</i> in the text (Herren, 2007). Have students solve the <i>Genetics and Heredity Crossword Puzzle (3.2)</i> using the terms listed in the indicator. ^{CS1, CS2, CS4, T6, R1, R2, R4}	a. Use a written test to evaluate student understanding.
b. Identify and describe the function of the major heredity	b. Use the PowerPoint presentation Genetics2 to present and discuss information on the composition and functions of DNA and RNA. ^{CS1, CS2, CS4, R1, R2, R5}	b. Use a written test to evaluate student understanding.

material of living organisms (DNA and RNA). (DOK 1)		
c. Predict the transmission of a trait from parents to offspring (Punnett square). (DOK 2)	c. Use the PowerPoint presentation Genetics to present and discuss information on heritability and transmission of traits from parents to offspring. Instruction should be limited to two traits. Have students complete an assignment to predict traits of offspring based on the pairing of dominant and recessive genes. CS1, CS2, CS4, R1, R2, S1	c. Use a written test to evaluate student understanding.
d. Explain how selective breeding methods are used to improve animals. (DOK 2)	d. Divide the class into groups of three to four students, and have each group investigate the development of a new breed of livestock (Polled Herefords, Barzona, Brangus, etc.). Have students compile a report on how selective breeding processes were used to develop this new breed. Hold a class discussion to identify key selective breeding practices that were used in the development process. Summarize and discuss these practices, and have students enter the summary statements into their electronic notebooks or journals. CS1, CS2, CS4, T2, T3, T4, T6, R1, R2, R5, W2, W4, W5	d. Evaluate the student reports for accuracy and completeness.
e. Investigate how biotechnology is used in animal production. (DOK 2)	e. Have students use the video Animal Biotechnology and take notes on how biotechnology techniques are used to improve animal production, including artificial insemination, embryo transfer, cloning, and genetic engineering. Have students write a one-page essay that discusses major points related to each biotechnology. CS1, CS2, CS4, T3, T4, T6, R1, R2, R5, R6, W2, W4, W5	e. Use the <i>Genetic Engineering Essay Rubric (3.3)</i> to evaluate the students' essays.

Standards

AFNR Industry Standards

- AS.02. Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics.
- AS.05. Evaluate and select animals based on scientific principles of animal production.
- BS.03. Demonstrate the application of biotechnology to AFNR.

Applied Academic Credit Standards

Biology I

- BIOI 2 Describe the biochemical basis of life, and explain how energy flows within and between the living systems.
- BIOI 4 Analyze and explain the structures and function of the levels of biological organization.
- BIOI 5 Demonstrate an understanding of the molecular basis of heredity.
- BIOI 6 Demonstrate an understanding of principles that explains the diversity of life and biological evolution.

Biology II

- BIOII 2 Describe and contrast the structures, functions, and chemical processes of the cell.
- BIOII 3 Investigate and discuss the molecular basis of heredity.
- BIOII 4 Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.

Genetics

- G 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- G 2 Analyze the structure and function of the cell and cellular organelles.
- G 3 Apply the principles of heredity to demonstrate genetic understandings.

Zoology

- ZO 2 Develop an understanding of levels of organization and animal classification.
- ZO 3 Differentiate among animal life cycles, behaviors, adaptations, and relationships.
- ZO 4 Demonstrate an understanding of the principles of animal genetic diversity and evolution.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS4 Productivity & Accountability

National Education Technology Standards for Students (NETS)

- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R4 Meaning of Words

R5	Generalizations and Conclusions
S1	Interpretation of Data
W2	Focusing on the Topic
W4	Organizing Ideas
W5	Using Language

Suggested References

- Burton, L. (2010). *Agriscience fundamentals and applications* (5th ed.). Albany, NY: Delmar.
- CEV Video. (n.d.). *CEV pathway: Animal systems pathway* [DVD]. Lubbock, TX: Author.
- Georgia Agriculture Education Curriculum Office. (n.d.). *Genetics*. Retrieved June 9, 2010, from http://aged.ces.uga.edu/Browseable_Folders/Power_Points/Agriscience%20and%20Biotechnology/Genetics2.ppt
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- Osksa, C. (n.d.). *Genetics* [PowerPoint]. Retrieved June 9, 2010, from http://aged.ces.uga.edu/Browseable_Folders/Power_Points/Animal%20Science/Breeding_and_Genetics/Animal_Science_Genetics-Casey_Osksa.ppt
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Science of Agricultural Animals

Unit 4: Animal Growth and Nutrition

20 Hours

Competency 1: Examine the role of nutrition in animal growth and health at different life stages. ^{AS.04, AQ.02, BIO1 3, ZO 3, ZO 4}

Suggested Enduring Understandings

1. Healthy growth and development of animals are dependent upon how well food is metabolized in the body.
2. Animals must have a balanced diet composed of six essential nutrients in order to meet growth and development potential.
3. Animals use protein, fat, and carbohydrates for energy and growth.
4. Different animals have varied nutritional requirements.
5. Animals with ruminant, monogastric, and avian digestive systems have different nutritional requirements.
6. The nutritional needs of different species of animals at birth are not the same.
7. As a young animal develops, the nutritional needs change according to the purpose for the animal and the species.
8. Growing animals have specific nutritional needs depending on their purpose.
9. As animals age past maturity, their nutritional needs change.
10. Animals at a reproductive age need specialized nutritional care.
11. Female animals who are nursing their young have special nutritional needs.
12. Concentrated feed and roughage feedstuffs are distinguished by their nutritional value and how they are digested.
13. The type of digestive system in an animal influences the amount of concentrates and roughages an animal can consume.

Suggested Essential Questions

1. How does metabolic rate affect animal growth and development?
2. What are the six essential nutrients that animals need in their diet?
3. What are the sources of energy and growth in an animal's diet?
4. What are the specific nutritional requirements for various domesticated animals?
5. What are the similarities and differences between the ruminant, monogastric, and avian digestive systems?
6. What types of nutrition do baby animals need?
7. What factors affect the nutritional needs of young animals?
8. How does the purpose of an animal affect what the animal needs nutritionally?
9. How do older animals' nutritional needs change over the years?
10. What types of nutrition changes are necessary for an animal at a reproductive age?
11. What nutrients do lactating mothers need in their diet?
12. What is the difference between a concentrate and roughage?
13. Which type of feed is better digested by ruminants, monogastric, and avian digestive systems?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Explain metabolism. (DOK 1)	a. Prior to teaching this competency, have students read the chapter on <i>Animal Nutrition</i> in the text (Herren, 2007). Discuss how the metabolic rate of some people allows them to	a. Use a written test to evaluate student understanding.

	eat more food than others and still not gain weight. Explain by using a diagram how the digestive system is designed and where the metabolic processes of anabolism, catabolism, and oxidation of nutrients occur within the digestive system. CS1, T2, R3	
b. List six nutrients essential to life, and identify the sources of the nutrients. (DOK 2)	b. Assign students to prepare an informational booklet depicting the six essential nutrients. The booklet should contain a description of the nutrient, photograph of the nutrient, or graphic depiction of the nutrient and a list of sources of the nutrient that would be available to the animal. CS1, CS2, CS4, CS5, T1, T2, T3, T6, W2, W4, W5	b. Use the <i>Nutritional Information Booklet Grading Rubric (4.1)</i> to evaluate student mastery.
c. Describe how carbohydrates, proteins, and fats are used to meet nutritional requirements of animals. (DOK 1)	c. Discuss how the body uses proteins, carbohydrates, and fats to produce energy and growth. The key concept is that energy comes from fats and carbohydrates and that protein is used only for body growth. Explain how energy and growth are important to the producer for maintaining a healthy and profitable animal production enterprise. CS1, CS2	c. Use a written test to evaluate student understanding.
d. Distinguish between concentrates and roughage feedstuffs. (DOK 1)	d. Define concentrates and roughages, and discuss how they are used in developing rations. CS1, CS2,	d. Use a written test to evaluate student understanding.
e. Associate common concentrates and roughages with specific animal rations. (DOK 1)	e. Discuss why both types of feedstuffs are included in many rations. Associate common concentrates and roughages with specific animal rations. CS1, CS2,	e. Use a written test to evaluate student understanding.
f. Develop a simple (two feedstuff mix) ration for an animal. (DOK 3)	f. After discussing and demonstrating the procedure for developing and balancing rations, assign groups of two to three students to determine nutritional requirements for a specific animal and then use nutritional tables to determine a ration. Instruct students to balance the ratio using the Pearson square method. Have the groups make an oral presentation to show the class the assigned animal's ration. CS1, CS2, CS3, CS4, CS5, S1	f. Use the <i>Oral Presentation on Animal Rations Rubric (4.2)</i> to evaluate student mastery.
g. Differentiate between monogastric, including catfish, ruminant, avian, and pseudo-	g. Give students diagrams of the different digestive systems. As you discuss each type of digestive system, instruct students to label each diagram. At the end of the discussion, have them compile a listing of similarities and differences of each system based on the	g. Use the <i>Grading Checklist for Digestive System Diagrams (4.3)</i> to evaluate student understanding.

ruminant feed utilization. (DOK 3)	diagrams. CS1, CS2, CS4, S1, W4, W5	
h. Explain the role of microorganisms in ruminants in increasing feed utilization. (DOK 3)	h. Use the PowerPoint presentation Livestock Digestive Systems to discuss how microorganisms in the rumen help ruminant animals' breakdown fiber, nonprotein nitrogen, and other feedstuffs to more efficiently utilize feed for growth and energy needs. Explain how this feature allows cows and sheep to eat feeds that humans cannot digest. Explain how the pH of the rumen must be maintained for the animal to survive. CS1, CS2	h. Use a written test to evaluate student understanding.
i. Discuss the advantages and disadvantages of different water sources. (DOK 2)	i. Assign small groups of students to create an advertisement promoting different sources of water in the local area that include the following: • Ponds • Streams • Wells • Springs • Community water supplies Assign one type of water source to each group, and instruct them to try to <i>sell</i> their water source by discussing the advantages and disadvantages of their assigned water source. CS1, CS2, CS3, CS4, T1, T2, T3, T4, T5, R1, R2, R3, R4, R5, W1, W2, W3, W4, W5	i. Use the <i>Water Advertisement Grading Rubric (4.4)</i> to evaluate student understanding on this indicator. See the <i>Feed Conversion Worksheet (4.5)</i> for an example.
j. Calculate a feed conversion ratio for a given animal. (DOK 2)	j. Define the concept of feed conversion, and discuss its importance in animal production. Demonstrate the formula for calculating feed conversion ratios. Provide students with data for several examples, and have them calculate a conversion ratio, or give them a ratio, and have them calculate how many pounds of feed it will take to get an animal to a certain weight. (See the <i>Feed Conversion Worksheet (4.5)</i> for an example.) CS2, CS4, T3, T4, M1, M3, M4	j. Grade worksheet on feed conversion ratios for accuracy.
k. Discuss the nutritional needs of newborn: needs for growth, nutritional needs for maintenance, gestation, and lactating. (DOK 1)	k. Assign students to work in groups of two or three to choose a particular breed of domestic animals. Instruct the students to research the animal to find details and photos or graphics of that particular animal at birth. The students should begin to compile a PowerPoint presentation on the animal breed to include the care and nutritional needs of their assigned animal at birth. CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T4, T6, R1, R2,	k. Use the <i>Animal Nutrition PowerPoint Rubric (4.6)</i> to evaluate student mastery.

Students should continue building their PowerPoint presentation begun with indicator a by adding information of the animal breed and its nutritional requirements as young animals grow into maturity. They should also include information on how to care for these animals at different stages in life. CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T4, T6, R1, R2, R4, R5, W2, W4, W5

Instruct students to continue their research on the assigned animal breed and include information in their presentation on care, management, and nutritional needs of the animal as it ages and maintains its quality of life. CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T4, T6, R1, R2, R4, R5, W2, W4, W5

Students are to continue their research on the assigned animal breed and include information in their presentation on reproductive processes and nutritional requirements for the animals as they prepare for reproduction or are pregnant. CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T4, T6, R1, R2, R4, R5, W2, W4, W5

Instruct students to finalize their research on the assigned animal breed and include information in the presentation on the nutritional needs for lactating females in this breed. CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T4, T6, R1, R2, R4, R5, W2, W4, W5

Competency 2: Assess the effects of hormones on animal growth. AS.04, ZO2, ZO3

Suggested Enduring Understandings

1. The endocrine system forms chemical substances called hormones, which influence animal growth.
2. Minerals play a major role in maintaining the health and development of an animal.
3. Fat-soluble and water soluble vitamins are necessary for animal growth and development.

Suggested Essential Questions

1. Which hormone producing glands have an effect on animal growth?
2. What are the minerals that affect the health and development of an animal?
3. Where do animals get the vitamins they need for growth and development?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. List and discuss the major hormone	a. Introduce the competency by explaining the difference in growth rate and body structure of	a. Use a written test to evaluate student

producing glands and their effect on growth. (DOK 1)	bulls and steers. Discuss the different hormones in the animal's body and how each affects growth. CS1, CS2	understanding.
b. Identify issues with consumers on the use of hormones in food animal production. (DOK 2)	b. Have students research news stories associated with hormones in food animal production, and summarize the advantages and concerns over their use in an article summary. CS1, CS2, CS4, T1, T2, T3, T4, T6, R1, R2, R4, R5, W2, W4, W5	b. Use the <i>Consumer Issues Article Rubric (4.7)</i> to evaluate student mastery.
c. Discuss the role and functions of macro and micro minerals in the normal growth and development of an animal. (DOK 1)	c. Have students compile a list of minerals and identify which are macro and which are micro. Associate each mineral with the growth and development of an animal including effects of shortages and surpluses of each mineral. CS1, CS2, CS4, T3, W4, W5	c. Use the <i>Grading Checklist for Lists of Vitamins and Minerals (4.8)</i> to evaluate student mastery.
d. Identify the major fat soluble and water soluble vitamin groups in animal feeds and their most common sources. (DOK 1)	d. Have students compile a listing of vitamins and identify which are fat soluble and which are water soluble. Identify how each aids the growth and development of the animal and common sources of each. CS1, CS2, CS4, T3, W4, W5	d. Use the <i>Grading Checklist for Lists of Vitamins and Minerals (4.8)</i> to evaluate student mastery.
e. Identify the major minerals in animal feeds and their most common sources. (DOK 1)	e. On the list compiled for indicator a, instruct students to add information on the source of the mineral for each major mineral listed. CS1, CS2, CS4, T3, W4, W5	e. Use the <i>Grading Checklist for Lists of Vitamins and Minerals (4.8)</i> to evaluate student mastery.

Standards

Agriculture, Food, and Natural Resources Standards

- AS.04. Apply principles of animal nutrition to ensure the proper growth, development, reproduction, and economic production of animals.

Academic Standards

- AQ 2 Develop an understanding of physical and chemical properties of water and aquatic environments.
BIOI 3 Investigate and evaluate the interaction between living organisms and their environment.
BIOII 4 Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.
BIOII 5 Develop an understanding of organism classification.
ZO 2 Develop an understanding of levels of organization and animal classification.
ZO 3 Differentiate among animal life cycles, behaviors, adaptations, and relationships.
ZO 4 Demonstrate an understanding of the principles of animal genetic diversity and evolution.

21st Century Learning Skills

- CS1 Flexibility & Adaptability
CS2 Initiative & Self-Direction
CS3 Social & Cross-Cultural Skills
CS4 Productivity & Accountability
CS5 Leadership & Responsibility

NETS for Students

- T1 Creativity and Innovation
T2 Communication and Collaboration
T3 Research and Information Fluency
T4 Critical Thinking, Problem Solving, and Decision Making
T6 Technology Operations and Concepts

ACT College Readiness Standards

- M1 Basic Operations and Applications
M3 Numbers: Concepts and Properties
M4 Expressions, Equations, and Inequalities
R1 Main Ideas and Author's Approach
R2 Supporting Details
R3 Sequential, Comparative, and Cause–Effect Relationships
R4 Meaning of Words
R5 Generalizations and Conclusions
S1 Interpretation of Data
W1 Expressing Judgments
W2 Focusing on the Topic
W3 Developing a Position
W4 Organizing Ideas
W5 Using Language

Suggested References

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CEV Video. (n.d.). *CEV pathway: Animal systems pathway* [DVD]. Lubbock, TX: Author.

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

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For additional references, activities, and web resources, please refer to: Information and Computer Technology B.R.I.D.G.E. Web site: <http://www.rcu.blackboard.com> (Available only to registered users).

Science of Agricultural Animals

Unit 5: Animal Reproduction

20 Hours

Competency 1: Examine the process of fertilization and conception in animal production. AS.02, AS.04, AS.05, ZO 3

Suggested Enduring Understandings

1. Most domesticated animals are raised for breeding offspring in order to make a profit for the animal producer.
2. Male and female sex cells each have distinct characteristics.
3. Controlling the breeding process for animals plays a key role in the success of the conception rate.
4. Sexual reproduction involves each parent providing half of its genetic material to create offspring.

Suggested Essential Questions

1. How does an animal producer manage the animal herd's reproduction cycles to insure the maximum profit available?
2. What are the differences in the male and female sex cells?
3. Why do producers need to control the breeding process for domesticated animals?
4. How does the reproductive process occur in different species of animals?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe the importance of reproduction and reproductive efficiency to animal enterprises. (DOK 3)	a. Lead a discussion on the role of reproduction in a profitable animal enterprise. Ask students to discuss the benefits of having an animal that reproduces every 12 months versus every 16 months. Using a teacher-made chart, show the loss of income over time that results from poor reproductive efficiency. CS1, CS2, T4, S1	a. Use a written test to evaluate student understanding.
b. Identify male and female sex cells. (DOK 1)	b. Using graphics or photos obtained from the textbook or Internet pertaining to animal reproductive cells, describe the anatomy of the male and female sex cells. Discuss the physical differences and the role that each plays in the reproduction process. CS1, T2, S3	b. Use a written test to evaluate student understanding.
c. Describe the mating and breeding process in animals. (DOK 2)	c. After a class discussion on the general process of mating between male and female animals, assign each student to research and write a report on a particular species of animal and find out the specific details of how the male and female animal in that breed mate. The students should also include in their written reports information on the rate of conception for that particular conception, the risks involved with breeding and conception, the number of offspring produced per birth, and the gestation period. CS1, CS2, CS3, CS4, CS5, T1, T2, T3, S1,	c. Use the <i>Animal Insemination Report Rubric (5.1)</i> to evaluate student mastery.

d. Describe the process of fertilization. (DOK 1)	d. Have students prepare a series of drawings showing how the sperm and egg unite to form an embryo. CS1, CS2, CS3, CS4, CS5, T1, M5, S3	d. Evaluate the drawings for accuracy and completeness.
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Competency 2: Examine the reproduction process. AS.02, AS.04, AS.05, ZO 2, ZO 3

Suggested Enduring Understandings

1. Male and female animals are uniquely designed for the reproduction process.
2. The mammalian reproductive cycle involves estrus, ovulation, fertilization, gestation, and parturition.
3. The gestation period varies for different species.
4. The reproductive organs in poultry serve to produce eggs.
5. Eggs can be produced that have not been fertilized.
6. The egg incubation period varies for different types of poultry.
7. Eggs intended for hatching require special care and handling.
8. Mississippi farm-raised fish eggs are deposited by a variety of methods in various locations depending on the species of fish.
9. Different species of Mississippi farm-raised fish require unique conditions in order to spawn.
10. Mississippi farm-raised fish eggs can be incubated in both natural and artificial settings.
11. Small fish (Mississippi farm-raised) have to be protected during the early stages of life in order to survive and grow into a marketable size.

Suggested Essential Questions

1. What are the differences between the male and female reproductive systems?
2. How are the mammalian reproductive cycles distinguished?
3. What is the gestation period for cows, horses, sheep, pigs, and goats?
4. How is an egg formed?
5. How can an egg be produced by chicken that has not been fertilized?
6. How long does it take for an egg to hatch?
7. What conditions must exist for an egg to hatch successfully?
8. How and where do Mississippi farm-raised fish lay eggs?
9. Are all Mississippi farm-raised fish eggs fertilized when they are deposited?
10. Do Mississippi farm-raised fish eggs need to be incubated?
11. How do the parent fish (Mississippi farm-raised) protect their young once they are hatched?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify the male and female reproduction organs, and discuss the function of each. (DOK 1)	a. Prior to teaching this unit, have students read the chapter on <i>The Reproduction Process</i> in the text (Herren, 2007). Use the Animal Reproduction PowerPoint presentation to illustrate and discuss reproductive anatomy and physiology in female mammals. If possible, obtain male and female reproductive organs from a local slaughter house, and perform a	a. Use a written test to evaluate student understanding.

dissection for students to observe. ^{CS, T2, S1}		
b. Identify the phases of the female mammalian reproductive cycle. (DOK 2)	b. Discuss the phases of the female reproductive cycle from ovulation to birth. Identify behavioral and physiological signs of estrus in female animals. ^{CS1, CS2, CS4}	b. Use a written test to evaluate student understanding.
c. Calculate the expected birth date for a given species based on conception date. (DOK 3)	c. Have students prepare a time line showing the estrus cycle for different species of animals. Identify the gestation periods for different species, and have students use a spreadsheet to calculate the expected birth date based on breeding date and the expected date of next estrus if the animal does not conceive. ^{CS1, CS2, CS4, T4, T6, M1, M2}	c. Evaluate the time line and spreadsheet for accuracy and completeness.
d. Identify and describe the purpose and/or function of the reproductive organs in poultry. (DOK 2)	d. Have students label a drawing of the male and female reproductive system of a chicken. Have students list the function of each part. ^{CS1, CS2, CS4}	d. Evaluate the drawings for accuracy and completeness.
e. Describe the reproductive process in poultry. (DOK 1)	e. Using slides 44–50 of the Animal Reproduction and Genetics PowerPoint presentation, illustrate and discuss the reproductive process in chickens, including the difference between a fertilized and unfertilized egg. ^{CS1, CS2, CS4}	e. Use a written test to evaluate student performance.
f. Indicate incubation period and conditions required by various species. (DOK 3)	f. Have students compile a chart showing key factors in incubating different species of poultry (chickens, turkeys, and quail), including length of incubation period, recommended temperature and humidity, special considerations, and so forth. Also, the chart should summarize procedures and conditions for hatching and caring for new born birds. ^{CS1, CS2, CS4, T2, T3, M2, M5}	f. Evaluate the chart for accuracy and completeness.
g. Describe procedures and conditions for hatching eggs and caring for newly hatched birds. (DOK 4)	g. Set up an incubator with fertilized duck, chicken, goose, or turkey eggs. Assign students to monitor the incubator, adjusting temperature and humidity as needed during the development of the eggs. Have students complete the <i>Incubator Data Chart</i> (5.4). Once the eggs hatch, assign groups of students to care for the newly hatched birds. ^{CS1, CS2, CS4, T3, T6 S1, S2, S3}	g. Evaluate student performance using the <i>Poultry Hatching Checklist</i> (5.4), and check the <i>Incubator Data Chart</i> (5.4) for accuracy and completeness.
h. Describe the general process of spawning and incubation with	h. Use the video Catfish from Rathburn to describe the process and conditions needed for spawning, hatching, and caring for fry. ^{CS1, CS2, CS4}	h. Use a written test to evaluate student understanding.

Mississippi farm-raised fish. (DOK 2)		
i. Indicate conditions for spawning of a species common in the local area. (DOK 2)	i. Assign students in groups of two to three to research a species of Mississippi farm-raised fish that is common to the local area. The students should create a multimedia presentation showing the spawning and incubation process for the assigned fish species. They will present their findings to the class. CS1, CS2, CS4, T2, T4, T6, W2, W4, W5	i. Use the <i>Multimedia Presentation Rubric (5.3)</i> to evaluate student mastery.
j. Apply procedures for the care for newly-hatched fry. (DOK 4)	j. Set up an aquaculture tank in the laboratory, and stock it with fingerlings from a local supplier. Demonstrate the care, management, and feeding requirements for the fry, and assign students a rotating work schedule to care for the fry. CS1, CS2, CS4, S1, S2, S3	j. Use the <i>Catfish Fry Management Rubric and Data Sheet (5.5)</i> to evaluate student mastery.

Competency 3: Examine reproductive methods. AS.02, AS.04, AS.05, ZO 2, ZO 3

Suggested Enduring Understandings

1. Animals can be bred naturally or artificially.
2. Artificial insemination can be used to produce healthier and faster growing animals.
3. The process of embryo transfer is a reproductive method where superior animals can be chosen to breed offspring with highly desirable characteristics.

Suggested Essential Questions

1. What artificial methods can be used to successfully breed animals?
2. Why does artificial insemination improve the health and growth rate of animals?
3. How does the process of embryo transfer work?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Observe and describe the artificial insemination method of breeding. (DOK 2)	a. Have students watch the video Cow to observe the process of artificial insemination in cattle. If possible, take students to a local breeder to observe the process, or invite the breeder to speak to the class on the process and its advantages and limitations. Have students summarize their findings from the video and the breeder in a one-page written report. CS1, CS2, CS4, W2, W4, W5	a. Use the <i>Artificial Insemination Report Rubric (5.1)</i> to evaluate student mastery.
b. Describe the process of embryo transfer. (DOK 2)	b. Have students watch the video Embryo Transfer to observe the process. If possible, obtain samples of frozen semen and embryos from a local veterinarian, a breeding company, or the local university. Thaw the samples, and have students examine them under the microscope to look for damaged or low-quality sperm or embryos. Explain how the process of embryo transfer works in the breeding	b. Use a written test to evaluate student performance.

industry. CS1, CS2, CS4, T6		
c. Observe and describe the procedure for collecting and processing semen. (DOK 2)	c. Have students watch the Bull, Freezing Bull Semen I , and Freezing Bull Semen II videos on the <i>Learning Reproduction in Farm Animals</i> Web site. Discuss the costs of collecting and freezing semen, as well as the price of buying frozen semen. Have students research factors that would affect the cost and value of frozen semen from different types of animals. Instruct students to write a written report on their findings. CS1, CS2, CS4, T3, T6, W2, W4, W5	c. Use the <i>Semen Collection and Processing Procedures Report Rubric (5.2)</i> to evaluate student mastery.

Standards

Agriculture, Food, and Natural Resources Standards

- AS.02 Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics.
- AS.04 Apply principles of animal nutrition to ensure the proper growth, development, reproduction, and economic production of animals.
- AS.05 Evaluate and select animals based on scientific principles of animal production.

Academic Standards

- ZO 2 Develop an understanding of levels of organization and animal classification.
- ZO 3 Differentiate among animal life cycles, behaviors, adaptations, and relationships.

21st Century Learning Skills

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS4 Productivity & Accountability

NETS for Students

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- M1 Basic Operations and Applications
- M2 Probability, Statistics, and Data Analysis
- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- S1 Interpretation of Data
- S2 Scientific Investigation
- S3 Evaluation of Models, Inferences, and Experimental Results
- W2 Focusing on the Topic
- W4 Organizing Ideas
- W5 Using Language

Suggested References

- Animal reproduction and genetics*. (n.d.). (PowerPoint). June 9, 2010, from www.clevelandcountyschools.org/schools/chs/agriculture/ans1_repro.ppt
- CEV Video. (n.d.). *CEV pathway: Animal systems pathway* [DVD]. Lubbock, TX: Author.
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- Gillespie, J.R., & Flanders, F.B. (2010). *Modern livestock and poultry production* (8th ed.). Albany, NY: Delmar Publishers.
- Herren, R. (2007). *The science of animal agriculture* (3rd ed.). Albany, NY: Delmar Publishers.
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- For additional references, activities, and web resources, please refer to: Information and Computer Technology B.R.I.D.G.E. Web site: <http://www.rcu.blackboard.com> (Available only to registered users).

Science of Agricultural Animals

Unit 6: Animal Evaluation

20 Hours

Competency 1: Evaluate market animals. AS.05, ZO 2, ZO 3, ZO 4

Suggested Enduring Understandings

1. The value of a market animal can be determined by its physical appearance.
2. In order to effectively evaluate an animal, knowledge of the external anatomy of the animal is necessary.
3. Market animals are bred for the cuts and quality of meat that will come from the animal.
4. When evaluating an animal, the type of animal is to be considered, as well as the muscle finish, carcass quality, balance, and style.
5. Valid reasons must be provided when ranking the quality of a class of market animals.

Suggested Essential Questions

1. What physical characteristics are used to evaluate a market animal?
2. Which anatomical characteristics are evaluated on an animal?
3. What are the major wholesale cuts of meat on an animal?
4. How do you evaluate an animal for quality?
5. What type of reasoning should be given for ranking a class of market animals?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Explain the importance of market animal evaluation. (DOK 1)	a. Prior to teaching this competency, have students read the appropriate chapter on Selection and Judging of the species from the text (Gillespie & Flanders, 2010). Discuss the basis for determining the value of a market animal based on its appearance, conformation, and yield of high value wholesale meat cuts. CS1, CS2	a. Use a written test to evaluate student understanding.
b. Label the external parts of an animal (beef, swine, goat, chicken, and lamb). (DOK 1)	b. Have students label a drawing of different species of market animals showing the major external parts. CS1, CS2	b. Grade the labeled drawings.
c. Identify the wholesale meat cuts on a market animal (beef, pork, goat, and lamb). (DOK 1)	c. Have students label a drawing of different species of market animals showing the major wholesale meat cuts on the carcass. CS1, CS2 T1, T2	c. Grade the labeled drawings of cuts of meat.
d. List the main points to consider when visually evaluating a market animal	d. Teachers should concentrate on evaluation of one species of animal for this competency. In most cases, this will be beef animals, but dairy cattle, swine, or sheep may be selected as well.	d. Use a written test to evaluate student understanding.

(type, muscle, finish, carcass merit, yield, quality, balance, and style). (DOK 2)	Provide students with a list of terms associated with market animal evaluation, and discuss/illustrate each term. Discuss the steps in evaluating a market animal. CS1, CS2	
e. Evaluate classes of market animals, and present reasons for each class. (DOK 3)	e. Provide students with the proper format placing a class of animals and presenting oral reasons. See the publication Oral Reasons for a procedure for taking notes and giving oral reasons. Using live animals (if possible) or a series of slides or video, have students judge and place a class of market animals and provide oral reasons to justify their placings. CS1, CS2, CS4	e. Use the <i>Livestock Placing and Oral Reasons Rubric (6.1)</i> to evaluate student mastery.

Competency 2: Investigate the selection of breeding animals. AS.05, ZO 2, ZO 3, ZO 4

Suggested Enduring Understandings

1. When selecting an animal for breeding purposes, the animal must be evaluated for soundness, growth capacity, breed, and sex characteristics.
2. Performance records and Expected Progeny Difference (EPD) scores are now being used to select breeding animals.
3. When ranking a class of breeding animals, valid reasons must be given for the ranking.

Suggested Essential Questions

1. How are breeding characteristics evaluated?
2. How is information from performance records and EPDs used to select a breeding animal?
3. What type of reasoning can be given for ranking a class of breeding animals?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Apply points to consider when selecting a breeding animal (structural soundness, growth, capacity, breed, and sex characteristics). (DOK 3)	a. Teachers should select beef cattle as the animal class to be used in teaching this competency. Other species can also be taught based on the instructor's preference. Discuss the characteristics that are most desirable in breeding stock for this class. Using a set of pictures or a video showing different animals, illustrate and discuss these characteristics. CS1, CS2	a. Use a written test to evaluate student understanding.
b. Use performance records and Expected Progeny Differences (EPDs) in selecting breeding animals. (DOK 3)	b. Discuss the concept of EPDs, and show examples of EPD data. Demonstrate the procedure for using this data, and provide students with a worksheet to allow them to select animals for breeding purposes. CS1, CS2 M1, M2, M3, M5, S1, S2	b. Grade student worksheet.
c. Evaluate classes of breeding animals, and present reasons for each	c. Using live animals (if possible) or a videotape or multimedia presentation, have students judge, place, and give reasons on a class of breeding animals. CS1, CS2, CS4, S1, S2	c. Use the <i>Livestock Placing and Oral Reasons Rubric (6.1)</i> to evaluate

Standards

Agriculture, Food, and Natural Resources Standards

AS.05 Evaluate and select animals based on scientific principles of animal production.

Academic Standards

ZO 2 Develop an understanding of levels of organization and animal classification.

ZO 3 Differentiate among animal life cycles, behaviors, adaptations, and relationships.

ZO 4 Demonstrate an understanding of the principles of animal genetic diversity and evolution.

21st Century Learning Skills

CS1 Flexibility & Adaptability

CS2 Initiative & Self-Direction

CS4 Productivity & Accountability

NETS for Students

T1 Creativity and Innovation

T2 Communication and Collaboration

ACT College Readiness Standards

M1 Basic Operations and Applications

M2 Probability, Statistics, and Data Analysis

M3 Numbers: Concepts and Properties

M5 Graphical Representations

S1 Interpretation of Data

S2 Scientific Investigation

Suggested References

CEV Video. (n.d.). *CEV pathway: Animal systems pathway* [DVD]. Lubbock, TX: Author.

CEV Multimedia, Inc. (n.d.). *Livestock judging*. [DVD]. Lubbock, TX, Author.

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Texas Cooperative Extension Service. (n.d.). *Approach to placing a market steer class*. Retrieved June 15, 2010, from <http://animalscience.tamu.edu/images/pdf/beef/beef-approach-to-placing.pdf>

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Science of Agricultural Animals

Unit 7: Production Management

10 Hours

Competency 1: Examine basic concepts of animal health to include disease prevention, control, and treatment. AS.03, AS.06, ZO 2

Suggested Enduring Understandings

1. Knowing the signs of good health is a first step in recognizing and diagnosing signs of poor health in an animal.
2. A disease is an infectious agent that results in decreased health in an animal. Diseases may be caused by bacteria, viruses, protozoa, injury, genetics, poor nutrition, or toxins.
3. Many factors contribute to an animal's ability to resist diseases including age, genetic background, stocking density, and natural immunity.
4. Environmental conditions such as temperature, humidity, air quality, and light can have a direct effect on animal health.
5. The white blood cells play an important role in helping animals stay healthy and fight diseases by either killing or digesting harmful organisms or substances in the body.
6. Vaccines, when properly administered, cause an animal to develop an immunity against a specific disease.
7. Proper nutrition, sanitation, vaccination, and observation/isolation of unhealthy animals promote animal health.
8. A herd or flock health plan includes knowledge of signs of good health, vaccinations and medication regimes, proper sanitation methods, parasite control, and prompt treatment and isolation of unhealthy animals.

Suggested Essential Questions

1. What are the signs of a healthy animal?
2. What is a disease, and what causes diseases?
3. What practices promote animal health?
4. How is a health plan developed for an animal enterprise?
5. What factors contribute to an animal's health and ability to resist diseases?
6. How do environmental conditions affect animal health?
7. What is the role of the white blood cells in helping the body to fight disease?
8. How do vaccines help an animal develop immunity?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe the signs of good health in animals. (DOK 1)	a. Prior to teaching this competency, have the students read the chapter on <i>Animal Health</i> in the text (Burton & Cooper, 2007). Using the PowerPoint presentation Animal Health , identify and describe the signs of healthy and signs of unhealthy animals, including	a. Use a written test to evaluate student understanding.

measurement of vital signs in different animals. CS 1, CS2, CS4, W2, W4, W5		
b. Define disease, and describe the major causes of diseases. (DOK 1)	b. Use the Animal Health PowerPoint presentation to define what a disease is, and discuss with the students the different vectors and causes of diseases. CS1, CS2, CS4	b. Use a written test to evaluate student understanding.
c. Describe how factors such as age, genetic background, stocking density, and natural immunity affect animal health and resistance to diseases. (DOK 1)	c. Invite a local producer to speak to the class regarding factors that contribute to disease resistance and immunity. Have students take notes and summarize major points in their electronic notebooks or journals. CS1, CS2, CS4, T6, W2, W4, W5	c. Use a written test to evaluate student understanding.
d. Examine the effects of environment conditions on animal health. (DOK 1)	d. Discuss with the class how environmental conditions such as temperature, humidity, air quality, and light affect animal health. CS1, CS2, CS4	d. Use a written test to evaluate student understanding.
e. Discuss the role and functions white blood cells in development of natural immunity. (DOK 1)	e. Have students watch the video White Blood Cells: Leucocytes and answer the questions in the <i>White Blood Cells Assignment (7.2)</i> . CS1, CS2, CS4, T6, W2, W4, W5	e. Evaluate the assignment for accuracy and completeness.
f. Describe how vaccinations prevent disease. (DOK 1)	f. Discuss the two types of vaccines (live bacteria and killed bacteria) and how these medications lead to development of immunity against a specific disease in an animal. Have students conduct a search to identify vaccinations that are commonly given to dogs, cattle, swine, and chickens. CS1, CS2, CS4, T4, T6, W2, W4, W5	f. Evaluate results of student search for accuracy and completeness.
g. Discuss practices that promote animal health. (DOK 1)	g. Use the Animal Health PowerPoint presentation to describe procedures for promoting animal health. CS1, CS2, CS4	g. Use a written test to evaluate student understanding.
h. Define the terms biosecurity and bioterrorism, and discuss their relationship to animal health programs. (DOK 1)	h. Using the PowerPoint presentations Biosecurity and Bioterrorism , define the two terms, and discuss how they relate to animal health programs. CS 1, CS2, CS4	h. Use a written test to evaluate student understanding.
i. Develop a plan for maintaining and	i. Divide the class into groups of three or four students, and assign each group a different	i. Use the <i>Animal Health Plan Rubric</i>

protecting animal health in a herd or flock. (DOK 3)

animal species to be produced. Have students search the Internet and other sources and compile a plan for maintaining and protecting animal health. CS 1, CS2, CS4, S1, S2, S3, T3, T4, T6, R2, R4, R5 W2, W3, W4, W5

(7.1) to evaluate student mastery.

Competency 2: Examine the role of pathogens in animal health to include parasites and plant toxins.

AS.03, ZO 2

Suggested Enduring Understandings

1. The most common pathogens are bacteria, viruses, protozoa, and toxins. These pathogens can be delivered by ingestion, physical contact, or inhalation.
2. Animal diseases are classified as contagious, infectious, genetic, and nutritional. Each type of disease involves a different type of treatment or response.
3. Internal and external parasites harm animals by robbing their bodies of nutrients, causing blood loss, reducing food intake, and in general weakening an animal and making it more susceptible to disease.
4. The major internal parasites of animals are roundworms, tapeworms, and flukes. The major external parasites are flies, ticks, mites, lice, and fungi.
5. Plant toxins affect animals by affecting different organ systems in the animal.
6. Medicine may be given to animals by injection, pills or boluses, drenches, powders, pastes, infusions, and application to the skin.

Suggested Essential Questions

1. What are the most common animal pathogens? How are they transmitted, controlled, and treated?
2. What are the different types or classes of animal disease?
3. How are medications delivered to animals?
4. How do internal and external parasites cause harm to an animal?
5. What are the major internal and external parasites of animals, and how do they affect the animal?
6. How do plant toxins affect an animal?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify common animal pathogens, and discuss their method of entry, control, and treatment. (DOK 1)	a. Use the PowerPoint presentation Animal Diseases to lead a discussion of the different pathogens (bacteria, viruses, protozoa, toxins, etc.) and how they enter and affect the body, as well as how they are controlled and treated. Have students summarize the findings and record in their electronic notebooks or journals. CS1, CS2, CS4, T6, W4, W5	a. Use a written test to evaluate student understanding.
b. Classify common diseases of animals. (DOK 1)	b. Use the PowerPoint presentation Animal Diseases to present information on the different types of diseases (contagious, noninfectious, genetic, and nutritional). Lead a discussion on how these types differ in the way	b. Use a written test to evaluate student understanding.

	they affect an animal and in the way they are treated and controlled. CS1, CS2, CS4:	
c. Describe how internal and external parasites cause harm to animals. (DOK 1)	c. Prior to teaching this competency, have the students read the chapter on <i>Parasites of Agricultural Animals</i> from the text (Herren, 2007). Use the PowerPoint presentation Integrated Parasite Management as a means to discuss internal and external parasites and the damage they cause animals. (Note: This PowerPoint is devoted to parasites of sheep and goats, but many of the points it makes are applicable to other species.) CS1, CS2, CS4	c. Use a written test to evaluate student understanding.
d. Classify internal and external parasites, and examine their life cycle and the harm they cause animals. (DOK 1)	d. Lead a discussion to identify and describe the life cycle of the major internal parasites (roundworms, tapeworms, and flukes) and external parasites (ticks, fleas, lice, mites, fungi, and flies). CS1, CS2, CS4	d. Use a written test to evaluate student understanding.
e. Examine ways in which plant toxins affect animal health. (DOK 2)	e. Use slides 24–26 of the PowerPoint presentation Animal Health as a means of discussing the most common plant toxins and their method of control. Assign a specific plant toxin to each student, and have him or her conduct a search and prepare a one-paragraph essay on the nature of the toxin, its effects on animals, and its control or treatment. CS1, CS2, CS4, T4, T6, R2, R4, W2, W4, W5	e. Evaluate student paragraphs for content accuracy and completeness.
f. Discuss methods for delivering medicine to animals. (DOK 1)	f. Have a local veterinarian or veterinary technician speak to the class of the different means for delivering medications, vaccines, and vermifuges to animals. Ask him or her to bring the equipment that is used and describe its use. Have students use the <i>Guest Speaker Summary Form (7.3)</i> to summarize the major methods used and associate each method with the necessary equipment and/or techniques. CS1, CS2, CS4, E1, E2, E3, E4, E5, E6, W1, W2, W3, W4, W5	f. Evaluate student summaries for accuracy and completeness.

Standards

AFNR Industry Standards

- AS.03. Provide for proper health care for animals.
- AS.06. Prepare and implement animal handling procedures for the safety of animals, producers, and consumers of animal products.

Applied Academic Credit Standards

Zoology

- ZO 2 Develop an understanding of levels of organization and animal classification.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS3 Social & Cross-Cultural Skills
- CS4 Productivity & Accountability
- CS5 Leadership & Responsibility

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T5 Digital Citizenship
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- E1 Topic Development in Terms of Purpose and Focus
- E2 Organization, Unity, and Coherence
- E3 Word Choice in Terms of Style, Tone, Clarity, and Economy
- E4 Sentence Structure and Formation
- E5 Conventions of Usage
- E6 Conventions of Punctuation
- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R3 Sequential, Comparative, and Cause–Effect Relationships
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- S1 Interpretation of Data
- S2 Scientific Investigation
- S3 Evaluation of Models, Inferences, and Experimental Results
- W1 Expressing Judgments
- W2 Focusing on the Topic
- W3 Developing a Position
- W4 Organizing Ideas
- W5 Using Language

Suggested References

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- Biosecurity*. (n.d.). (PowerPoint). Retrieved June 9, 2010, from http://aged.ces.uga.edu/Browseable_Folders/Power_Points/Animal%20Science/Animal_Health/Animal%20Health_Biosecurity.ppt
- Bioterrorism*. (n.d.). (PowerPoint). Retrieved June 9, 2010, from http://aged.ces.uga.edu/Browseable_Folders/Power_Points/Animal%20Science/Animal_Health/Animal%20Health_Bioterrorism.ppt
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- Schoenian, S. (n.d.). *Integrated parasite control (IPM)* (PowerPoint). Retrieved June 9, 2010, from <http://www.sheepandgoat.com/PPT/IPM.pdf>
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Science of Agricultural Animals

Unit 8: Marketing

5 Hours

Competency 1: Identify and describe facility and equipment, and develop a production management plan needs for various animal enterprises. AS.06, AS.07, PST.04, BIOII 4, ZO 3

Suggested Enduring Understandings

1. Most animals require some type of facility and equipment for proper management.
2. Facility design must take into account the natural behavior of the animal to be housed, safety for the animal and humans, sanitation, and environmental controls.
3. In today's market and economy, careful management is absolutely essential to success and profitability.
4. Records of animal breeding and productivity are necessary for evaluating animal performance and decision making and planning.
5. An animal production management plan includes goals, a calendar of activities, a list of equipment materials and facilities needed, and an estimated income and expenses budget.

Suggested Essential Questions

1. What are the general needs for facilities and equipment for successful animal management?
2. What factors must be taken into account in designing and equipping an animal facility?
3. What are practices are critical for successful management of an animal enterprise?
4. How are records of animal breeding and production kept?
5. What should be included in an enterprise production management plan?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Discuss general facility needs for different classes of animals. (DOK 1)	a. Assign each student a different class of animals (beef brood cows, feeder calves, swine farrowing operations, feeder pigs, broilers, layers, goats, sheep, dogs, etc.). Have the student search the Internet and other sources to determine the general facility and equipment needs of the animal as related to shelter, feeding, birthing, watering, and so forth. Have each student compile a list of facilities and equipment needed for the animal and describe its purpose or use. CS1, CS2, CS4, T3, T4, T6, R2, R4, R5, W2, W4, W5	a. Evaluate list for completeness and accuracy.
b. Identify and describe factors to consider in designing and equipping an animal facility.	b. Discuss factors to take into consideration in designing facilities for animals including the animals' natural behavior, safety for the animal and workers, sanitation, environmental controls (temperature, humidity, and air quality), and space requirements for each	b. Use a written test to evaluate student understanding.

(DOK 1)	animal to use the facility. ^{CS1, CS2, CS4}	
c. Design a facility for a given animal enterprise to include an equipment list. (DOK 4)	c. Have students draw a plan for a facility for a given animal and a list of equipment and fixtures that should be included. ^{CS1, CS2, CS4, T1, T4, T6, R2, R4, R5, W2, W4, W5}	c. Use the <i>Animal Facility Plan Rubric (8.1)</i> to evaluate student mastery.
d. Explore critical practices in managing an animal enterprise. (DOK 1)	d. Based on previous discussions in the class, have students brainstorm critical practices that must be included in a management plan for an animal enterprise. These could include facility, equipment, and housing needs; feeds and nutrition; selection of animals for breeding; breeding practices and timing; record keeping; health planning; and marketing. ^{CS1, CS2, CS4}	d. Use a written test to evaluate student understanding.
e. Design a record keeping system for maintaining breeding and production records of animals. (DOK 3)	e. Ask students if they know the definition of the word pedigree or if they know what makes a registered quarter horse different from a regular horse. Lead into a discussion on how breeding records are used to establish the value of many animals and how bloodlines can be used to improve traits within a breed. Discuss with the students the different types of records that are kept on animals, including pedigree, individual animal breeding, performance, health, and production records. Have students search the Internet and other sources to see examples of breeding and production records for different animals. Using a spreadsheet or database program, have students design and present a record keeping form for an animal. ^{CS1, CS2, CS4, T1, T3, T4, T6, R1, R2, R4, R5, W2, W4, W5}	e. Use the <i>Breed Record Form Rubric (8.2)</i> to evaluate the student mastery.
f. Develop a production management plan for a given animal enterprise. (DOK 4)	f. Introduce the students to the concept of a management plan for an animal enterprise. Define and discuss the major components of a management plan. Divide the class into groups of two to three students, and assign each student a specific animal enterprise. Have the groups use the Internet and other resources to identify components of a management plan related to their enterprise and develop a plan for their animal. ^{CS1, CS2, CS4, T1, T2, T3, T4, T6, R1, R2, R4, R5, W2, W4, W5}	f. Use the <i>Production Management Plan Rubric (8.3)</i> to evaluate student performance on this indicator.

Competency 2: Analyze marketing practices for animals and livestock product. ^{ABS.06}

Suggested Enduring Understandings

1. Meat animals are marketed in a wide variety of ways from sale at local auctions to contract sales to major companies and processors.
2. Companion animals such as dogs and cats are usually sold to the public through local advertising or to major pet store companies.
3. Laboratory animals are usually sold in lots to labs under a contract.

Suggested Essential Questions

1. What practices are used to market meat animals? What are their advantages and limitations?
2. How are companion animals marketed?
3. How are laboratory animals marketed?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe and analyze marketing practices for meat animals (cattle, swine, sheep, etc.). (DOK 1)	a. Prior to teaching this competency, have students read the chapter on Marketing in Agriscience in the text (Cooper & Burton, 2007). Have a livestock buyer or auction operator speak to the class regarding markets and marketing practices for meat animals in the local area. Have students use the <i>Guest Speaker Summary Form (8.4)</i> to record important points regarding local market practices for meat animals. Compare costs of the various marketing methods to determine the most cost efficient method of marketing. CS1, CS2, CS4, T6, W2, W4, W5	a. Use a written test to evaluate student understanding.
b. Describe and analyze marketing practices for companion animals. (DOK 1)	b. Have students visit a local pet store and search for companion animals for sale through the Internet, newspapers, and other local advertising magazines. Ask students to investigate how the price of a dog or cat is determined. Lead a classroom discussion on marketing practices for companion animals. Summarize major points on the LCD projector, and have students enter into their electronic notebooks or journals. CS1, CS2, CS4, T6, W2, W4, W5	b. Use a written test to evaluate student understanding.
c. Describe and analyze marketing practices for laboratory animals. (DOK 1)	c. Have students visit laboratory animal breeding sites on the Internet and collect information on the cost of laboratory animals. Lead a class discussion on laboratory animal marketing practices. Use the LCD projector to summarize major points, and have students record these points in their electronic notebooks or journals. CS1, CS2, CS4, T6, W2, W4, W5	c. Use a written test to evaluate student understanding.

Standards

AFNR Industry Standards

- AS.06. Prepare and implement animal handling procedures for the safety of animals, producers, and consumers of animal products.
- AS.07. Select animal facilities and equipment that provide for the safe and efficient production, housing, and handling of animals
- PST.04. Plan, build, and maintain agricultural structures.

Applied Academic Credit Standards

Biology II

- BIOII 4 Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.

Zoology

- ZO 3 Differentiate among animal life cycles, behaviors, adaptations, and relationships.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
- CS2 Initiative & Self-Direction
- CS4 Productivity & Accountability

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
- T3 Research and Information Fluency
- T4 Critical Thinking, Problem Solving, and Decision Making
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- R2 Supporting Details
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- W2 Focusing on the Topic
- W4 Organizing Ideas
- W5 Using Language

Suggested References

- Bicundo, J., Burris, R., Laurent, K., Akers, J., & Turner L. (n.d.). *Handling beef cattle*. Retrieved June 9, 2010, from <http://www.uky.edu/Ag/AnimalSciences/pubs/kybeefbook03.pdf>
- Burton, L. (2010). *Agriscience fundamentals and applications* (5th ed.). Albany, NY: Delmar.
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- Swine Facilities*. (n.d.). Retrieved June 9, 2010, from <http://www.tifton.uga.edu/eng/handbook/SECTJ.htm>

Science of Agricultural Animals

Unit 9: Companion Animal Care

5 Hours

Competency 1: Examine the types, care, and management of companion and service animals. AS.01, ZO 1, ZO 2

Suggested Enduring Understandings

1. Knowledge of the domestication history and distinguishing characteristics of companion animals are useful when working with the animals.
2. The raising, training, care, and feeding of companion animals offers rewarding careers to qualified individuals and has economic impact on local communities and the nation as a whole.
3. Approved practices for the care, feeding, and breeding of companion animals should be carefully followed.

Suggested Essential Questions

1. What are the distinguishing characteristics of the different types of companion animals?
2. How do companion animals make an economic impact on a community and the nation as a whole?
3. What are some of the approved practices for breeding, raising, feeding, and marketing companion animals?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe the history of domestication and characteristics of companion and service animals. (DOK 2)	a. Introduce this competency by asking students to name their favor pet. Ask them why this pet was their favorite, and lead into a discussion on the benefits that companion animals offer to people. Assign each student a specific breed or type of companion animal, and tell them that they are going to become the class expert on that breed or animal. Students may volunteer to become an expert on a specific animal. Have the students begin their study of the animal by searching for information on the history of the animal, when it was domesticated, and where it came from. Have students find information describing distinguishing characteristics of the animal and its life cycle. Have students summarize their findings in a paragraph. CS1, CS2, CS4, T1, T2, T3, T4, T6, E1, E2, E3, E4, E5, E6, R1, R2, R4, R5, W2, W4, W5	a. Use the <i>Companion Animal Multimedia Presentation Rubric (9.1)</i> to evaluate student mastery.
b. Examine the economic impact of companion and service animals. (DOK 2)	b. Continue the study of companion animals by asking students how much money is spent on their pet every year, including feed, accessories, veterinary care, and so forth. Have students investigate the economic impact of their chosen or assigned animal to include average cost of a young animal, number of	b. Use the <i>Companion Animal Multimedia Presentation Rubric (9.1)</i> to evaluate student

	animals sold each year, and estimated expenses for upkeep of the animal. Have the students summarize their findings in a table to identify the average cost of keeping an animal for 1 year. Point out that the pet industry does affect the economy and offers rewarding careers. CS1, CS2, CS4, T1, T2, T3, T4, T6, E1, E2, E3, E4, E5, E6, R1, R2, R4, R5, W2, W4, W5	mastery.
c. Investigate approved practices in care, feeding, and housing of companion and service animals. (DOK 3)	c. Ask the students to identify different practices that are used in the care, feeding, and housing of their pets. Have them continue to investigate and research approved practices for their assigned or chosen animal, including environmental factors, nutrition and diet, health care practices and concerns, and breeding and birthing practices. Have the students summarize their findings in a fact sheet. Have the students compile their findings into a PowerPoint presentation including representative pictures of male and female, adult and young animals. Have the students deliver their presentations to the class. CS1, CS2, CS4, T1, T2, T3, T4, T6, E1, E2, E3, E4, E5, E6, R1, R2, R4, R5, W2, W4, W5	c. Use the <i>Companion Animal Multimedia Presentation Rubric (9.1)</i> to evaluate student mastery.

Standards

AFNR Industry Standards

- AS.01 Examine the components, historical development, global implications, and future trends of the animal systems industry.

Applied Academic Credit Standards

Zoology

- ZO 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
ZO 2 Develop an understanding of levels of organization and animal classification.

21st Century Learning Standards

- CS1 Flexibility & Adaptability
CS2 Initiative & Self-Direction
CS4 Productivity & Accountability

National Education Technology Standards for Students (NETS)

- T1 Creativity and Innovation
T2 Communication and Collaboration
T3 Research and Information Fluency
T4 Critical Thinking, Problem Solving, and Decision Making
T6 Technology Operations and Concepts

ACT College Readiness Standards

- E1 Topic Development in Terms of Purpose and Focus
E2 Organization, Unity, and Coherence
E3 Word Choice in Terms of Style, Tone, Clarity, and Economy
E4 Sentence Structure and Formation
E5 Conventions of Usage
E6 Conventions of Punctuation
R1 Main Ideas and Author's Approach
R2 Supporting Details
R4 Meaning of Words
R5 Generalizations and Conclusions
W2 Focusing on the Topic
W4 Organizing Ideas
W5 Using Language

Suggested References

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

CEV Video. (n.d.). *CEV pathway: Animal systems pathway* [DVD]. Lubbock, TX: Author.

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

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

Student Competency Profile

Student Name: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Introduction to Animal Agriculture

- _____ 1. Investigate the nature of large animal agriculture and its associated enterprises.
- _____ 2. Examine consumer concerns and their effect on animal production.
- _____ 3. Explore concepts of animal welfare and behavior.

Unit 2: Experiential Learning (SAE)

- _____ 1. Plan and implement an experiential learning program.
- _____ 2. Maintain records and documentation of experiential learning activities, projects, and enterprises.

Unit 3: Animals as Living Organisms

- _____ 1. Examine the characteristics of life and living organisms.
- _____ 2. Examine the anatomy and physiology of animals.
- _____ 3. Investigate the importance of heredity and genetics.

Unit 4: Animal Growth and Nutrition

- _____ 1. Examine the role of nutrition in animal growth at health different life stages.
- _____ 2. Assess the effects of hormones on animal growth.

Unit 5: Animal Reproduction

- _____ 1. Examine the process of fertilization and conception in animal production.
- _____ 2. Examine the reproduction process.
- _____ 3. Examine reproductive methods.

Unit 6: Animal Evaluation

- _____ 1. Evaluation of market animals.
- _____ 2. Investigate the selection of breeding animals.

Unit 7: Production Management

- _____ 1. Examine basic concepts of animal health to include disease prevention, control, and treatment.
- _____ 2. Examine the role of pathogens in animal health to include parasites and plant toxins.

Unit 8: Marketing

- _____ 1. Identify and describe facility and equipment, and develop a production management plan needs for various animal enterprises.
- _____ 2. Analyze marketing practices for animals and livestock product.

Unit 9: Companion Animal Care

- _____ 1. Examine the types, care, and management of companion and service animals.

Appendix A: Suggested Assignments, Rubrics, and Checklists

Name: _____

Date: _____

Period: _____

Breeds of Livestock Assignment (1.1)

Using the Internet and other resources, identify and describe the following breeds of animals.

1. Holstein

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

2. Jersey

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

3. Guernsey

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

4. Hereford

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

5. Angus

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

6. Brahman

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

7. Charolais

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

8. Santa Gertrudis

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

9. Shorthorn

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

10. Texas Longhorn

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

11. American Landrace

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

12. Hampshire

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

13. Duroc

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

14. Poland China

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

15. Suffolk

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

16. Hampshire

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

17. Boer

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

18. Nubian

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

19. Cornish

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

20. White Leghorn

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

21. White Plymouth Rock

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

22. American Quarter Horse

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

23. Arabian

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

24. Standardbred

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

25. Tennessee Walking Horse

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

26.

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

27.

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

28.

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

29.

Country of Origin:		Use/Classification:	
Average Adult Male Size:		Average Adult Female Size:	
Distinguishing Physical Characteristics:			
Strengths:			
Limitations/Weaknesses:			

Name: _____

Date: _____

Period: _____

Animal Welfare Fact Sheet Rubric (1.2)

- | | |
|--|----|
| 1. Statement of the Issue: The fact sheet stated the issues to be addressed in a comprehensive detailed manner. | 25 |
| 2. Animal Rights Concerns: The fact sheet stated the concerns of the animal rights activists in an objective clear manner. | 25 |
| 3. Animal Welfare Response: The fact sheet stated the responses to the concerns in an objective clear manner. | 25 |
| 4. Grammar, Spelling, Punctuation, etc. | 25 |

TOTAL SCORE

100

Name: _____

Date: _____

Period: _____

21st Century Life and Career Skills (1.3)

Today's life and work environments require far more than thinking skills and content knowledge. The ability to navigate the complex life and work environments in the globally competitive information age requires students to pay rigorous attention to developing adequate life and career skills.

CS1 Global Awareness

1. Using 21st century skills to understand and address global issues
2. Learning from and working collaboratively with individuals representing diverse cultures, religions, and lifestyles in a spirit of mutual respect and open dialogue in personal, work, and community contexts
3. Understanding other nations and cultures, including the use of non-English languages

CS2 Financial, Economic, Business, and Entrepreneurial Literacy

1. Knowing how to make appropriate personal economic choices
2. Understanding the role of the economy in society
3. Using entrepreneurial skills to enhance workplace productivity and career options

CS3 Civic Literacy

1. Participating effectively in civic life through knowing how to stay informed and understanding governmental processes
2. Exercising the rights and obligations of citizenship at local, state, national, and global levels
3. Understanding the local and global implications of civic decisions

CS4 Health Literacy

1. Obtaining, interpreting, and understanding basic health information and services and using such information and services in ways that enhance health
2. Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance, and stress reduction
3. Using available information to make appropriate health-related decisions
4. Establishing and monitoring personal and family health goals
5. Understanding national and international public health and safety issues

CS5 Environmental Literacy

1. Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water, and ecosystems.
2. Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.).
3. Investigate and analyze environmental issues, and make accurate conclusions about effective solutions.
4. Take individual and collective action towards addressing environmental challenges (e.g., participating in global actions, designing solutions that inspire action on environmental issues).

CSS2-Learning and Innovation Skills

CS6 Creativity and Innovation

1. Think Creatively

2. Work Creatively with Others
3. Implement Innovations

CS7 Critical Thinking and Problem Solving

1. Reason Effectively
2. Use Systems Thinking
3. Make Judgments and Decisions
4. Solve Problems

CS8 Communication and Collaboration

1. Communicate Clearly
2. Collaborate with Others

CSS3-Information, Media and Technology Skills

CS9 Information Literacy

1. Access and Evaluate Information
2. Use and Manage Information

CS10 Media Literacy

1. Analyze Media
2. Create Media Products

CS11 ICT Literacy

1. Apply Technology Effectively

CSS4-Life and Career Skills

CS12 Flexibility and Adaptability

1. Adapt to change
2. Be Flexible

CS13 Initiative and Self-Direction

1. Manage Goals and Time
2. Work Independently
3. Be Self-directed Learners

CS14 Social and Cross-Cultural Skills

1. Interact Effectively with others
2. Work Effectively in Diverse Teams

CS15 Productivity and Accountability

1. Manage Projects
2. Produce Results

CS16 Leadership and Responsibility

1. Guide and Lead Others
2. Be Responsible to Others

Name: _____

Date: _____

Period: _____

21st Century Life and Career Skills Rubric (1.4)

The following scale can be used to assess application of each of the Life and Career Skills of students.

Superior	(18–20 points) The student consistently demonstrates all aspects of this skill in classroom and laboratory activities.
Exceptional	(15–17 points) The student consistently demonstrates most of the aspects of this skills in classroom and laboratory activities but lapses at times on one to two of the indicators.
Adequate	(12–14 points) The students demonstrates knowledge of the skill during classroom and laboratory activities but lapses on three or more indicators from time to time.
Improving	(9–11 points) The student is vaguely aware of the skill but shows only marginal evidence of being able to apply it in the classroom or laboratory.
Minimal	(0–8 points) The student consistently fails to demonstrate knowledge or application of the skill.

**Flexibility and
Adaptability**

**Initiative & Self-
Direction**

**Social & Cross-Cultural
Skills**

**Productivity &
Accountability**

**Leadership &
Responsibility**

TOTAL SCORE

Name: _____

Date: _____

Period: _____

PowerPoint Presentation on Animal Careers Rubric (1.5)

Content	Provided detailed information on skills required, education and training, salaries and benefits, and occupational outlook	Provided general information on skills required, education and training, salaries and benefits, and occupational outlook	Provided limited information on skills required, education and training, salaries and benefits, and occupational outlook	Did not provide information on all required topics
Accuracy and Reliability	All information was accurate and reliable.	All information was generally accurate and reliable.	All information was generally accurate and somewhat reliable.	Information was inaccurate and/or unreliable.
References	Cited four or more references	Cited three references	Cited two references	Cited only one reference
Grammar, Spelling, Punctuation, etc.	No mistakes	One to two minor mistakes	Three to four minor mistakes or one major error	More than four minor mistakes or two or more major errors
Visual Aids	Attractive, accurate, and grammatically correct	Adequate, mostly accurate, and few grammatical errors	Poorly planned, somewhat accurate, and some grammatical errors	Weak, inaccurate, and many grammatical errors
Length	Appropriate length	Slightly too long or short	Moderately too long or short	Extremely too long or short
TOTAL				

Comments:

Name: _____

Date: _____

Period: _____

Taxonomy of Common Domestic Animals Assignment (1.6)

Taxonomy of Common Domestic Animals

Identify the class, order, family, genus, and species of each of the following domestic animals:

Hereford

Cattle

Leghorn

Chickens

Brahman

Cattle

Quarter

Horses

Border Collie

Dogs

Persian Cats

Landrace Hogs

Canaries

Dorset Sheep

Name: _____

Date: _____

Period: _____

Rubric for Experiential Learning Planning and Record Keeping (2.1)

Scoring Criteria				
	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Long-range and short-term goals reflect the educational and career goals of the student.				
The SAE plan/training agreement reflects growth in student skill and proficiency.				
Records accurately reflect all SAE accomplishments of the student over the year.				
Records are maintained on a timely basis.				
Journals or calendars are maintained on a timely basis and serve as the source for record keeping.				
Hours and earnings are recorded based on activities.				
A summary of all activities is provided at the end of each grading period.				
Financial records are maintained accurately.				
Financial records are summarized at the end of the year.				

Name: _____

Date: _____

Period: _____

Common Life Processes (3.1)

Digestion

Respiration

Growth

Movement

Excretion

Reproduction

Sensitivity

How are life processes related to each other in a normal, healthy animal?

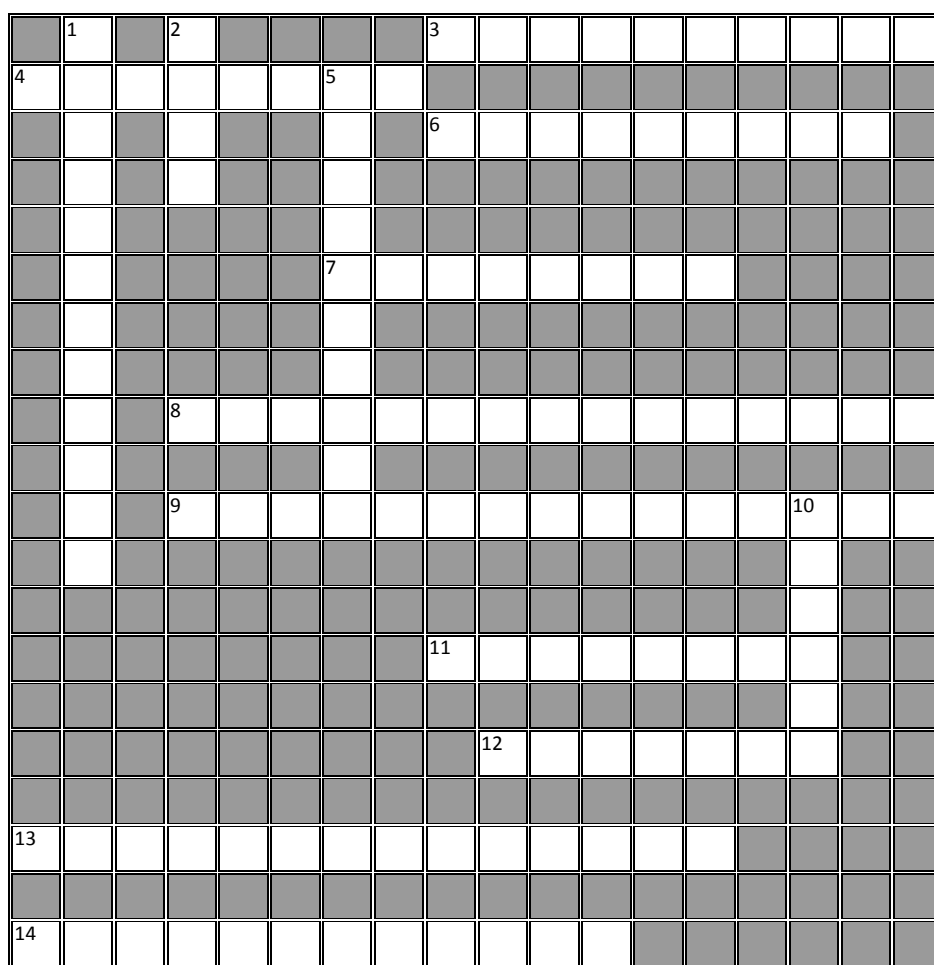
What would happen to an animal if one of the life processes failed?

Name: _____

Date: _____

Period: _____

Genetics and Heredity Crossword Puzzle (3.2)



- | | |
|--|---|
| 3. A pair of genes that call for a specific characteristic that is identical | 1. The portion of differences in animals that is transmitted from parent to offspring |
| 4. The science that deals with the processes of inheritance | 2. The basic unit of inheritance |
| 6. The observable characteristics of an animal | 5. A linear arrangement of genes |
| 7. An accident of heredity where an animal has different characteristics from what the genetic code intended | 10. An alternative form of a gene |
| 8. A gene that is neither dominant nor recessive | |
| 9. A distinguishing characteristic that is passed from parent to offspring | |
| 11. The genetic makeup of the animal | |
| 12. An animal reproductive cell (sperm or egg) | |
| 13. A gene that is masked by the characteristics of another gene | |

Name: _____

Date: _____

Period: _____

Genetic Engineering Essay Rubric (3.3)

Content	Covers all major points in detail	Covers most major points in general	Covers some major points	Does not cover major points
Grammar	Correct and effective use of grammar and mechanics	Occasional errors in use of grammar and mechanics	Problems in use of grammar and mechanics	Repeated errors in use of grammar and mechanics
Organization	Ideas flow smoothly and logically with clarity and coherence	Logical order and appropriate sequencing of ideas with adequate transition	Some evidence of an organizational plan or strategy	Lacks organization
TOTAL				

Name: _____

Date: _____

Period: _____

Nutritional Informational Booklet Rubric (4.1)

Title Page	The booklet has a creative, easy to understand, and relevant title page.	The booklet has a creative and relevant title page.	The booklet has a relevant title page.	The booklet has a cover page with very little information.
Required Content	The booklet includes information on all six essential nutrients as well as additional information.	All six essential nutrients are included on the booklet.	All but one of the required essential nutrients are included in the booklet.	Several required content elements were missing.
Photographs or Graphics	All six essential nutrient informational pages included a photo or graphic.	Five of the six essential nutrient informational pages included a photo or graphic.	Four of the six essential elements had a graphic or photograph.	Only one or none of the pages included a graphic.
Attractiveness	The booklet is exceptionally attractive in terms of design, layout, and neatness.	The booklet is attractive in terms of design, layout, and neatness.	The booklet is acceptably attractive though it may be a bit messy.	The booklet is distractingly messy or very poorly designed.
Grammar	There are no grammatical or mechanical mistakes in the booklet.	There are one to two grammatical or mechanical mistakes in the booklet.	There are three to four grammatical or mechanical mistakes in the booklet.	There are more than four grammatical or mechanical mistakes in the booklet.

Name:

Date:

Period:

Oral Presentation on Animal Rations Rubric (4.2)

Assign groups of two to three students to determine nutritional requirements for a specific animal, and then use nutritional tables to determine a ration. Instruct students to balance the ratio using the Pearson square method. Instruct the groups to make an oral presentation to show the class the assigned animal's ration.

Content	Clear, appropriate, and correct information was presented on the assigned animal's nutritional needs.	Mostly clear, appropriate, and correct information was presented on the assigned animal's nutritional needs.	Somewhat confusing, incorrect, or flawed information was presented on the assigned animal's nutritional needs.	Confusing, incorrect, or flawed information was presented on the assigned animal's nutritional needs.
Clarity on Balancing the Ration	Logical, interesting sequence of information was used in balancing the ration.	Logical sequence of information was used in balancing the ration.	Unclear sequence of information was used in balancing the ration.	No sequence of information was used in balancing the ration.
Presentation	Clear voice and precise pronunciation	Clear voice and mostly correct pronunciation	Low voice and incorrect pronunciation	Mumbling and incorrect pronunciation
Visual Aids	Attractive, accurate, and grammatically correct	Adequate, mostly accurate, and few grammatical errors	Poorly planned, somewhat accurate, and some grammatical errors	Weak, inaccurate, and many grammatical errors
Eye Contact	Maintains eye contact, seldom looking at notes	Maintains eye contact most of time but frequently returns to notes	Occasionally uses eye contact but reads most of information	No eye contact because reading information
				TOTAL

Name: _____
Date: _____
Period: _____

Grading Checklist for Digestive System Diagrams (4.3)

- | | |
|---|----|
| 1. The ruminant digestive system diagram was properly labeled. | 20 |
| 2. The monogastric digestive system was properly labeled. | 20 |
| 3. The avian, or chicken, digestive system was properly labeled. | 20 |
| 4. A list of at least five similarities between the various types was made. | 20 |
| 5. A list of at least five differences between the various types was made. | 20 |

TOTAL SCORE	100
--------------------	------------

Name: _____

Date: _____

Period: _____

Water Advertisement Grading Rubric (4.4)

The brochure did the following:	Excellent	Good	Needs Improvement	Unacceptable
	4	3	2	1
Featured an attractive design that included color and graphics				
Highlighted the advantages of the water source in a clear concise manner				
Compared the water source to other water sources in a manner that clearly showed its superiority				
Used appropriate language, sentence structure, grammar, and spelling				
Contained facts and figures that were accurate and reliable				
Listed references for more information				

Notes:

Name: _____

Date: _____

Period: _____

Feed Conversion Worksheet (4.5)

Given the following information, calculate the feed conversion ratio for each animal.

1. A steer weights 240 lb when placed in a feedlot. If the animal eats 6,500 lb of feedstuffs and is sold at a weight of 1,050 lb, what would the feed conversion ratio be?

2. If it takes 15 lb of feed to grow a 1-day-old chick into a 6 ½-lb broiler, what is the feed conversion ratio? (Assume the chick weight is not significant.)

3. Feeder pigs are usually weaned when they are around 50 lb in weight and sold for slaughter at 220 lb. If it takes 630 lb of feed to grow each pig, what is the feed conversion ratio?

4. Catfish are usually stocked as fingerlings. If 10-in. fingerlings weigh approximately ¼ lb each and it takes 2 lb of feed to grow them to 1 ½-lb market fish, what is the feed conversion ratio?

5. If a 50-lb feeder lamb requires 625 lb of feed to reach a market weight of 125 lb, what is the feed conversion ratio?

Given the following information, calculate the amount of feed that will be needed to do the following.

1. Feed 100 head of feeder cattle from an average weight of 400 lb to an average weight of 1,000 lb if the feed conversion ratio is 8.3 : 1.

2. Feed 3,000 1-day-old chicks to a weight of 6 lb each if the feed conversion ratio is 2.2 : 1.

Name: _____

Date: _____

Period: _____

Animal Nutrition PowerPoint Rubric (4.6)

	4 points	3 points	2 points	1 point
Content	All six topics were addressed in the presentation with additional detail and information.	All six topics were addressed in the presentation.	Somewhat confusing, incorrect, or flawed. Did not address all of the topics very effectively	Confusing, incorrect, or flawed. Did not address the assigned topic at all
Clarity	Logical, interesting sequence was followed.	Logical sequence was followed.	Unclear sequence	No sequence at all
Presentation	Clear voice and precise pronunciation	Clear voice and mostly correct pronunciation	Low voice and incorrect pronunciation	Mumbling and incorrect pronunciation
Visual Aids	Attractive, accurate, grammatically correct, included photos or graphics in all slides	Adequate, mostly accurate, few grammatical errors, included photos or graphics in most of the slides	Poorly planned, somewhat accurate, some grammatical errors, very few photos or graphics added	Weak, inaccurate, many grammatical error, little or no photos or graphics
Length	Appropriate length	Slightly too long or short	Moderately too long or short	Extremely too long or short
Participation	Well-balanced participation by all group members	All group members have significant participation.	Most group members participate.	One main speaker with little participation from other group members
Total Score:				

Name: _____

Date: _____

Period: _____

Consumer Issues Article Rubric (4.7)

The student does the following:	Excellent	Good	Needs Improvement	Unacceptable
	4	3	2	1
Accurately summarizes the main point of the article				
Provides interesting, supportive, and complete statements				
Demonstrates that the writer comprehends the topic of the article				
Uses accurate spelling				
Uses correct grammar				
Demonstrates proper punctuation				
Prepares paragraphs that emphasize appropriate points				
Demonstrates correct sentence structure				
Demonstrates correct paragraphing				
Documents sources and references clearly and accurately				
Total Score:				

Name: _____

Date: _____

Period: _____

Grading Checklist for Lists of Vitamins and Minerals (4.8)

- | | |
|--|----|
| 1. The list of minerals necessary for animal growth and development was complete and each mineral was labeled as macro or micro. | 25 |
| 2. The effects of surpluses and deficiencies of each mineral were identified. | 15 |
| 3. The source of each major mineral is listed. | 10 |
| 4. A complete list of vitamins was provided, and each was labeled fat soluble or water soluble. | 25 |
| 5. Common sources of each vitamin were listed. | 10 |
| 6. The list of vitamins included how each aided in the growth and development of animals. | 15 |

TOTAL SCORE	100
--------------------	------------

Name: _____

Date: _____

Period: _____

Artificial Insemination Report Rubric (5.1)

Topic	Very detailed information was given on artificial insemination for the given animal.	Detailed information was given on artificial insemination for the assigned animal.	General information was provided on artificial insemination.	Limited information was provided.
Content	Clear thesis and focus that remains apparent; all required information was present.	Thesis and focus remain apparent; most of the required information was included.	It addresses subject matter with minimal support; some of the required information was included.	Does not focus on topic; required information was not included.
Grammar	Correct and effective use of grammar and mechanics	Occasional errors in use of grammar and mechanics	Problems in use of grammar and mechanics	Repeated errors in use of grammar and mechanics
Organization	Ideas flow smoothly and logically with clarity and coherence.	Logical order and appropriate sequencing of ideas with adequate transition	Some evidence of an organizational plan or strategy	Lacks organization
Total Score:				

Name: _____

Date: _____

Period: _____

Semen Collection and Processing Procedures Report Rubric (5.2)

Content	All major procedures were described in accurate detail.	All major procedures were described in general.	Most major procedures were addressed.	Several major features were not included in the report.
Grammar	Correct and effective use of grammar and mechanics	Occasional errors in use of grammar and mechanics	Problems in use of grammar and mechanics	Repeated errors in use of grammar and mechanics
Organization	Ideas flow smoothly and logically with clarity and coherence.	Logical order and appropriate sequencing of ideas with adequate transition	Some evidence of an organizational plan or strategy	Lacks organization
Total Score:				

Name: _____

Date: _____

Period: _____

Multimedia Presentation Assessment (5.3)

Content	Clear, appropriate, and correct	Mostly clear, appropriate, and correct	Somewhat confusing, incorrect, or flawed	Confusing, incorrect, or flawed
Clarity	Logical, interesting sequence	Logical sequence	Unclear sequence	No sequence
Presentation	Clear voice and precise pronunciation	Clear voice and mostly correct pronunciation	Low voice and incorrect pronunciation	Mumbling and incorrect pronunciation
Visual Aids	Attractive, accurate, grammatically correct	Adequate, mostly accurate, few grammatical errors	Poorly planned, somewhat accurate, some grammatical errors	Weak, inaccurate, many grammatical errors
Length	Appropriate length	Slightly too long or short	Moderately too long or short	Extremely too long or short
Participation	Well-balanced participation by all group members	All group members have significant participation	Most group members participate	One main speaker with little participation from other group members
Eye Contact	Maintains eye contact, seldom looking at notes	Maintains eye contact most of time but frequently returns to notes	Occasionally uses eye contact but reads most of information	No eye contact because reading information
Total Score:				

Name: _____

Date: _____

Period: _____

Poultry Hatchery Rubric and Incubator Data Chart (5.4)

Rate the student's ability to perform the following welding procedures using the following scale:

4– Can perform consistently and accurately without need of any supervision or direction

3– Can perform consistently and accurately with minimum supervision or direction

2–Can perform consistently and accurately with moderate supervision or direction

1–Cannot perform consistently or accurately without direct supervision

- _____ 1. Student cleaned and prepared incubator for hatching.
- _____ 2. Student set temperature and humidity controls to recommended setting and verified that readings were accurate.
- _____ 3. Student inspected eggs for cracks or other defects and placed eggs in the incubator in the correct position.
- _____ 4. Student checked eggs during the incubation process using an egg candler and removed eggs that were not showing normal embryo development. Eggs were turned either manually or automatically three to five times each day.
- _____ 5. As chicks hatched, they were removed from the incubator when they were dry and placed in a brooder or other cage and kept at the recommended temperature.
- _____ 6. Student checked chicks daily and provided feed and water beginning 48 hr after hatching.

Incubator Data Chart

Day	Date	Turner Works ¹			Temperature		Wet Bulb	Water Checked	Candling	Remarks
		1	2	3	Room	Incubator				
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19		XXX	XXX	XXX						
20		XXX	XXX	XXX						
21		XXX	XXX	XXX						

¹Check egg turner at least three times a day except days 19–21.

Name: _____

Date: _____

Period: _____

Catfish Fry Management Rubric and Data Sheet (5.5)

Rate the student's ability to perform the following welding procedures using the following scale:

4– Can perform consistently and accurately without need of any supervision or direction

3– Can perform consistently and accurately with minimum supervision or direction

2–Can perform consistently and accurately with moderate supervision or direction

1–Cannot perform consistently or accurately without direct supervision

- _____ 1. Student checked water temperature and made adjustments to maintain a temperature of 78° - 82°F.
- _____ 2. Student checked water pH and made adjustments to maintain a pH of 7.0 or higher.
- _____ 3. Student checked dissolved oxygen level of water and made adjustments to maintain a level of 4.0 ppm or higher.
- _____ 4. Student checked salinity level of water and made adjustments to maintain a level of less than 0.5 ppm.
- _____ 5. Student checked calcium hardness level of the water and made adjustments to maintain a level of at least 5 ppm.
- _____ 6. Student checked ammonium level of water and made adjustments to maintain a level of less than 0.05 ppm.
- _____ 7. Student feed the fry as per the assigned schedule.
- _____ 8. Student maintained the aquarium and its accessories as per posted procedures.

Catfish Fry Data Chart

Day	Date	Temp.	Ph	DO	Salinity	Hard- ness	Ammonium	Feeding	Tank Maint.	Remarks
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19		XXX	XXX	XXX						
20		XXX	XXX	XXX						
21		XXX	XXX	XXX						

Name: _____

Date: _____

Period: _____

Livestock Placing and Oral Reasons Rubric (6.1)

Placing	Placed all animals in the correct order (50 pts)	Placed three of the four animals in the correct order (40 pts)	Placed two of the four animals in the correct order (20 pts)	Placed only one of the four animals in the correct order (10 pts)
Oral Reasons Accuracy	All statements were correct. (10 pts)	Only one or two inaccurate statements were made. (7 pts)	Three to four inaccurate statements were made. (4 pts)	Five or more inaccurate statements were made. (1 pt)
Completeness	All major differences among the animals were presented. (10 pts)	One or two major differences were not presented. (7 pts)	Three or four major differences were not presented. (4 pts)	Five or more major differences were not presented. (1 pt)
Presentation and Delivery	Reasons were logical, voice was clear and strong, and correct grammar was used. (10 pts)	Reasons were logical, but voice and grammar could have been better. (7 pts)	Reasons were mostly logical, and voice and grammar were weak. (4 pts)	Reasons were not logical; voice and grammar were very weak. (1 pt)
Length	The presentation took 2–2½ min. (10 pts)	The presentation took 1½–2 min or 2½ - 3 min. (7 pts)	The presentation took ½–1½ min or 3–3½ min. (4 pts)	The presentation took less than 30 sec or more than 3½ min. (1 pt)
Terminology	Correct terminology was used throughout the presentation. (10 pts)	One or two incorrect terms were used in the presentation. (7 pts)	Three or four incorrect terms were used in the presentation. (4 pts)	Five or more incorrect terms were used in the presentation. (1 pts)
TOTAL				

Name: _____

Date: _____

Period: _____

Animal Health Plan Rubric (7.1)

Described characteristics of a healthy animal	15
Described procedures for evaluating health of new animals brought into the enterprise	15
Described procedures for maintaining sanitation and environmental conditions for optimum health	15
Described a vaccination schedule	15
Described procedures for treating and controlling parasites	15
Described procedures for isolating and treating animals that appear to be unhealthy	15
Used proper grammar, vocabulary, punctuation, etc.	10
TOTAL SCORE	100

Name: _____

Date: _____

Period: _____

White Blood Cells Assignment (7.2)

Watch the video *White Blood Cells*, and answer the following questions:

1. What are leucocytes, and what function do they perform within the blood?
2. What are lymphocytes, and what function do they perform within the blood?
3. What is an antigen, and what function does it perform within the blood?
4. Where are most blood cells created?
5. What is a T-cell, and how does it function within the blood?

Name: _____
Date: _____
Period: _____

Guest Speaker Summary Form (7.3)

Name of Speaker: _____

1. List five main ideas expressed in the presentation.

1. _____
2. _____
3. _____
4. _____
5. _____

2. Write a brief summary relating the topics of the presentation to your life.

Name: _____

Date: _____

Period: _____

Animal Facility Plan Rubric (8.1)

Design	The overall design of the facility shows great detail related to the natural behavior of the animal to be housed.	The overall design of the facility shows moderate detail related to the natural behavior of the animal.	The overall design of the facility shows some detail related to the natural behavior of the animal.	The overall design of the facility shows limited detail related to the natural behavior of the animal.
Pens and Cages	Pens and cages for the facility are appropriately sized and constructed of high-quality materials to protect animals and workers.	Pens and cages for the facility are appropriately sized and constructed of materials that should protect animals and workers.	Pens and cages for the facility are somewhat appropriate in size and constructed of materials that should protect animals and workers.	Pens and cages for the facility are not appropriate in size and/or not constructed of materials that should protect animals and workers.
Other Equipment	Other equipment and accessories (watering and feed troughs, squeezes and restraining devices, lighting, heating, ventilation, etc.) are sufficient for the animals to be handled and placed for efficient use.	Other equipment and accessories are somewhat sufficient for the animals to be handled and placed for efficient use.	Other equipment and accessories are limited for the animals to be handled and placed for efficient use.	Other equipment is not sufficient for the animals to be handled and/or not efficiently placed.
Written Description	The written description of the facility is highly detailed and provides a detailed list of all materials and equipment needed.	The written description of the facility provides is general in nature and provides a detailed list of almost all materials and equipment needed.	The written description of the facility is limited in detail and provides a partial list of all materials and equipment needed.	The written description of the facility is very limited and the detailed list of all materials and equipment needed is very brief or inadequate.
Drawing	The drawing is neat and to scale and provides a clear illustration of the total facility layout.	The drawing is neat and provides a good illustration of the total facility layout. No scale is provided.	The drawing provides a limited illustration of the total facility layout.	The drawing does not match the written description.
TOTAL				

Name: _____

Date: _____

Period: _____

Breeding Record Form Rubric (8.2)

1. The form provides means for entering information and pictures that positively identify the animal or group of animals (poultry) (breed, gender, birth date, color, identification number/tattoo, breed registration number picture, etc.).	15
2. The form provides means for entering the pedigree (ancestrage) of the animal.	15
3. The form provides means for entering production records on the animal (growth rate, offspring, milk production, egg production, etc.).	15
4. The form provides means for entering health information about the animal (vaccinations, diseases, treatments, injuries, etc.).	15
5. The form provides a calendar for recording and planning activities in the animal's life (weaning date, breeding dates, delivery dates, etc.).	15
6. The form provides a means for entering income received and expenses incurred for the animal (sales of offspring or products, feed expenses, health expenses, overhead expenses, etc.).	15
7. The form is free from grammatical errors and is designed in a user-friendly manner.	10
TOTAL SCORE	100

Name: _____

Date: _____

Period: _____

Animal Enterprise Production Management Plan Rubric (8.3)

1. The plan clearly defines production goals for the enterprises.	15
2. The plan clearly identifies equipment, facilities, land, and other resources that will be needed to conduct the enterprise.	15
3. The plan includes a calendar of production related activities that must be performed.	20
4. The plan includes an estimated income and expense budget for the enterprise.	20
5. The plan includes details on how products from the enterprise will be marketed.	15
6. The plan is free of grammatical errors.	15
TOTAL SCORE	100

Name: _____
Date: _____
Period: _____

Guest Speaker Summary Form (8.4)

Name of Speaker: _____

1. List five main ideas expressed in the presentation.

1. _____
2. _____
3. _____
4. _____
5. _____

2. Write a brief summary relating the topics of the presentation to your life.

Name: _____

Date: _____

Period: _____

Companion Animal Multimedia Presentation Rubric (9.1)

History and Characteristics	Described the history of the animal, its origin, distinguishing characteristics and life cycle in detail (50 pts)	Described the history of the animal, its origin, distinguishing characteristics and life cycle in moderate detail (40 pts)	Described the history of the animal, its origin, distinguishing characteristics and life cycle in general (20 pts)	Described the history of the animal, its origin, distinguishing characteristics and life cycle in limited detail (10 pts)
Economic Impact	Provided specific details based on documented research (10 pts)	Provided general details based on limited research (7 pts)	Provided brief details based on research (4 pts)	Provided limited details without citing sources (1 pt)
Approved Practices	Provided specific details on all major approved practices (10 pts)	Provided specific details on most approved practices (7 pts)	Provided general details on most approved practices (4 pts)	Provided limited or no details on most practices (1 pt)
Presentation and Delivery	Presentation was clear, interesting, and informative. Graphics and slides captured all major points. (10 pts)	Presentation was clear, interesting, and informative. Graphics and slides captured most major points. (7 pts)	Presentation was unclear on some points. Graphics and slides were omitted on some points. (4 pts)	Presentation was not well organized and unclear. Graphics and slides were insufficient for support. (1 pt)
Sources	At least five valid and reliable sources were cited. (10 pts)	At least four valid and reliable sources were cited. (7 pts)	At least three valid and reliable sources were cited. (4 pts)	Less than three sources were cited, or some sources could not be determined to be valid and reliable. (1 pt)
Grammar, Spelling, Syntax, etc.	No errors were present. (10 pts)	One or two minor errors were present. (7 pts)	One major error and/or three to four minor errors were present. (4 pts)	More than one major error or more than four minor errors were present. (1 pt)
				TOTAL

Appendix B: 21st Century Skills Standards

CSS1-21st Century Themes

CS1 Global Awareness

1. Using 21st century skills to understand and address global issues
2. Learning from and working collaboratively with individuals representing diverse cultures, religions, and lifestyles in a spirit of mutual respect and open dialogue in personal, work, and community contexts
3. Understanding other nations and cultures, including the use of non-English languages

CS2 Financial, Economic, Business and Entrepreneurial Literacy

1. Knowing how to make appropriate personal economic choices
2. Understanding the role of the economy in society
3. Using entrepreneurial skills to enhance workplace productivity and career options

CS3 Civic Literacy

1. Participating effectively in civic life through knowing how to stay informed and understanding governmental processes
2. Exercising the rights and obligations of citizenship at local, state, national, and global levels
3. Understanding the local and global implications of civic decisions

CS4 Health Literacy

1. Obtaining, interpreting, and understanding basic health information and services and using such information and services in ways that enhance health
2. Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance, and stress reduction
3. Using available information to make appropriate health-related decisions
4. Establishing and monitoring personal and family health goals
5. Understanding national and international public health and safety issues

CS5 Environmental Literacy

1. Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water, and ecosystems
2. Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.)
3. Investigate and analyze environmental issues, and make accurate conclusions about effective solutions
4. Take individual and collective action towards addressing environmental challenges (e.g., participating in global actions, designing solutions that inspire action on environmental issues)

CSS2-Learning and Innovation Skills

CS6 Creativity and Innovation

1. Think Creatively
2. Work Creatively with Others
3. Implement Innovations

CS7 Critical Thinking and Problem Solving

1. Reason Effectively
2. Use Systems Thinking
3. Make Judgments and Decisions
4. Solve Problems

CS8 Communication and Collaboration

1. Communicate Clearly
2. Collaborate with Others

CSS3-Information, Media and Technology Skills

CS9 Information Literacy

1. Access and Evaluate Information
2. Use and Manage Information

CS10 Media Literacy

1. Analyze Media
2. Create Media Products

CS11 ICT Literacy

1. Apply Technology Effectively

CSS4-Life and Career Skills

CS12 Flexibility and Adaptability

1. Adapt to change
2. Be Flexible

CS13 Initiative and Self-Direction

1. Manage Goals and Time
2. Work Independently
3. Be Self-directed Learners

CS14 Social and Cross-Cultural Skills

1. Interact Effectively with others
2. Work Effectively in Diverse Teams

CS15 Productivity and Accountability

1. Manage Projects
2. Produce Results

CS16 Leadership and Responsibility

1. Guide and Lead Others
2. Be Responsible to Others

Appendix C: MS Academic Standards

MISSISSIPPI SCIENCE FRAMEWORK COMPETENCIES

Marine and Aquatic Science

AQ 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
AQ 2	Develop an understanding of physical and chemical properties of water and aquatic environments.
AQ 3	Apply an understanding of the diverse organisms found in aquatic environments.
AQ 4	Draw conclusions about the relationships between human activity and aquatic organisms.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Formulate questions that can be answered through research and experimental design. (DOK 3)
- c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
- f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
- g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. **Develop an understanding of physical and chemical properties of water and aquatic environments.**

- a. Analyze the physical and chemical properties of water, and justify why it is essential to living organisms. (DOK 1)
- b. Explain the causes and characteristics of tides. (DOK 1)
- c. Research, create diagrams, and summarize principles related to waves and current characteristics and formation. (DOK 2)
- d. Compare and contrast the physical and chemical parameters of dissolved O₂, pH, temperature, salinity, and results obtained through analysis of different water column depths/zones. (DOK 2)
- e. Investigate the causes and effects of erosion and discuss conclusions. (DOK 2)
- f. Describe and differentiate among the major geologic features of specific aquatic environments. (DOK 1)
 - Plate tectonics
 - Rise, slope, elevation, and depth
 - Formation of dunes, reefs, barrier/volcanic islands, and coastal/flood plains
 - Watershed formation as it relates to bodies of freshwater
- g. Compare and contrast the unique abiotic and biotic characteristics of selected aquatic ecosystems. (DOK 2)
 - Barrier island, coral reef, tidal pool, and ocean
 - River, stream, lake, pond, and swamp
 - Bay, sound, estuary, and marsh

3. **Apply an understanding of the diverse organisms found in aquatic environments.**

- a. Analyze and explain the diversity and interactions among aquatic life. (DOK 3)
 - Adaptations of representative organisms for their aquatic environments

- Relationship of organisms in food chains/webs within aquatic environments
- b. Research, calculate, and interpret population data. (DOK 2)
- c. Research and compare reproductive processes in aquatic organisms. (DOK 2)
- d. Differentiate among characteristics of planktonic, nektonic, and benthic organisms. (DOK 1)
- e. Explore the taxonomy of aquatic organisms, and use dichotomous keys to differentiate among the organisms. (DOK 2)
- f. Research and explain the symbiotic relationships in aquatic ecosystems. (DOK 3)
- 4. **Draw conclusions about the relationships between human activity and aquatic organisms.**
 - a. Describe the impact of natural and human activity on aquatic ecosystems, and evaluate the effectiveness of various solutions to environmental problems. (DOK 3)
 - Sources of pollution in aquatic environments and methods to reduce the effects of the pollution
 - Effectiveness of a variety of methods of environmental management and stewardship
 - Effects of urbanization on aquatic ecosystems and the effects of continued expansion
 - b. Research and cite evidence of the effects of natural phenomena such as hurricanes, floods, or drought on aquatic habitats and organisms. (DOK 3)
 - c. Discuss the advantages and disadvantages involved in applications of modern technology in aquatic science. (DOK 2)
 - Careers related to aquatic science
 - Modern technology within aquatic science (e.g., mariculture and aquaculture)
 - Contributions of aquatic technology to industry and government

Biology I

BI0I 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BI0I 2	Describe the biochemical basis of life, and explain how energy flows within and between the living systems.
BI0I 3	Investigate and evaluate the interaction between living organisms and their environment.
BI0I 4	Analyze and explain the structures and function of the levels of biological organization.
BI0I 5	Demonstrate an understanding of the molecular basis of heredity.
BI0I 6	Demonstrate an understanding of principles that explain the diversity of life and biological evolution.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
 - a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
 - d. Formulate questions that can be answered through research and experimental design. (DOK 3)
 - e. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 2)
 - f. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
 - g. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - h. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
 - i. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. Describe the biochemical basis of life, and explain how energy flows within and between the living systems.

- a. Explain and compare with the use of examples the types of bond formation (e.g., covalent, ionic, hydrogen, etc.) between or among atoms. (DOK 2)
 - Subatomic particles and arrangement in atoms
 - Importance of ions in biological processes
- b. Develop a logical argument defending water as an essential component of living systems (e.g., unique bonding and properties including polarity, high specific heat, surface tension, hydrogen bonding, adhesion, cohesion, and expansion upon freezing). (DOK 2)
- c. Classify solutions as acidic, basic, or neutral, and relate the significance of the pH scale to an organism's survival (e.g., consequences of having different concentrations of hydrogen and hydroxide ions). (DOK 2)
- d. Compare and contrast the structure, properties, and principle functions of carbohydrates, lipids, proteins, and nucleic acids in living organisms. (DOK 2)
 - Basic chemical composition of each group
 - Building components of each group (e.g., amino acids, monosaccharides, nucleotides, etc.)
 - Basic functions (e.g., energy, storage, cellular, heredity) of each group
- e. Examine the life processes to conclude the role enzymes play in regulating biochemical reactions. (DOK 2)
 - Enzyme structure
 - Enzyme function, including enzyme-substrate specificity and factors that affect enzyme function (pH and temperature)
- f. Describe the role of adenosine triphosphate (ATP) in making energy available to cells. (DOK 1)
 - ATP structure
 - ATP function
- g. Analyze and explain the biochemical process of photosynthesis and cellular respiration, and draw conclusions about the roles of the reactant and products in each. (DOK 3)
 - Photosynthesis and respiration (reactants and products)
 - Light-dependent reactions and light independent reactions in photosynthesis, including requirements and products of each
 - Aerobic and anaerobic processes in cellular respiration, including products each and energy differences

3. Investigate and evaluate the interaction between living organisms and their environment.

- a. Compare and contrast the characteristics of the world's major biomes (e.g., deserts, tundra, taiga, grassland, temperate forest, tropical rainforest). (DOK 2)
 - Plant and animal species
 - Climate (temperature and rainfall)
 - Adaptations of organisms
- b. Provide examples to justify the interdependence among environmental elements. (DOK 2)
 - Biotic and abiotic factors in an ecosystem (e.g., water, carbon, oxygen, mold, leaves)
 - Energy flow in ecosystems (e.g., energy pyramids and photosynthetic organisms to herbivores, carnivores, and decomposers)
 - Roles of beneficial bacteria
 - Interrelationships of organisms (e.g., cooperation, predation, parasitism, commensalism, symbiosis, and mutualism)
- c. Examine and evaluate the significance of natural events and human activities on major ecosystems (e.g., succession, population growth, technology, loss of genetic diversity, consumption of resources). (DOK 2)

4. Analyze and explain the structures and function of the levels of biological organization.

- a. Differentiate among plant and animal cells and eukaryotic and prokaryotic cells. (DOK 2)
 - Functions of all major cell organelles and structures (e.g., nucleus, mitochondrion, rough ER, smooth ER, ribosomes, Golgi bodies, vesicles, lysosomes, vacuoles, microtubules,

- microfilaments, chloroplast, cytoskeleton, centrioles, nucleolus, chromosomes, nuclear membrane, cell wall, cell membrane [active and passive transport], cytosol)
 - Components of mobility (e.g., cilia, flagella, pseudopodia)
- b. Differentiate between types of cellular reproduction. (DOK 1)
 - Main events in the cell cycle and cell mitosis (including differences in plant and animal cell divisions)
 - Binary fission (e.g., budding, vegetative propagation, etc.)
 - Significance of meiosis in sexual reproduction
 - Significance of crossing over
- c. Describe and differentiate among the organizational levels of organisms (e.g., cells, tissues, organs, systems, types of tissues.) (DOK 1)
- d. Explain and describe how plant structures (vascular and nonvascular) and cellular functions are related to the survival of plants (e.g., movement of materials, plant reproduction). (DOK 1)
- 5. **Demonstrate an understanding of the molecular basis of heredity.**
 - a. Analyze and explain the molecular basis of heredity and the inheritance of traits to successive generations by using the Central Dogma of Molecular Biology. (DOK 3)
 - Structures of DNA and RNA
 - Processes of replication, transcription, and translation
 - Messenger RNA codon charts
 - b. Utilize Mendel's laws to evaluate the results of monohybrid Punnett squares involving complete dominance, incomplete dominance, codominance, sex linked, and multiple alleles (including outcome percentage of both genotypes and phenotypes). (DOK 2)
 - c. Examine inheritance patterns using current technology (e.g., pedigrees, karyotypes, gel electrophoresis). (DOK 2)
 - d. Discuss the characteristics and implications of both chromosomal and gene mutations. (DOK 2)
 - Significance of nondisjunction, deletion, substitutions, translocation, frame shift mutation in animals
 - Occurrence and significance of genetic disorders such as sickle cell anemia, Tay-Sachs disorder, cystic fibrosis, hemophilia, Down syndrome, color blindness
- 6. **Demonstrate an understanding of principles that explain the diversity of life and biological evolution.**
 - a. Draw conclusions about how organisms are classified into a hierarchy of groups and subgroups based on similarities that reflect their evolutionary relationships. (DOK 2)
 - Characteristics of the six kingdoms
 - Major levels in the hierarchy of taxa (e.g., kingdom, phylum/division, class, order, family, genus, and species)
 - Body plans (symmetry)
 - Methods of sexual reproduction (e.g., conjugation, fertilization, pollination)
 - Methods of asexual reproduction (e.g., budding, binary fission, regeneration, spore formation)
 - b. Critique data (e.g., comparative anatomy, Biogeography, molecular biology, fossil record, etc.) used by scientists (e.g., Redi, Needham, Spallanzani, Pasteur) to develop an understanding of evolutionary processes and patterns. (DOK 3)
 - c. Research and summarize the contributions of scientists (including Darwin, Malthus, Wallace, Lamarck, and Lyell) whose work led to the development of the theory of evolution. (DOK 2)
 - d. Analyze and explain the roles of natural selection, including the mechanisms of speciation (e.g., mutations, adaptations, geographic isolation) and applications of speciation (e.g., pesticide and antibiotic resistance). (DOK 3)
 - e. Differentiate among chemical evolution, organic evolution, and the evolutionary steps along the way to aerobic heterotrophs and photosynthetic autotrophs. (DOK 2)

Biology II

BIOII 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BIOII 2	Describe and contrast the structures, functions, and chemical processes of the cell.
BIOII 3	Investigate and discuss the molecular basis of heredity.
BIOII 4	Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.
BIOII 5	Develop an understanding of organism classification.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- Use current technologies such as CD-ROM, DVD, Internet, and on-line data search to explore current research related to a specific topic. (DOK 3)
- Clarify research questions and design laboratory investigations. (DOK 3)
- Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
- Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. Describe and contrast the structures, functions, and chemical processes of the cell.

- Relate the structure and function of a selectively permeable membrane to its role in diffusion and osmosis. (DOK 2)
- Summarize how cell regulation controls and coordinates cell growth and division. (DOK 2)
- Analyze and describe the function of enzymes in biochemical reactions. (DOK 2)
 - The impact of enzymatic reactions on biochemical processes
 - Factors that affect enzyme function (e.g., pH, concentration, temperature, etc.)
- Differentiate between photosynthesis and cellular respiration. (DOK 2)
 - Cellular sites and major pathways of anaerobic and aerobic respiration (with reactants, products, and ATP per monosaccharide)
 - Cellular respiration with respect to the sites at which they take place, the reactions involved, and the energy input and output in each stage (e.g., glycolysis, Krebs cycle, electron transport chain)
 - Pigments, absorption, reflection of light, and light-dependent and light-independent reactions of photosynthesis
 - Oxidation and reduction reactions

3. Investigate and discuss the molecular basis of heredity.

- Explain how the process of meiosis clarifies the mechanism underlying Mendel's conclusions about segregation and independent assortment on a molecular level. (DOK 1)
- Research and explain how major discoveries led to the determination of DNA structure. (DOK 2)
- Relate gene expression (e.g., replication, transcription, translation) to protein structure and function. (DOK 2)
 - Translation of a messenger RNA strand into a protein
 - Processing by organelles so that the protein is appropriately packaged, labeled, and eventually exported by the cell
 - Messenger RNA codon charts to determine the effects of different types of mutations on amino acid sequence and protein structure (e.g., sickle cell anemia resulting from base substitution mutation)
 - Gene expression regulated in organisms so that specific proteins are synthesized only when they are needed by the cell (e.g., allowing cell specialization)
- Assess the potential implications of DNA technology with respect to its impact on society. (DOK 3)

- Modern DNA technologies (e.g., polymerase chain reaction (PCR), gene splicing, gel electrophoresis, transformation, recombinant DNA) in agriculture, medicine, and forensics
- e. Develop a logical argument defending or refuting bioethical issues arising from applications of genetic technology (e.g., the human genome project, cloning, gene therapy, stem cell research). (DOK 3)
- 4. **Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.**
 - a. Explain the history of life on earth, and infer how geological changes provide opportunities and constraints for biological evolution. (DOK 2)
 - Main periods of the geologic timetable of earth's history
 - Roles of catastrophic and gradualistic processes in shaping planet Earth
 - b. Provide support for the argument based upon evidence from anatomy, embryology, biochemistry, and paleontology that organisms descended with modification from common ancestry. (DOK 2)
 - c. Identify and provide supporting evidence for the evolutionary relationships among various organisms using phylogenetic trees and cladograms. (DOK 2)
 - d. Formulate a scientific explanation based on fossil records of ancient life-forms, and describe how new species could originate as a result of geological isolation and reproductive isolation. (DOK 2)
 - e. Compare and contrast the basic types of selection (e.g., disruptive, stabilizing, directional, etc.). (DOK 2)
 - f. Cite examples to justify behaviors that have evolved through natural selection (e.g., migration, parental care, use of tools, etc.). (DOK 1)
 - g. Research and explain the contributions of 19th century scientists (e.g., Malthus, Wallace, Lyell, and Darwin) on the formulation of ideas about evolution. (DOK 2)
 - h. Develop a logical argument describing ways in which the influences of 20th century science have impacted the development of ideas about evolution (e.g., synthetic theory of evolution, molecular biology). (DOK 3)
 - i. Analyze changes in an ecosystem resulting from natural causes (succession), changes in climate, human activity (pollution and recycling), or introduction of nonnative species. (DOK 2)
- 5. **Develop an understanding of organism classification.**
 - a. Classify organisms according to traditional Linnaean classification characteristics (e.g., cell structure, biochemistry, anatomy, fossil record, methods of reproduction) and the cladistic approach. (DOK 2)
 - b. Categorize organisms according to the characteristics that distinguish them as Bacteria, Archaea, or Eucarya. (DOK 1)
 - Bacteria, fungi, and protists
 - Characteristics of invertebrates (e.g., habitat, reproduction, body plan, locomotion) as related to phyla (e.g., Porifera, Cnidarians, Nematoda, Annelida, Platyhelminthes, and Arthropoda) and classes (e.g., Insecta, Crustacea, Arachnida, Mollusca, Echinodermata)
 - Characteristics of vertebrates (e.g., habitat, reproduction, body plan, locomotion) as related to classes (e.g., Agnatha, Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, Mammalia)
 - Nomenclature of various types of plants (e.g., Bryophyta, Tracheophyta, Gymnospermae, Angiospermae, Monocotyledonae, Dicotyledonae, vascular plants, nonvascular plants)

Botany

- | | |
|------|--|
| BO 1 | Apply inquiry-based and problem-solving processes and skills to scientific investigations. |
| BO 2 | Distinguish among the characteristics of botanical organization, structure, and function. |
| BO 3 | Demonstrate an understanding of plant reproduction. |
| BO 4 | Draw conclusions about the factors that affect the adaptation and survival of plants. |
| BO 5 | Relate an understanding of plant genetics to its uses in modern living. |

- 1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
 - a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols

- Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Formulate questions that can be answered through research and experimental design. (DOK 3)
 - c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
 - d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
 - e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
 - g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
2. **Distinguish among the characteristics of botanical organization, structure, and function.**
 - a. Relate plant cell structures to their functions (e.g., major organelles, cell wall components, photosynthetic chemical reactions, plant pigments, plant tissues, roots, stems, leaves, flowers). (DOK 1)
 - b. Differentiate the characteristics found in various plant divisions. (DOK 2)
 - Differences and similarities of nonvascular plants
 - Characteristics of seed-bearing and non-seed bearing vascular plants relative to taxonomy
 - Major vegetative structures and their modifications in angiosperms and gymnosperms
 - c. Compare and contrast leaf modifications of gymnosperms and angiosperms (e.g., needles, overlapping scales, simple leaves, compound leaves, evergreen trees, and deciduous trees). (DOK 2)
 - d. Apply the modern classification scheme utilized in naming plants to identify plant specimens. (DOK 2)
 - Classification scheme used in botany
 - Classification of native Mississippi plants
 - e. Use inquiry to investigate and discuss the physical and chemical processes of plants. (DOK 3)
 - Relationships among photosynthesis, cellular respiration, and translocation
 - Importance of soil type and soil profiles to plant survival
 - Mechanism of water movement in plants
 - Effects of environmental conditions for plant survival
 - Tropic responses of a plant organ to a given stimulus
 3. **Demonstrate an understanding of plant reproduction.**
 - a. Compare and contrast reproductive structures (e.g., cones, flowers). (DOK 2)
 - b. Differentiate among the vegetative organs of monocots, herbaceous dicots, and woody dicots. (DOK 1)
 - c. Differentiate between the structures and processes of sexual and asexual reproduction in plants. (DOK 1)
 - Reproductive structures, their modifications, and the mechanisms involved in plant reproduction
 - Functions of flower parts, seeds, cones
 - Spore production in bryophytes and ferns
 - d. Explain and provide examples of the concept of alternation of generations and its examples. (DOK 2)
 - e. Categorize types of fruits and methods of seed distribution in plants. (DOK 1)
 - f. Research and compare various methods of plant propagation. (DOK 2)
 4. **Draw conclusions about the factors that affect the adaptation and survival of plants.**
 - a. List and assess several adaptations of plants to survive in a given biome. (DOK 2)
 - b. Design and conduct an experiment to determine the effects of environmental factors on photosynthesis. (DOK 3)
 - c. Explain how natural selection and the evolutionary consequences (e.g., adaptation or extinction) support scientific explanations for similarities of ancient life-forms in the fossil record and molecular similarities present in living organisms. (DOK 2)
 - d. Research factors that might influence or alter plant stability, and propose actions that may reduce the negative impacts of human activity. (DOK 2)
 5. **Relate an understanding of plant genetics to its uses in modern living.**
 - a. Research, prepare, and present a position relating to issues surrounding the current botanical trends involving biotechnology. (DOK 3)

- b. Apply an understanding of the principles of plant genetics to analyze monohybrid and dihybrid crosses, and predict the potential effects the crosses might have on agronomy and agriculture. (DOK 3)
- c. Discuss the effects of genetic engineering of plants on society. (DOK 2)
- d. Describe the chemical compounds extracted from plants, their economical importance, and the impact on humans. (DOK 3)
 - Plant extracts, their function, and origin
 - Impact of the timber industry on local and national economy

Chemistry I

CHI 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
CHI 2	Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.
CHI 3	Develop an understanding of the periodic table.
CHI 4.	Analyze the relationship between microscopic and macroscopic models of matter.
CHI 5	Compare factors associated with acid/base and oxidation/reduction reactions.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
- b. Clarify research questions and design laboratory investigations. (DOK 3)
- c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
- e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.

- a. Describe and classify matter based on physical and chemical properties and interactions between molecules or atoms. (DOK 1)
 - Physical properties (e.g., melting points, densities, boiling points) of a variety of substances
 - Substances and mixtures
 - Three states of matter in terms of internal energy, molecular motion, and the phase transitions between them
- b. Research and explain crucial contributions and critical experiments of Dalton, Thomson, Rutherford, Bohr, de Broglie, and Schrödinger, and describe how each discovery contributed to the current model of atomic and nuclear structure. (DOK 2)
- c. Develop a model of atomic and nuclear structure based on theory and knowledge of fundamental particles. (DOK 2)
 - Properties and interactions of the three fundamental particles of the atom
 - Laws of conservation of mass, constant composition, definite proportions, and multiple proportions
- d. Write appropriate equations for nuclear decay reactions, describe how the nucleus changes during these reactions, and compare the resulting radiation with regard to penetrating ability. (DOK 1)
 - Three major types of radioactive decay (e.g., alpha, beta, gamma) and the properties of the emissions (e.g., composition, mass, charge, penetrating power)
 - The concept of half-life for a radioactive isotope (e.g., carbon-14 dating) based on the principle that the decay of any individual atom is a random process
- e. Compare the properties of compounds according to their type of bonding. (DOK 1)

- Covalent, ionic, and metallic bonding
 - Polar and nonpolar covalent bonding
 - Valence electrons and bonding atoms
- f. Compare different types of intermolecular forces, and explain the relationship between intermolecular forces, boiling points, and vapor pressure when comparing differences in properties of pure substances. (DOK 1)
- g. Develop a three-dimensional model of molecular structure. (DOK 2)
- Lewis dot structures for simple molecules and ionic compounds
 - Valence shell electron pair repulsion theory (VSEPR)
- 3. Develop an understanding of the periodic table.**
- a. Calculate the number of protons, neutrons, and electrons in individual isotopes using atomic numbers and mass numbers, write electron configurations of elements and ions following the Aufbau principle, and balance equations representing nuclear reactions. (DOK 1)
- b. Analyze patterns and trends in the organization of elements in the periodic table, and compare their relationship to position in the periodic table. (DOK 2)
- Atomic number, atomic mass, mass number, and number of protons, electrons, and neutrons in isotopes of elements
 - Average atomic mass calculations
 - Chemical characteristics of each region
 - Periodic properties (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius)
- c. Classify chemical reactions by type. (DOK 2)
- Single displacement, double displacement, synthesis (combination), decomposition, disproportionation, combustion, or precipitation
 - Products (given reactants) or reactants (given products) for each reaction type
 - Solubility rules for precipitation reactions and the activity series for single and double displacement reactions
- d. Use stoichiometry to calculate the amount of reactants consumed and products formed. (DOK 3)
- Difference between chemical reactions and chemical equations
 - Formulas and calculations of the molecular (molar) masses
 - Empirical formula given the percent composition of elements
 - Molecular formula given the empirical formula and molar mass
- 4. Analyze the relationship between microscopic and macroscopic models of matter.**
- a. Calculate the number of protons, neutrons, and electrons in individual isotopes using atomic numbers and mass numbers, write electron configurations of elements and ions following the Aufbau principle, and balance equations representing nuclear reactions. (DOK 1)
- b. Analyze patterns and trends in the organization of elements in the periodic table, and compare their relationship to position in the periodic table. (DOK 2)
- Atomic number, atomic mass, mass number, and number of protons, electrons, and neutrons in isotopes of elements
 - Average atomic mass calculations
 - Chemical characteristics of each region
 - Periodic properties (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius)
- c. Classify chemical reactions by type. (DOK 2)
- Single displacement, double displacement, synthesis (combination), decomposition, disproportionation, combustion, or precipitation
 - Products (given reactants) or reactants (given products) for each reaction type
 - Solubility rules for precipitation reactions and the activity series for single and double displacement reactions
- d. Use stoichiometry to calculate the amount of reactants consumed and products formed. (DOK 3)
- Difference between chemical reactions and chemical equations

- Formulas and calculations of the molecular (molar) masses
- Empirical formula given the percent composition of elements
- Molecular formula given the empirical formula and molar mass

5. Compare factors associated with acid/base and oxidation/reduction reactions.

- 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
- Classify species in aqueous solutions according to the Arrhenius and Bronsted-Lowry definitions respectively, and predict products for aqueous neutralization reactions. (DOK 2)
- Analyze a reduction/oxidation reaction (REDOX) to assign oxidation numbers (states) to reaction species, and identify the species oxidized and reduced, the oxidizing agent, and reducing agent. (DOK 2)

Organic Chemistry

- ORGC 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ORGC 2 Demonstrate an understanding of the properties, structure, and function of organic compounds.
- ORGC 3 Discuss the versatility of polymers and the diverse application of organic chemicals.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- Formulate questions that can be answered through research and experimental design. (DOK 3)
- Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
- Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
- Recognize and analyze alternative explanations for experimental results, and make predictions based on observations and prior knowledge. (DOK 3)
- Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. Demonstrate an understanding of the properties, structure, and function of organic compounds.

- 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
- Relate structure to physical and chemical properties of hydrocarbon. (DOK 1)
- 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)
- Write, complete, and classify common reactions for aliphatic, aromatic, and cyclic hydrocarbons. (DOK 1)
- Construct, solve, and explain equations representing combustion reactions, substitution reactions, dehydrogenation reactions, and addition reactions. (DOK 2)
- Classify functional groups (e.g., alcohols, ethers, aldehydes, ketones, carboxylic acids, esters, amines, amides, and nitriles) by their structure and properties. (DOK 2)

- Structural formulas from functional group names and vice versa
 - Chemical and physical properties of compounds containing functional groups
 - Equations representing the transformation of one functional group into another
3. **Discuss the versatility of polymers and the diverse application of organic chemicals.**
- a. Describe and classify the synthesis, properties, and uses of polymers. (DOK 2)
 - Common polymers
 - Synthesis of polymers from monomers by addition or condensation
 - Condensations of plastics according to their commercial types
 - Elasticity and other polymer properties
 - b. Develop a logical argument supporting the use of organic chemicals and their application in industry, drug manufacture, and biological chemistry. (DOK 1)
 - Common uses of polymers and organic compounds in medicine, drugs, and personal care products
 - Compounds that have the property to dye materials
 - Petrochemical production
 - Biologically active compounds in terms of functional group substrate interaction
 - c. Research and summarize the diversity, applications, and economics of industrial chemicals (solvents, coatings, surfactants, etc.). (DOK 3)

Earth and Space Science

- E1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- E2 Develop an understanding of the history and evolution of the universe and earth.
- E3 Discuss factors that are used to explain the geological history of earth.
- E4 Demonstrate an understanding of earth systems relating to weather and climate.
- E5 Apply an understanding of ecological factors to explain relationships between earth systems.

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers.
 - b. Formulate questions that can be answered through research and experimental design. (DOK 3)
 - c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
 - d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
 - e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
 - g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
2. **Develop an understanding of the history and evolution of the universe and earth.**
- a. Summarize the origin and evolution of the universe. (DOK 2)
 - Big bang theory
 - Microwave background radiation
 - The Hubble constant
 - Evidence of the existence of dark matter and dark energy in the universe and the history of the universe
 - b. Differentiate methods used to measure space distances, including astronomical unit, light-year, stellar parallax, Cepheid variables, and the red shift. (DOK 1)

- c. Interpret how gravitational attraction played a role in the formation of the planetary bodies and how the fusion of hydrogen and other processes in “ordinary” stars and supernovae lead to the formation of all other elements. (DOK 2)
- d. Summarize the early evolution of the earth, including the formation of Earth’s solid layers (e.g., core, mantle, and crust), the distribution of major elements, the origin of internal heat sources, and the initiation of plate tectonics. (DOK 2)
 - How the decay of radioactive isotopes is used to determine the age of rocks, earth, and the solar system
 - How Earth acquired its initial oceans and atmosphere
3. **Discuss factors which are used to explain the geological history of earth.**
 - a. Develop an understanding of how plate tectonics create certain geological features, materials, and hazards. (DOK 1)
 - Plate tectonic boundaries (e.g., divergent, convergent, and transform)
 - Modern and ancient geological features to each kind of plate tectonic boundary
 - Production of particular groups of igneous and metamorphic rocks and mineral resources
 - Sedimentary basins created and destroyed through time
 - b. Compare and contrast types of mineral deposits/groups (e.g., oxides, carbonates, halides, sulfides, sulfates, silicates, phosphates). (DOK 2)
 - c. Categorize minerals and rocks by determining their physical and/or chemical characteristics. (DOK 2)
 - d. Justify the causes of certain geological hazards (e.g., earthquakes, volcanoes, tsunamis) to their effects on specific plate tectonic locations. (DOK 2)
 - e. Interpret and explain how rock relationships and fossils are used to reconstruct the geologic history of the earth. (DOK 2)
 - f. Apply principles of relative age (e.g., superposition, original horizontality, crosscutting relations, and original lateral continuity) to support an opinion related to earth’s geological history. (DOK 3)
 - Types of unconformity (e.g., disconformity, angular unconformity, nonconformity)
 - Geological timetable
 - g. Apply the principle of uniformitarianism to relate sedimentary rock associations and their fossils to the environments in which the rocks were deposited. (DOK 2)
 - h. Compare and contrast the relative and absolute dating methods (e.g., the principle of fossil succession, radiometric dating, and paleomagnetism) for determining the age of the earth. (DOK 1)
4. **Demonstrate an understanding of earth systems relating to weather and climate.**
 - a. Explain the interaction of earth systems that affect weather and climate. (DOK 1)
 - Latitudinal variations in solar heating
 - The effects of Coriolis forces on ocean currents, cyclones, anticyclones, ocean currents, topography, and air masses (e.g., warm fronts, cold fronts, stationary fronts, and occluded fronts).
 - b. Interpret the patterns in temperature and precipitation that produce the climate regions on earth, and relate them to the hazards associated with extreme weather events and climate change (e.g., hurricanes, tornadoes, El Niño/La Niña, global warming). (DOK 2)
 - c. Justify how changes in global climate and variation in earth/sun relationships contribute to natural and anthropogenic (human-caused) modification of atmospheric composition. (DOK 2)
 - d. Summarize how past and present actions of ice, wind, and water contributed to the types and distributions of erosional and depositional features in landscapes. (DOK 1)
 - e. Research and explain how external forces affect earth’s topography. (DOK 2)
 - How surface water and groundwater act as the major agents of physical and chemical weathering
 - How soil results from weathering and biological processes
 - Processes and hazards associated with both sudden and gradual mass wasting
5. **Apply an understanding of ecological factors to explain relationships between earth systems.**
 - a. Draw conclusions about how life on earth shapes earth systems and responds to the interaction of earth systems (lithosphere, hydrosphere, atmosphere, and biosphere). (DOK 3)
 - Nature and distribution of life on earth, including humans, to the chemistry and availability of water
 - Distribution of biomes (e.g., terrestrial, freshwater, and marine) to climate regions through time

- Geochemical and ecological processes (e.g., rock, hydrologic, carbon, nitrogen) that interact through time to cycle matter and energy and how human activity alters the rates of these processes (e.g., fossil fuel formation and combustion, damming and channeling of rivers)
- b. Interpret the record of shared ancestry (fossils), evolution, and extinction as related to natural selection. (DOK 2)
- c. Identify the cause and effect relationships of the evolutionary innovations that most profoundly shaped earth systems. (DOK 1)
 - Photosynthesis and the atmosphere
 - Multicellular animals and marine environments
 - Land plants and terrestrial environments
- d. Cite evidence about how dramatic changes in earth's atmosphere influenced the evolution of life. (DOK 1)

Environmental Science

- ES 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ES 2 Develop an understanding of the relationship of ecological factors that affect an ecosystem.
- ES 3 Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Formulate questions that can be answered through research and experimental design. (DOK 3)
- c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
- f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
- g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK3)

2. Develop an understanding of the relationship of ecological factors that affect an ecosystem.

- a. Compare ways in which the three layers of the biosphere change over time and their influence on an ecosystem's ability to support life. (DOK 2)
- b. Explain the flow of matter and energy in ecosystems. (DOK 2)
 - Interactions between biotic and abiotic factors
 - Indigenous plants and animals and their roles in various ecosystems
 - Biogeochemical cycles within the environment
- c. Predict the impact of the introduction, removal, and reintroduction of an organism on an ecosystem. (DOK 3)
- d. Develop a logical argument explaining the relationships and changes within an ecosystem. (DOK 2)
 - How a species adapts to its niche
 - Process of primary and secondary succession and its effects on a population
 - How changes in the environment might affect organisms
- e. Explain the causes and effects of changes in population dynamics (e.g., natural selection, exponential growth, predator/prey relationships) to carrying capacity and limiting factors. (DOK 2)
- f. Research and explain how habitat destruction leads to the loss of biodiversity. (DOK 2)

- g. Compare and contrast the major biomes of the world's ecosystems, including location, climate, adaptations and diversity. (DOK 1)
- 3. **Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.**
 - a. Summarize the effects of human activities on resources in the local environments. (DOK 2)
 - Sources, uses, quality, and conservation of water
 - Renewable and nonrenewable resources
 - Effects of pollution (e.g., water, noise, air, etc.) on the ecosystem
 - b. Research and evaluate the impacts of human activity and technology on the lithosphere, hydrosphere, and atmosphere, and develop a logical argument to support how communities restore ecosystems. (DOK 3)
 - c. Research and evaluate the use of renewable and nonrenewable resources, and critique efforts to conserve natural resources and reduce global warming in the United States including (but not limited) to Mississippi. (DOK 3)

Genetics

- G 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
 - G 2 Analyze the structure and function of the cell and cellular organelles.
 - G 3 Apply the principles of heredity to demonstrate genetic understandings.
1. **Use critical thinking and scientific problem solving in designing and performing biological research and experimentation. (L, P, E)**
 - a. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
 - b. Clarify research questions and design laboratory investigations. (DOK 3)
 - c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
 - d. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for pie, bar, and line graphs) to draw conclusions and make inferences. (DOK 3)
 - e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
 - f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
 - g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)
 2. **Review the structure and function of the cell as it applies to genetics. (L)**
 - a. Cite evidence to illustrate how the structure and function of cells are involved in the maintenance of life. (DOK 2)
 - b. Describe how organic components are integral to biochemical processes. (DOK 2)
 - c. Differentiate among the processes by which plants and animals reproduce. (DOK 1)
 - Cell cycle and mitosis
 - Meiosis, spermatogenesis, and oogenesis
 - d. Explain the significance of the discovery of nucleic acids. (DOK 1)
 - e. Analyze and explain the structure and function of DNA and RNA in replication, transcription, translation and DNA repair. (DOK 2)
 - f. Cite examples to compare the consequences of the different types of mutations. (DOK 1)
 - g. Draw conclusions about the importance and potential impacts of the process of gene transfer used in biotechnology. (DOK 3)
 3. **Analyze the structure and function of DNA and RNA molecules. (L, P)**
 - a. Cite evidence that supports the significance of Mendel's concept of "particulate inheritance" to explain the understanding of heredity. (DOK 1)
 - b. Apply classical genetics principles to solve basic genetic problems. (DOK 2)

- Genes and alleles, dominance, recessiveness, the laws of segregation, and independent assortment
- Inheritance of autosomal and sex-linked traits
- Inheritance of traits influenced by multiple alleles and traits with polygenetic inheritance
- Chromosomal theory of inheritance
- c. Apply population genetic concepts to summarize variability of multicellular organisms. (DOK 2)
 - Genetic variability
 - Hardy-Weinberg formula
 - Migration and genetic drift
 - Natural selection in humans
- d. Distinguish and explain the applications of various tools and techniques used in DNA manipulation. (DOK 1)
 - Steps in genetic engineering experiments
 - Use of restriction enzymes
 - Role of vectors in genetic research
 - Use of transformation techniques
- e. Research and present a justifiable explanation the practical uses of biotechnology (e.g., chromosome mapping, karyotyping, and pedigrees). (DOK 2)
- f. Develop and present a scientifically-based logical argument for or against moral and ethical issues related to genetic engineering. (DOK 3)
- g. Research genomics (human and other organisms), and predict benefits and medical advances that may result from the use of genome projects. (DOK 2)

Geology

GE1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
GE2	Develop an understanding of plate tectonics and geochemical and ecological processes that affect earth.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Formulate questions that can be answered through research and experimental design. (DOK 3)
- c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
- f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
- g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. Develop an understanding of plate tectonics and geochemical and ecological processes that affect earth.

- a. Differentiate the components of the earth's atmosphere and lithosphere. (DOK 1)
- b. Research and summarize explanations of how earth acquired its initial atmosphere and oceans. (DOK 3)
- c. Compare the causes and effects of internal and external components that shape earth's topography. (DOK 2)
 - Physical weathering (e.g., atmospheric, glacial, etc.)
 - Chemical weathering agents (e.g., acid precipitation, carbon dioxide, oxygen, water, etc.)

- d. Develop an understanding of how plate tectonics create certain geologic features, materials, and hazards. (DOK 2)
 - Types of crustal movements and the resulting landforms (e.g., seafloor spreading, paleomagnetic measurements, and orogenesis)
 - Processes that create earthquakes and volcanoes
 - Asthenosphere
- e. Summarize the theories of plate development and continental drift, and describe the causes and effects involved in each. (DOK 2)
- f. Develop a logical argument to explain how geochemical and ecological processes (e.g., rock, hydrologic, carbon, nitrogen) interact through time to cycle matter and energy and how human activity alters the rates of these processes (e.g., fossil fuel formation and combustion, damming, and channeling of rivers). (DOK 2)
- g. Interpret how the earth's geological time scale relates to geological history, landforms, and life-forms. (DOK 2)
- h. Research and describe different techniques for determining relative and absolute age of the earth (e.g., index of fossil layers, superposition, radiometric dating, etc.). (DOK 1)
- i. Summarize the geological activity of the New Madrid fault line, and compare and contrast it to geological activity in other parts of the world. (DOK 2)
- j. Identify and differentiate the major geological features in Mississippi (e.g., Delta, Coastal Areas, etc.). (DOK 1)
- k. Evaluate an emergency preparedness plan for natural disasters associated with crustal movement. (DOK 3)

Physical Science

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| PS 1 | Apply inquiry-based and problem-solving processes and skills to scientific investigations. |
| PS 2 | Describe and explain how forces affect motion. |
| PS 3 | Demonstrate an understanding of general properties and characteristics of waves. |
| PS 4 | Develop an understanding of the atom. |
| PS 5 | Investigate and apply principles of physical and chemical changes in matter. |

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- a. Use appropriate laboratory safety symbols and procedures to design and conduct a scientific investigation. (DOK 2)
 - Safety symbols and safety rules in all laboratory activities
 - Proper use and care of the compound light microscope
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- b. Identify questions that can be answered through scientific investigations. (DOK 3)
- c. Identify and apply components of scientific methods in classroom investigations. (DOK 3)
 - Predicting, gathering data, drawing conclusions
 - Recording outcomes and organizing data from a variety of sources (e.g., scientific articles, magazines, student experiments, etc.)
 - Critically analyzing current investigations/problems using periodicals and scientific scenarios
- d. Interpret and generate graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures and data to draw conclusions about the validity of research. (DOK 3)
- f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- g. Communicate effectively to present and explain scientific results, using appropriate terminology and graphics. (DOK 3)

2. Describe and explain how forces affect motion.

- a. Demonstrate and explain the basic principles of Newton's three laws of motion including calculations of acceleration, force, and momentum. (DOK 2)

- Inertia and distance-time graphs to determine average speed
 - Net force (accounting for gravity, friction, and air resistance) and the resulting motion of objects
 - Effects of the gravitational force on objects on Earth and effects on planetary and lunar motion
 - Simple harmonic motion (oscillation)
- b. Explain the connection between force, work, and energy. (DOK 2)
 - Force exerted over a distance (results in work done)
 - Force-distance graph (to determine work)
 - Network on an object that contributes to change in kinetic energy (work-to-energy theorem)
 - c. Describe (with supporting details and diagrams) how the kinetic energy of an object can be converted into potential energy (the energy of position) and how energy is transferred or transformed (conservation of energy). (DOK 2)
 - d. Draw and assess conclusions about charges and electric current. (DOK 2)
 - Static/current electricity and direct current/alternating current
 - Elements in an electric circuit that are in series or parallel
 - Conductors and insulators
 - Relationship between current flowing through a resistor and voltage flowing across a resistor
 - e. Cite evidence and explain the application of electric currents and magnetic fields as they relate to their use in everyday living (e.g., the application of fields in motors and generators and the concept of electric current using Ohm's law). (DOK 2)
- 3. Demonstrate an understanding of general properties and characteristics of waves.**
- a. Differentiate among transverse, longitudinal, and surface waves as they propagate through a medium (e.g., string, air, water, steel beam). (DOK 1)
 - b. Compare properties of waves (e.g., superposition, interference, refraction, reflection, diffraction, Doppler effect), and explain the connection among the quantities (e.g., wavelength, frequency, period, amplitude, and velocity). (DOK 2)
 - c. Classify the electromagnetic spectrum's regions according to frequency and/or wavelength, and draw conclusions about their impact on life. (DOK 2)
 - The emission of light by electrons when moving from higher to lower levels
 - Energy (photons as quanta of light)
 - Additive and subtractive properties of colors
 - Relationship of visible light to the color spectrum
 - d. Explain how sound intensity is measured and its relationship to the decibel scale. (DOK 1)
- 4. Develop an understanding of the atom.**
- a. Cite evidence to summarize the atomic theory. (DOK 1)
 - Models for atoms
 - Hund's rule and Aufbau process to specify the electron configuration of elements
 - Building blocks of matter (e.g., proton, neutron, and electron) and elementary particles (e.g., positron, mesons, neutrinos, etc.)
 - Atomic orbitals (s, p, d, f) and their basic shapes
 - b. Explain the difference between chemical and physical changes, and demonstrate how these changes can be used to separate mixtures and compounds into their components. (DOK 2)
 - c. Research the history of the periodic table of the elements, and summarize the contributions that led to the atomic theory. (DOK 2)
 - Contributions of scientists (e.g., John Dalton, J.J. Thomson, Ernest Rutherford, Newton, Einstein, Neils, Bohr, Louis de Broglie, Erwin Schrödinger, etc.)
 - Technology (e.g., X-rays, cathode-ray tubes, spectroscopes)
 - Experiments (e.g., gold-foil, cathode-ray, etc.)
 - d. Utilize the periodic table to predict and explain patterns and draw conclusions about the structure, properties, and organization of matter. (DOK 2)
 - Atomic composition and valence electron configuration (e.g., atomic number, mass number of protons, neutrons, electrons, isotopes, and ions)
 - Periodic trends using the periodic table (e.g., valence, reactivity, atomic radius)

- Average atomic mass from isotopic abundance
- Solids, liquids, and gases
- Periodic properties of elements (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, atomic/covalent/ionic radius) and how they relate to position in the periodic table

5. Investigate and apply principles of physical and chemical changes in matter.

- Write chemical formulas for compounds comprising monatomic and polyatomic ions. (DOK 1)
- Balance chemical equations. (DOK 2)
- Classify types of chemical reactions (e, g., composition, decomposition, single displacement, double displacement, combustion, acid/base reactions). (DOK 2)

Physics I

PHYI 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
PHYI 2	Develop an understanding of concepts related to forces and motion.
PHYI 3	Develop an understanding of concepts related to work and energy.
PHYI 4	Discuss the characteristics and properties of light and sound.
PHYI 5	Apply an understanding of magnetism, electric fields, and electricity.
PHYI 6	Analyze and explain concepts of nuclear physics.

1. Investigate and apply principles of physical and chemical changes in matter.

- Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
- Clarify research questions, and design laboratory investigations. (DOK 3)
- Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
- Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)

2. Develop an understanding of concepts related to forces and motion.

- Use inquiry to investigate and develop an understanding of the kinematics and dynamics of physical bodies. (DOK 3)
 - Vector and scalar quantities
 - Vector problems (solved mathematically and graphically)
 - Vector techniques and free-body diagrams to determine the net force on a body when several forces are acting on it
 - Relations among mass, inertia, and weight
- Analyze, describe, and solve problems by creating and utilizing graphs of one-dimensional motion (e.g., position, distance, displacement, time, speed, velocity, acceleration, the special case of free fall). (DOK 2)
- Analyze real-world applications to draw conclusions about Newton's three laws of motion. (DOK 2)
- Apply the effects of the universal gravitation law to graph and interpret the force between two masses, acceleration due to gravity, and planetary motion. (DOK 2)
 - Situations where g is constant (falling bodies)
 - Concept of centripetal acceleration undergoing uniform circular motion
 - Kepler's third law
 - Oscillatory motion and the mechanics of waves

3. Develop an understanding of concepts related to work and energy.

- Explain and apply the conservation of energy and momentum. (DOK 2)

- Concept of work and applications
 - Concept of kinetic energy, using the elementary work-energy theorem
 - Concept of conservation of energy with simple examples
 - Concepts of energy, work, and power (qualitatively and quantitatively)
 - Principles of impulse in inelastic and elastic collisions
- b. Analyze real-world applications to draw conclusions about mechanical potential energy (the energy of configuration). (DOK 3)
 - c. Apply the principles of impulse, and compare conservation of momentum and conservation of kinetic energy in perfectly inelastic and elastic collisions. (DOK 1)
 - d. Investigate and summarize the principles of thermodynamics. (DOK 2)
 - How heat energy is transferred from higher temperature to lower temperature until equilibrium is reached
 - Temperature and thermal energy as related to molecular motion and states of matter
 - Problems involving specific heat and heat capacity
 - First and second laws of thermodynamics as related to heat engines, refrigerators, and thermal efficiency
 - e. Develop the kinetic theory of ideal gases and explain the concept of Carnot efficiency. (DOK 2)
4. **Discuss the characteristics and properties of light and sound.**
- a. Describe and model the characteristics and properties of mechanical waves. (DOK 2)
 - Simple harmonic motion
 - Relationships among wave characteristics such as velocity, period, frequency, amplitude, phase, and wavelength
 - Energy of a wave in terms of amplitude and frequency.
 - Standing waves and waves in specific media (e.g., stretched string, water surface, air, etc.)
 - b. Differentiate and explain the Doppler effect as it relates to a moving source and to a moving observer. (DOK 1)
 - c. Explain the laws of reflection and refraction, and apply Snell's law to describe the relationship between the angles of incidence and refraction. (DOK 2)
 - d. Use ray tracing and the thin lens equation to solve real-world problems involving object distance from lenses. (DOK 2)
 - e. Investigate and draw conclusions about the characteristics and properties of electromagnetic waves. (DOK 2)
5. **Apply an understanding of magnetism, electric fields, and electricity.**
- a. Analyze and explain the relationship between electricity and magnetism. (DOK 2)
 - Characteristics of static charge and how a static charge is generated
 - Electric field, electric potential, current, voltage, and resistance as related to Ohm's law
 - Magnetic poles, magnetic flux and field, Ampère's law and Faraday's law
 - Coulomb's law
 - b. Use schematic diagrams to analyze the current flow in series and parallel electric circuits, given the component resistances and the imposed electric potential. (DOK 2)
 - c. Analyze and explain the relationship between magnetic fields and electrical current by induction, generators, and electric motors. (DOK 2)
6. **Analyze and explain concepts of nuclear physics.**
- a. Analyze and explain the principles of nuclear physics. (DOK 1)
 - The mass number and atomic number of the nucleus of an isotope of a given chemical element
 - The conservation of mass and the conservation of charge
 - Nuclear decay
 - b. Defend the wave-particle duality model of light, using observational evidence. (DOK 3)
 - Quantum energy and emission spectra
 - Photoelectric and Compton effects

Spatial Information Science

- SP 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- SP 2 Develop an understanding of geographic information systems.

1. Demonstrate the basic concepts of global positioning systems (GPS). (E)

- Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
- Clarify research questions, and design laboratory investigations. (DOK 3)
- Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, and theory development). (DOK 3)
- Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences). (DOK 3)
- Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
- Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBLs, etc.). (DOK 3)

2. Demonstrate the basic concepts of remote sensing. (E, P)

- Describe the characteristics of the electromagnetic spectrum.
- Using images and graphs, interpret the absorption/reflection spectrum.
- Distinguish between passive vs. active sensor systems.
- Analyze the effects of changes in spatial, temporal, and spectral resolution.
- Analyze the effects on images due to changes in scale.
- Identify the types of sensor platforms.

Zoology

- ZO 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ZO 2 Develop an understanding of levels of organization and animal classification.
- ZO 3 Differentiate among animal life cycles, behaviors, adaptations, and relationships.
- ZO 4 Demonstrate an understanding of the principles of animal genetic diversity and evolution.

1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.

- Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
- Formulate questions that can be answered through research and experimental design. (DOK 3)
- Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
- Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
- Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
- Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

2. Develop an understanding of levels of organization and animal classification.

- Explain how organisms are classified, and identify characteristics of major groups. (DOK 1)
 - Levels of organization of structures in animals (e.g., cells, tissues, organs, and systems)

- Characteristics used to classify organisms (e.g., cell structure, biochemistry, anatomy, fossil record, and methods of reproduction)
- b. Identify and describe characteristics of the major phyla. (DOK 1)
 - Symmetry and body plan
 - Germ layers and embryonic development
 - Organ systems (e.g., digestive, circulatory, excretory, and reproductive)
 - Locomotion and coordination
- c. Distinguish viruses from bacteria and protists, and give examples. (DOK 1)
- d. Differentiate among the characteristics of bacteria, archaea, and eucarya. (DOK 1)
 - Phylogenic sequencing of the major phyla
 - Invertebrate characteristics (e.g., habitat, reproduction, body plan, locomotion) of the following phyla: Porifera, Cnidarians, Nematoda, Annelida, Platyhelminthes, Arthropoda, Insecta, Crustacea, Arachnida, Mollusca [Bivalvia and Gastropoda], and Echinodermata)
 - Vertebrate characteristics (e.g., habitat, reproduction, body plan, locomotion) of the following classes: Agnatha, Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, and Mammalia
- 3. **Differentiate among animal life cycles, behaviors, adaptations, and relationships.**
 - a. Describe life cycles, alternation of generations, and metamorphosis of various animals, and evaluate the advantages and disadvantages of asexual and sexual reproduction. (DOK 1)
 - b. Describe and explain concepts of animal behavior, and differentiate between learned and innate behavior. (DOK 1)
 - Division of labor within a group of animals
 - Communication within animals groups
 - Degree of parental care given in animal groups
 - c. Evaluate the unique protective adaptations of animals as they relate to survival. (DOK 2)
 - d. Compare and contrast ecological relationships, and make predictions about the survival of populations under given circumstances. (DOK 3)
 - Terrestrial and aquatic ecosystems
 - Herbivores, carnivores, omnivores, decomposers and other feeding relationships
 - Symbiotic relationships such as mutualism, commensalisms, and parasitism
 - e. Contrast food chains and food webs. (DOK 2)
- 4. **Demonstrate an understanding of the principles of animal genetic diversity and evolution.**
 - a. Categorize and explain sources of genetic variation on the cellular level (e.g., mutations, crossing over, and nondisjunction) and the population level (e.g., nonrandom mating, migration, etc.). (DOK 2)
 - Relationship between natural selection and evolution
 - Mutations, crossing over, nondisjunction
 - Nonrandom mating, migration, etc.
 - Effects of genetic drift on evolution
 - b. Develop a logical argument defending or refuting issues related to genetic engineering of animals. (DOK 3)

Appendix D: ACT College Readiness Standards

English

E1 Topic Development in Terms of Purpose and Focus

- Identify the basic purpose or role of a specified phrase or sentence.
- Delete a clause or sentence because it is obviously irrelevant to the essay.
- Identify the central idea or main topic of a straightforward piece of writing.
- Determine relevancy when presented with a variety of sentence-level details.
- Identify the focus of a simple essay, applying that knowledge to add a sentence that sharpens that focus or to determine if an essay has met a specified goal.
- Delete material primarily because it disturbs the flow and development of the paragraph.
- Add a sentence to accomplish a fairly straightforward purpose such as illustrating a given statement.
- Apply an awareness of the focus and purpose of a fairly involved essay to determine the rhetorical effect and suitability of an existing phrase or sentence or to determine the need to delete plausible but irrelevant material.
- Add a sentence to accomplish a subtle rhetorical purpose such as to emphasize, to add supporting detail, or to express meaning through connotation.
- Determine whether a complex essay has accomplished a specific purpose.
- Add a phrase or sentence to accomplish a complex purpose, often expressed in terms of the main focus of the essay.

E2 Organization, Unity, and Coherence

- Use conjunctive adverbs or phrases to show time relationship in simple narrative essays (e.g., *then, this time, etc.*).
- Select the most logical place to add a sentence in a paragraph.
- Use conjunctive adverbs or phrases to express straightforward logical relationships (e.g., *first, afterward, in response*).
- Decide the most logical place to add a sentence in an essay.
- Add a sentence that introduces a simple paragraph.
- Determine the need for conjunctive adverbs or phrases to create subtle logical connections between sentences (e.g., *therefore, however, in addition*).
- Rearrange the sentences in a fairly uncomplicated paragraph for the sake of logic.
- Add a sentence to introduce or conclude the essay or to provide a transition between paragraphs when the essay is fairly straightforward.
- Make sophisticated distinctions concerning the logical use of conjunctive adverbs or phrases, particularly when signaling a shift between paragraphs.
- Rearrange sentences to improve the logic and coherence of a complex paragraph.
- Add a sentence to introduce or conclude a fairly complex paragraph.
- Consider the need for introductory sentences or transitions, basing decisions on a thorough understanding of both the logic and rhetorical effect of the paragraph and essay.

E3 Word Choice in Terms of Style, Tone, Clarity, and Economy

- Revise sentences to correct awkward and confusing arrangements of sentence elements.
- Revise vague nouns and pronouns that create obvious logic problems.
- Delete obviously synonymous and wordy material in a sentence.
- Revise expressions that deviate from the style of an essay.
- Delete redundant material when information is repeated in different parts of speech (e.g., *alarmingly startled*).
- Use the word or phrase most consistent with the style and tone of a fairly straightforward essay.
- Determine the clearest and most logical conjunction to link clauses.
- Revise a phrase that is redundant in terms of the meaning and logic of the entire sentence.
- Identify and correct ambiguous pronoun references.
- Use the word or phrase most appropriate in terms of the content of the sentence and tone of the essay.
- Correct redundant material that involves sophisticated vocabulary and sounds acceptable as conversational English (e.g., *an aesthetic viewpoint* versus *the outlook of an aesthetic viewpoint*).
- Correct vague and wordy or clumsy and confusing writing containing sophisticated language.
- Delete redundant material that involves subtle concepts or that is redundant in terms of the paragraph as a whole.

E4 Sentence Structure and Formation

- Use conjunctions or punctuation to join simple clauses.
- Revise shifts in verb tense between simple clauses in a sentence or between simple adjoining sentences.
- Determine the need for punctuation and conjunctions to avoid awkward sounding sentence fragments and fused sentences.
- Decide the appropriate verb tense and voice by considering the meaning of the entire sentence.
- Recognize and correct marked disturbances of sentence flow and structure (e.g., participial phrase fragments, missing or incorrect relative pronouns, dangling or misplaced modifiers).
- Revise to avoid faulty placement of phrases and faulty coordination and subordination of clauses in sentences with subtle structural problems.
- Maintain consistent verb tense and pronoun person on the basis of the preceding clause or sentence.
- Use sentence-combining techniques, effectively avoiding problematic comma splices, run-on sentences, and sentence fragments, especially in sentences containing compound subjects or verbs.
- Maintain a consistent and logical use of verb tense and pronoun person on the basis of information in the paragraph or essay as a whole.
- Work comfortably with long sentences and complex clausal relationships within sentences, avoiding weak conjunctions between independent clauses and maintaining parallel structure between clauses.

E5 Conventions of Usage

- Solve such basic grammatical problems as how to form the past and past participle of irregular but commonly used verbs and how to form comparative and superlative adjectives.
- Solve such grammatical problems as whether to use an adverb or adjective form, how to ensure straightforward subject–verb and pronoun–antecedent agreement, and which preposition to use in simple contexts.
- Recognize and use the appropriate word in frequently confused pairs such as *there* and *their*, *past* and *passed*, and *led* and *lead*.
- Use idiomatically appropriate prepositions, especially in combination with verbs (e.g., *long for*, *appeal to*).
- Ensure that a verb agrees with its subject when there is some text between the two.
- Ensure that a pronoun agrees with its antecedent when the two occur in separate clauses or sentences.
- Identify the correct past and past participle forms of irregular and infrequently used verbs, and form present–perfect verbs by using *have* rather than *of*.
- Correctly use reflexive pronouns, the possessive pronouns *its* and *your*, and the relative pronouns *who* and *whom*.

- Ensure that a verb agrees with its subject in unusual situations (e.g., when the subject–verb order is inverted or when the subject is an indefinite pronoun).
- Provide idiomatically and contextually appropriate prepositions following verbs in situations involving sophisticated language or ideas.
- Ensure that a verb agrees with its subject when a phrase or clause between the two suggests a different number for the verb.

E6 Conventions of Punctuation

- Delete commas that create basic sense problems (e.g., between verb and direct object).
- Provide appropriate punctuation in straightforward situations (e.g., items in a series).
- Delete commas that disturb the sentence flow (e.g., between modifier and modified element).
- Use commas to set off simple parenthetical phrases.
- Delete unnecessary commas when an incorrect reading of the sentence suggests a pause that should be punctuated (e.g., between verb and direct object clause).
- Use punctuation to set off complex parenthetical phrases.
- Recognize and delete unnecessary commas based on a careful reading of a complicated sentence (e.g., between the elements of a compound subject or compound verb joined by *and*).
- Use apostrophes to indicate simple possessive nouns.
- Recognize inappropriate uses of colons and semicolons.
- Use commas to set off a nonessential/nonrestrictive appositive or clause.
- Deal with multiple punctuation problems (e.g., compound sentences containing unnecessary commas and phrases that may or may not be parenthetical).
- Use an apostrophe to show possession, especially with irregular plural nouns.
- Use a semicolon to indicate a relationship between closely related independent clauses.
- Use a colon to introduce an example or an elaboration.

Math

M1 Basic Operations and Applications

- Perform one-operation computation with whole numbers and decimals.
- Solve problems in one or two steps using whole numbers.
- Perform common conversions (e.g., inches to feet or hours to minutes).
- Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent.
- Solve some routine two-step arithmetic problems.
- Solve routine two-step or three-step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and computing with a given average.
- Solve multistep arithmetic problems that involve planning or converting units of measure (e.g., feet per second to miles per hour).
- Solve word problems containing several rates, proportions, or percentages.
- Solve complex arithmetic problems involving percent of increase or decrease and problems requiring integration of several concepts from pre-algebra and/or pre-geometry (e.g., comparing percentages or averages, using several ratios, and finding ratios in geometry settings).

M2 Probability, Statistics, and Data Analysis

- Calculate the average of a list of positive whole numbers.
- Perform a single computation using information from a table or chart.
- Calculate the average of a list of numbers.
- Calculate the average, given the number of data values and the sum of the data values.
- Read tables and graphs.
- Perform computations on data from tables and graphs.

- Use the relationship between the probability of an event and the probability of its complement.
- Calculate the missing data value, given the average and all data values but one.
- Translate from one representation of data to another (e.g., a bar graph to a circle graph).
- Determine the probability of a simple event.
- Exhibit knowledge of simple counting techniques.*
- Calculate the average, given the frequency counts of all the data values.
- Manipulate data from tables and graphs.
- Compute straightforward probabilities for common situations.
- Use Venn diagrams in counting.*
- Calculate or use a weighted average.
- Interpret and use information from figures, tables, and graphs.
- Apply counting techniques.
- Compute a probability when the event and/or sample space is not given or obvious.
- Distinguish between mean, median, and mode for a list of numbers.
- Analyze and draw conclusions based on information from figures, tables, and graphs.
- Exhibit knowledge of conditional and joint probability.

M3 Numbers: Concepts and Properties

- Recognize equivalent fractions and fractions in lowest terms.
- Recognize one-digit factors of a number.
- Identify a digit's place value.
- Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor.
- Find and use the least common multiple.
- Order fractions.
- Work with numerical factors.
- Work with scientific notation.
- Work with squares and square roots of numbers.
- Work problems involving positive integer exponents.*
- Work with cubes and cube roots of numbers.*
- Determine when an expression is undefined.*
- Exhibit some knowledge of the complex numbers.†
- Apply number properties involving prime factorization.
- Apply number properties involving even and odd numbers and factors and multiples.
- Apply number properties involving positive and negative numbers.
- Apply rules of exponents.
- Multiply two complex numbers.†
- Draw conclusions based on number concepts, algebraic properties, and/or relationships between expressions and numbers.
- Exhibit knowledge of logarithms and geometric sequences.
- Apply properties of complex numbers.

M4 Expressions, Equations, and Inequalities

- Exhibit knowledge of basic expressions (e.g., identify an expression for a total as $b + g$).
- Solve equations in the form $x + a = b$, where a and b are whole numbers or decimals.
- Substitute whole numbers for unknown quantities to evaluate expressions.
- Solve one-step equations having integer or decimal answers.
- Combine like terms (e.g., $2x + 5x$).
- Evaluate algebraic expressions by substituting integers for unknown quantities.
- Add and subtract simple algebraic expressions.
- Solve routine first-degree equations.

- Perform straightforward word-to-symbol translations.
- Multiply two binomials.*
- Solve real-world problems using first-degree equations.
- Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions).
- Identify solutions to simple quadratic equations.
- Add, subtract, and multiply polynomials.*
- Factor simple quadratics (e.g., the difference of squares and perfect square trinomials).*
- Solve first-degree inequalities that do not require reversing the inequality sign.*
- Manipulate expressions and equations.
- Write expressions, equations, and inequalities for common algebra settings.
- Solve linear inequalities that require reversing the inequality sign.
- Solve absolute value equations.
- Solve quadratic equations.
- Find solutions to systems of linear equations.
- Write expressions that require planning and/or manipulating to accurately model a situation.
- Write equations and inequalities that require planning, manipulating, and/or solving.
- Solve simple absolute value inequalities.

M5 Graphical Representations

- Identify the location of a point with a positive coordinate on the number line.
- Locate points on the number line and in the first quadrant.
- Locate points in the coordinate plane.
- Comprehend the concept of length on the number line.*
- Exhibit knowledge of slope.*
- Identify the graph of a linear inequality on the number line.*
- Determine the slope of a line from points or equations.*
- Match linear graphs with their equations.*
- Find the midpoint of a line segment.*
- Interpret and use information from graphs in the coordinate plane.
- Match number line graphs with solution sets of linear inequalities.
- Use the distance formula.
- Use properties of parallel and perpendicular lines to determine an equation of a line or coordinates of a point.
- Recognize special characteristics of parabolas and circles (e.g., the vertex of a parabola and the center or radius of a circle).†
- Match number line graphs with solution sets of simple quadratic inequalities.
- Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$.
- Solve problems integrating multiple algebraic and/or geometric concepts.
- Analyze and draw conclusions based on information from graphs in the coordinate plane.

M6 Properties of Plane Figures

- Exhibit some knowledge of the angles associated with parallel lines.
- Find the measure of an angle using properties of parallel lines.
- Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90° , 180° , and 360°).
- Use several angle properties to find an unknown angle measure.
- Recognize Pythagorean triples.*
- Use properties of isosceles triangles.*
- Apply properties of 30° - 60° - 90° , 45° - 45° - 90° , similar, and congruent triangles.
- Use the Pythagorean theorem.
- Draw conclusions based on a set of conditions.

- Solve multistep geometry problems that involve integrating concepts, planning, visualization, and/or making connections with other content areas.
- Use relationships among angles, arcs, and distances in a circle.

M7 Measurement

- Estimate or calculate the length of a line segment based on other lengths given on a geometric figure.
- Compute the perimeter of polygons when all side lengths are given.
- Compute the area of rectangles when whole number dimensions are given.
- Compute the area and perimeter of triangles and rectangles in simple problems.
- Use geometric formulas when all necessary information is given.
- Compute the area of triangles and rectangles when one or more additional simple steps are required.
- Compute the area and circumference of circles after identifying necessary information.
- Compute the perimeter of simple composite geometric figures with unknown side lengths.*
- Use relationships involving area, perimeter, and volume of geometric figures to compute another measure.
- Use scale factors to determine the magnitude of a size change.
- Compute the area of composite geometric figures when planning or visualization is required.

M8 Functions

- Evaluate quadratic functions, expressed in function notation, at integer values.
- Evaluate polynomial functions, expressed in function notation, at integer values.†
- Express the sine, cosine, and tangent of an angle in a right triangle as a ratio of given side lengths.†
- Evaluate composite functions at integer values.†
- Apply basic trigonometric ratios to solve right-triangle problems.†
- Write an expression for the composite of two simple functions.†
- Use trigonometric concepts and basic identities to solve problems.†
- Exhibit knowledge of unit circle trigonometry.†
- Match graphs of basic trigonometric functions with their equations.

Notes

- Students who score in the 1–12 range are most likely beginning to develop the knowledge and skills assessed in the other ranges.
- Standards followed by an asterisk (*) apply to the PLAN and ACT Mathematics tests only.
- Standards followed by a dagger (†) apply to the ACT Mathematics test only.

Reading

R1 Main Ideas and Author's Approach

- Recognize a clear intent of an author or narrator in uncomplicated literary narratives.
- Identify a clear main idea or purpose of straightforward paragraphs in uncomplicated literary narratives.
- Infer the main idea or purpose of straightforward paragraphs in uncomplicated literary narratives.
- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in uncomplicated passages.
- Identify a clear main idea or purpose of any paragraph or paragraphs in uncomplicated passages.
- Infer the main idea or purpose of straightforward paragraphs in more challenging passages.
- Summarize basic events and ideas in more challenging passages.
- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in more challenging passages.
- Infer the main idea or purpose of more challenging passages or their paragraphs.
- Summarize events and ideas in virtually any passage.

- Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in virtually any passage.
- Identify clear main ideas or purposes of complex passages or their paragraphs.

R2 Supporting Details

- Locate basic facts (e.g., names, dates, events) clearly stated in a passage.
- Locate simple details at the sentence and paragraph level in uncomplicated passages.
- Recognize a clear function of a part of an uncomplicated passage.
- Locate important details in uncomplicated passages.
- Make simple inferences about how details are used in passages.
- Locate important details in more challenging passages.
- Locate and interpret minor or subtly stated details in uncomplicated passages.
- Discern which details, though they may appear in different sections throughout a passage, support important points in more challenging passages.
- Locate and interpret minor or subtly stated details in more challenging passages.
- Use details from different sections of some complex informational passages to support a specific point or argument.
- Locate and interpret details in complex passages.
- Understand the function of a part of a passage when the function is subtle or complex.

R3 Sequential, Comparative, and Cause—Effect Relationships

- Determine when (e.g., first, last, before, after) or if an event occurred in uncomplicated passages.
- Recognize clear cause—effect relationships described within a single sentence in a passage.
- Identify relationships between main characters in uncomplicated literary narratives.
- Recognize clear cause—effect relationships within a single paragraph in uncomplicated literary narratives.
- Order simple sequences of events in uncomplicated literary narratives.
- Identify clear relationships between people, ideas, and so forth in uncomplicated passages.
- Identify clear cause—effect relationships in uncomplicated passages.
- Order sequences of events in uncomplicated passages.
- Understand relationships between people, ideas, and so forth in uncomplicated passages.
- Identify clear relationships between characters, ideas, and so forth in more challenging literary narratives.
- Understand implied or subtly stated cause—effect relationships in uncomplicated passages.
- Identify clear cause—effect relationships in more challenging passages.
- Order sequences of events in more challenging passages.
- Understand the dynamics between people, ideas, and so forth in more challenging passages.
- Understand implied or subtly stated cause—effect relationships in more challenging passages.
- Order sequences of events in complex passages.
- Understand the subtleties in relationships between people, ideas, and so forth in virtually any passage.
- Understand implied, subtle, or complex cause—effect relationships in virtually any passage.

R4 Meaning of Words

- Understand the implication of a familiar word or phrase and of simple descriptive language.
- Use context to understand basic figurative language.
- Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in uncomplicated passages.
- Use context to determine the appropriate meaning of virtually any word, phrase, or statement in uncomplicated passages.
- Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in more challenging passages.

- Determine the appropriate meaning of words, phrases, or statements from figurative or somewhat technical contexts.
- Determine, even when the language is richly figurative and the vocabulary is difficult, the appropriate meaning of context-dependent words, phrases, or statements in virtually any passage.

R5 Generalizations and Conclusions

- Draw simple generalizations and conclusions about the main characters in uncomplicated literary narratives.
- Draw simple generalizations and conclusions about people, ideas, and so forth in uncomplicated passages.
- Draw generalizations and conclusions about people, ideas, and so forth in uncomplicated passages.
- Draw simple generalizations and conclusions using details that support the main points of more challenging passages.
- Draw subtle generalizations and conclusions about characters, ideas, and so forth in uncomplicated literary narratives.
- Draw generalizations and conclusions about people, ideas, and so forth in more challenging passages.
- Use information from one or more sections of a more challenging passage to draw generalizations and conclusions about people, ideas, and so forth.
- Draw complex or subtle generalizations and conclusions about people, ideas, and so forth, often by synthesizing information from different portions of the passage.
- Understand and generalize about portions of a complex literary narrative.

Science

S1 Interpretation of Data

- Select a single piece of data (numerical or non-numerical) from a simple data presentation (e.g., a table or graph with two or three variables, a food web diagram).
- Identify basic features of a table, graph, or diagram (e.g., headings, units of measurement, axis labels).
- Select two or more pieces of data from a simple data presentation.
- Understand basic scientific terminology.
- Find basic information in a brief body of text.
- Determine how the value of one variable changes as the value of another variable changes in a simple data presentation.
- Select data from a complex data presentation (e.g., a table or graph with more than three variables, a phase diagram).
- Compare or combine data from a simple data presentation (e.g., order or sum data from a table).
- Translate information into a table, graph, or diagram.
- Compare or combine data from two or more simple data presentations (e.g., categorize data from a table using a scale from another table).
- Compare or combine data from a complex data presentation.
- Interpolate between data points in a table or graph.
- Determine how the value of one variable changes as the value of another variable changes in a complex data presentation.
- Identify and/or use a simple (e.g., linear) mathematical relationship between data.
- Analyze given information when presented with new, simple information.
- Compare or combine data from a simple data presentation with data from a complex data presentation.
- Identify and/or use a complex (e.g., nonlinear) mathematical relationship between data.
- Extrapolate from data points in a table or graph.
- Compare or combine data from two or more complex data presentations.
- Analyze given information when presented with new, complex information.

S2 Scientific Investigation

- Understand the methods and tools used in a simple experiment.
- Understand the methods and tools used in a moderately complex experiment.
- Understand a simple experimental design.
- Identify a control in an experiment.
- Identify similarities and differences between experiments.
- Understand the methods and tools used in a complex experiment.
- Understand a complex experimental design.
- Predict the results of an additional trial or measurement in an experiment.
- Determine the experimental conditions that would produce specified results.
- Determine the hypothesis for an experiment.
- Identify an alternate method for testing a hypothesis.
- Understand precision and accuracy issues.
- Predict how modifying the design or methods of an experiment will affect results.
- Identify an additional trial or experiment that could be performed to enhance or evaluate experimental results.

S3 Evaluation of Models, Inferences, and Experimental Results

- Select a simple hypothesis, prediction, or conclusion that is supported by a data presentation or a model.
- Identify key issues or assumptions in a model.
- Select a simple hypothesis, prediction, or conclusion that is supported by two or more data presentations or models.
- Determine whether given information supports or contradicts a simple hypothesis or conclusion and why.
- Identify strengths and weaknesses in one or more models.
- Identify similarities and differences between models.
- Determine which model(s) is/are supported or weakened by new information.
- Select a data presentation or a model that supports or contradicts a hypothesis, prediction, or conclusion.
- Select a complex hypothesis, prediction, or conclusion that is supported by a data presentation or model.
- Determine whether new information supports or weakens a model and why.
- Use new information to make a prediction based on a model.
- Select a complex hypothesis, prediction, or conclusion that is supported by two or more data presentations or models.
- Determine whether given information supports or contradicts a complex hypothesis or conclusion and why.

Writing

W1 Expressing Judgments

- Show a little understanding of the persuasive purpose of the task, but neglect to take or to maintain a position on the issue in the prompt.
- Show limited recognition of the complexity of the issue in the prompt.
- Show a basic understanding of the persuasive purpose of the task by taking a position on the issue in the prompt but may not maintain that position.
- Show a little recognition of the complexity of the issue in the prompt by acknowledging, but only briefly describing, a counterargument to the writer's position.
- Show understanding of the persuasive purpose of the task by taking a position on the issue in the prompt.
- Show some recognition of the complexity of the issue in the prompt by doing the following:
 - Acknowledging counterarguments to the writer's position
 - Providing some response to counterarguments to the writer's position
- Show clear understanding of the persuasive purpose of the task by taking a position on the specific issue in the prompt and offering a broad context for discussion.

- Show recognition of the complexity of the issue in the prompt by doing the following:
 - Partially evaluating implications and/or complications of the issue
 - Posing and partially responding to counterarguments to the writer's position
- Show clear understanding of the persuasive purpose of the task by taking a position on the specific issue in the prompt and offering a critical context for discussion.
- Show understanding of the complexity of the issue in the prompt by doing the following:
 - Examining different perspectives
 - Evaluating implications or complications of the issue
 - Posing and fully discussing counterarguments to the writer's position

W2 Focusing on the Topic

- Maintain a focus on the general topic in the prompt through most of the essay.
- Maintain a focus on the general topic in the prompt throughout the essay.
- Maintain a focus on the general topic in the prompt throughout the essay, and attempt a focus on the specific issue in the prompt.
- Present a thesis that establishes focus on the topic.
- Maintain a focus on discussion of the specific topic and issue in the prompt throughout the essay.
- Present a thesis that establishes a focus on the writer's position on the issue.
- Maintain a clear focus on discussion of the specific topic and issue in the prompt throughout the essay.
- Present a critical thesis that clearly establishes the focus on the writer's position on the issue.

W3 Developing a Position

- Offer a little development, with one or two ideas; if examples are given, they are general and may not be clearly relevant; resort often to merely repeating ideas.
- Show little or no movement between general and specific ideas and examples.
- Offer limited development of ideas using a few general examples; resort sometimes to merely repeating ideas.
- Show little movement between general and specific ideas and examples.
- Develop ideas by using some specific reasons, details, and examples.
- Show some movement between general and specific ideas and examples.
- Develop most ideas fully, using some specific and relevant reasons, details, and examples.
- Show clear movement between general and specific ideas and examples.
- Develop several ideas fully, using specific and relevant reasons, details, and examples.
- Show effective movement between general and specific ideas and examples.

W4 Organizing Ideas

- Provide a discernible organization with some logical grouping of ideas in parts of the essay.
- Use a few simple and obvious transitions.
- Present a discernible, though minimally developed, introduction and conclusion.
- Provide a simple organization with logical grouping of ideas in parts of the essay.
- Use some simple and obvious transitional words, though they may at times be inappropriate or misleading.
- Present a discernible, though underdeveloped, introduction and conclusion.
- Provide an adequate but simple organization with logical grouping of ideas in parts of the essay but with little evidence of logical progression of ideas.
- Use some simple and obvious, but appropriate, transitional words and phrases.
- Present a discernible introduction and conclusion with a little development.
- Provide unity and coherence throughout the essay, sometimes with a logical progression of ideas.
- Use relevant, though at times simple and obvious, transitional words and phrases to convey logical relationships between ideas.
- Present a somewhat developed introduction and conclusion.

- Provide unity and coherence throughout the essay, often with a logical progression of ideas.
- Use relevant transitional words, phrases, and sentences to convey logical relationships between ideas.
- Present a well-developed introduction and conclusion.

W5 Using Language

- Show limited control of language by doing the following:
 - Correctly employing some of the conventions of standard English grammar, usage, and mechanics but with distracting errors that sometimes significantly impede understanding
 - Using simple vocabulary
 - Using simple sentence structure
 - Correctly employing some of the conventions of standard English grammar, usage, and mechanics but with distracting errors that sometimes impede understanding
 - Using simple but appropriate vocabulary
 - Using a little sentence variety, though most sentences are simple in structure
 - Correctly employing many of the conventions of standard English grammar, usage, and mechanics but with some distracting errors that may occasionally impede understanding
 - Using appropriate vocabulary
 - Using some varied kinds of sentence structures to vary pace
 - Correctly employing most conventions of standard English grammar, usage, and mechanics with a few distracting errors but none that impede understanding
 - Using some precise and varied vocabulary
 - Using several kinds of sentence structures to vary pace and to support meaning
 - Correctly employing most conventions of standard English grammar, usage, and mechanics with just a few, if any, errors
 - Using precise and varied vocabulary
 - Using a variety of kinds of sentence structures to vary pace and to support meaning

Appendix E: Pathway Content Standards

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

The AFNR Pathway Content Standards and Performance Elements are adapted from *National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards*. Reprinted with permission from the National Council for Agricultural Education, 1410 King Street, Suite 400, Alexandria, VA 22314. (800) 772-0939. Copyright © 2009. A complete copy of the National Standards can be downloaded from the Team Ag Ed Learning Center at <https://aged.learn.com>.

AGRIBUSINESS SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of principles and techniques for the development and management of agribusiness systems.

- ABS.01. Utilize economic principles to establish and manage an AFNR enterprise.**
 - ABS.01.01. Apply principles of capitalism in the business environment.
 - ABS.01.02. Apply principles of entrepreneurship in businesses.
- ABS.02. Utilize appropriate management planning principles in AFNR business enterprises.**
 - ABS.02.01. Compose and analyze a business plan for an enterprise.
 - ABS.02.02. Read, interpret, evaluate, and write a mission statement to guide business goals, objectives, and resource allocation.
 - ABS.02.03. Apply appropriate management skills to organize a business.
 - ABS.02.04. Recruit, train, and retain appropriate and productive human resources for business.
- ABS.03. Utilize record keeping to accomplish AFNR business objectives while complying with laws and regulations.**
 - ABS.03.01. Prepare and maintain all files needed to accomplish effective record keeping.
 - ABS.03.02. Implement appropriate inventory management practices.
- ABS.04. Apply generally accepted accounting principles and skills to manage cash budgets, credit budgets, and credit for AFNR businesses.**
 - ABS.04.01. Use accounting fundamentals to accomplish dependable bookkeeping and fiscal management.
- ABS.05. Assess accomplishment of goals and objectives by an AFNR business.**
 - ABS.05.01. Maintain and interpret financial information (income statements, balance sheets, inventory, purchase orders, accounts receivable, and cash-flow analyses) for businesses.
- ABS.06. Use industry-accepted marketing practices to accomplish AFNR business objectives.**
 - ABS.06.01. Conduct appropriate market and marketing research.
 - ABS.06.02. Develop a marketing plan.
 - ABS.06.03. Develop strategies for marketing plan implementation.
 - ABS.06.04. Develop specific tactics to market AFNR products and services.
- ABS.07. Create a production system plan.**
 - ABS.07.01. Prepare a step-by-step production plan that identifies needed resources.
 - ABS.07.02. Develop a production and operational plan.
 - ABS.07.03. Utilize appropriate techniques to determine the most likely strengths, weaknesses, and inconsistencies in a business plan, and relate these to risk management strategies.
 - ABS.07.04. Manage risk and uncertainty.

ANIMAL SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and practices to the production and management of animals.

- AS.01. Examine the components, historical development, global implications, and future trends of the animal systems industry.**
 - AS.01.01. Evaluate the development and implications of animal origin, domestication, and distribution.
- AS.02. Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics.**
 - AS.02.01. Classify animals according to hierarchical taxonomy and agricultural use.
 - AS.02.02. Apply principles of comparative anatomy and physiology to uses within various animal systems.
 - AS.02.03. Select animals for specific purposes and maximum performance based on anatomy and physiology.
- AS.03. Provide for the proper health care of animals.**
 - AS.03.01. Prescribe and implement a prevention and treatment program for animal diseases, parasites, and other disorders.
 - AS.03.02. Provide for the biosecurity of agricultural animals and production facilities.
- AS.04. Apply principles of animal nutrition to ensure the proper growth, development, reproduction, and economic production of animals.**
 - AS.04.01. Formulate feed rations to provide for the nutritional needs of animals.
 - AS.04.02. Prescribe and administer animal feed additives and growth promotants in animal production.
- AS.05. Evaluate and select animals based on scientific principles of animal production.**
 - AS.05.01. Evaluate the male and female reproductive systems in selecting animals.
 - AS.05.02. Evaluate animals for breeding readiness and soundness.
 - AS.05.03. Apply scientific principles in the selection and breeding of animals.
- AS.06. Prepare and implement animal handling procedures for the safety of animals, producers and consumers of animal products.**
 - AS.06.01. Demonstrate safe animal handling and management techniques.
 - AS.06.02. Implement procedures to ensure that animal products are safe.
- AS.07. Select animal facilities and equipment that provide for the safe and efficient production, housing, and handling of animals.**
 - AS.07.01. Design animal housing, equipment, and handling facilities for the major systems of animal production.
 - AS.07.02. Comply with government regulations and safety standards for facilities used in animal production.
- AS.08. Analyze environmental factors associated with animal production.**
 - AS.08.01. Reduce the effects of animal production on the environment.
 - AS.08.02. Evaluate the effects of environmental conditions on animals.

BIOTECHNOLOGY

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to biotechnology in agriculture.

BS.01. Recognize the historical, social, cultural, and potential applications of biotechnology.

- BS.01.01. Distinguish major innovators, historical developments, and potential applications of biotechnology in agriculture.
- BS.01.02. Determine regulatory issues, and identify agencies associated with biotechnology.
- BS.01.03. Analyze the ethical, legal, social, and cultural issues relating to biotechnology.

BS.02 Demonstrate laboratory skills as applied to biotechnology.

- BS.02.01. Maintain and interpret biotechnology laboratory records.
- BS.02.02. Operate biotechnology laboratory equipment according to standard procedures.
- BS.02.03. Demonstrate proper laboratory procedures using biological materials.
- BS.02.04. Safely manage biological materials, chemicals, and wastes used in the laboratory.
- BS.02.05. Perform microbiology, molecular biology, enzymology, and immunology procedures.

BS.03. Demonstrate the application of biotechnology to Agriculture, Food, and Natural Resources (AFNR).

- BS.03.01. Evaluate the application of genetic engineering to improve products of AFNR systems.
- BS.03.02. Perform biotechnology processes used in AFNR systems.
- BS.03.03. Use biotechnology to monitor and evaluate procedures performed in AFNR systems.

ENVIRONMENTAL SERVICE SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the management of environmental service systems.

ESS.01. Use analytical procedures to plan and evaluate environmental service systems.

- ESS.01.01. Analyze and interpret samples.

ESS.02. Assess the impact of policies and regulations on environmental service systems.

- ESS.02.01. Interpret laws affecting environmental service systems.

ESS.03. Apply scientific principles to environmental service systems.

- ESS.03.01. Apply meteorology principles to environmental service systems.
- ESS.03.02. Apply soil science principles to environmental service systems.
- ESS.03.03. Apply hydrology principles to environmental service systems.
- ESS.03.04. Apply best management techniques associated with the properties, classifications, and functions of wetlands.
- ESS.03.05. Apply chemistry principles to environmental service systems.
- ESS.03.06. Apply microbiology principles to environmental service systems.

ESS.04. Operate environmental service systems to manage a facility environment.

- ESS.04.01. Use pollution control measures to maintain a safe facility environment.
- ESS.04.02. Manage safe disposal of all categories of solid waste.
- ESS.04.03. Apply the principles of public drinking water treatment operations to ensure safe water at a facility.
- ESS.04.04. Apply principles of wastewater treatment to manage wastewater disposal in keeping with rules and regulations.
- ESS.04.05. Manage hazardous materials to assure a safe facility and to comply with applicable regulations.

- ESS.05. Examine the relationships between energy sources and environmental service systems.**
ESS.05.01. Compare and contrast the impact of conventional and alternative energy sources on the environment.
- ESS.06. Use tools, equipment, machinery, and technology to accomplish tasks in environmental service systems.**
ESS.06.01. Use technological and mathematical tools to map land, facilities, and infrastructure.
ESS.06.02. Maintain tools, equipment, and machinery in safe working order for tasks in environmental service systems.

FOOD PRODUCTS AND PROCESSING SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles, practices, and techniques in the processing, storage, and development of food products.

- FPP.01. Examine components of the food industry and historical development of food products and processing.**
FPP.01.01. Evaluate the significance and implications of changes and trends in the food products and processing industry.
FPP.01.02. Work effectively with industry organizations, groups, and regulatory agencies affecting the food products and processing industry.
- FPP.02. Apply safety principles, recommended equipment, and facility management techniques to the food products and processing industry.**
FPP.02.01. Manage operational procedures, and create equipment and facility maintenance plans.
FPP.02.02. Implement Hazard Analysis and Critical Control Point (HACCP) procedures to establish operating parameters.
FPP.02.03. Apply safety and sanitation procedures in the handling, processing, and storing of food products.
FPP.02.04. Demonstrate worker safety procedures with food product and processing equipment and facilities.
- FPP.03. Apply principles of science to the food products and processing industry.**
FPP.03.01. Apply principles of science to food processing to provide a safe, wholesome, and nutritious food supply.
- FPP.04. Select and process food products for storage, distribution, and consumption.**
FPP.04.01. Utilize harvesting, selection, and inspection techniques to obtain quality food products for processing.
FPP.04.02. Evaluate, grade, and classify processed food products.
FPP.04.03. Process, preserve, package, and present food and food products for sale and distribution.

NATURAL RESOURCE SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the management of natural resources.

- NRS.01. Explain interrelationships between natural resources and humans necessary to conduct management activities in natural environments.**
NRS.01.01. Apply knowledge of natural resource components to the management of natural resource systems.

- NRS01.02. Classify natural resources.
- NRS.02. Apply scientific principles to natural resource management activities.**
 - NRS.02.01. Develop a safety plan for work with natural resources.
 - NRS.02.02. Demonstrate cartographic skills to aid in developing, implementing, and evaluating natural resource management plans.
 - NRS.02.03. Measure and survey natural resource status to obtain planning data.
 - NRS.02.04. Demonstrate natural resource enhancement techniques.
 - NRS.02.05. Interpret laws related to natural resource management and protection.
 - NRS.02.06. Apply ecological concepts and principles to natural resource systems.
- NRS.03. Apply knowledge of natural resources to production and processing industries.**
 - NRS.03.01. Produce, harvest, process, and use natural resource products.
- NRS.04. Demonstrate techniques used to protect natural resources.**
 - NRS.04.01. Manage fires in natural resource systems.
 - NRS.04.02. Diagnose plant and wildlife diseases, and follow protocol to prevent their spread.
 - NRS.04.03. Manage insect infestations of natural resources.
- NRS.05. Use effective methods and venues to communicate natural resource processes to the public.**
 - NRS.05.01. Communicate natural resource information to the public.

PLANT SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the production and management of plants.

- PS.01. Apply knowledge of plant classification, plant anatomy, and plant physiology to the production and management of plants.**
 - PS.01.01. Classify agricultural plants according to taxonomy systems.
 - PS.01.02. Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.
 - PS.01.03. Apply knowledge of plant physiology and energy conversion to plant systems.
- PS.02. Prepare and implement a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.**
 - PS.02.01. Determine the influence of environmental factors on plant growth.
 - PS.02.02. Prepare growing media for use in plant systems.
 - PS.02.03. Develop and implement a fertilization plan for specific plants or crops.
- PS.03. Propagate, culture, and harvest plants.**
 - PS.03.01. Demonstrate plant propagation techniques.
 - PS.03.02. Develop and implement a plant management plan for crop production.
 - PS.03.03. Develop and implement a plan for integrated pest management.
 - PS.03.04. Apply principles and practices of sustainable agriculture to plant production.
 - PS.03.05. Harvest, handle, and store crops.
- PS.04. Employ elements of design to enhance an environment.**
 - PS.04.01. Create designs using plants.

POWER, STRUCTURAL AND TECHNICAL SYSTEMS

Pathway Content Standard: The student will demonstrate competence in the application of principles and techniques for the development and management of power, structural, and technical systems.

- PST.01. Use physical science principles and engineering applications with power, structural, and technical systems to solve problems and improve performance.**
- PST.01.01. Select energy sources in power generation appropriate to the situation.
 - PST.01.02. Apply physical science laws and principles to identify, classify, and use lubricants.
 - PST.01.03. Identify and use hand and power tools and equipment for service, construction, and fabrication.
- PST.02. Design, operate, and maintain mechanical equipment, structures, biological systems, land treatment, power, and technology.**
- PST.02.01. Perform service routines to maintain power units and equipment.
 - PST.02.02. Operate, service, and diagnose the condition of power units and equipment.
- PST.03. Service and repair mechanical equipment and power systems.**
- PST.03.01. Troubleshoot and repair internal combustion engines.
 - PST.03.02. Utilize manufacturers' guidelines to service and repair the power transmission systems of equipment.
 - PST.03.03. Service and repair hydraulic and pneumatic systems.
 - PST.03.04. Troubleshoot and service electrical systems.
 - PST.03.05. Service vehicle heating and air-conditioning systems.
 - PST.03.06. Service and repair steering, suspension, traction, and vehicle performance systems.
- PST.04. Plan, build and maintain agricultural structures.**
- PST.04.01. Create sketches and plans of agricultural structures.
 - PST.04.02. Apply structural plans, specifications, and building codes.
 - PST.04.03. Examine structural requirements for materials and procedures, and estimate construction cost.
 - PST.04.05. Follow architectural and mechanical plans to construct and/or repair equipment, buildings, and facilities.
- PST.05. Apply technology principles in the use of agricultural technical systems.**
- PST.05.01. Use instruments and meters to test and monitor electrical and electronic processes.
 - PST.05.02. Prepare and/or use electrical drawings to design, install, and troubleshoot control systems.
 - PST.05.03. Use geospatial technologies in agricultural applications.

Appendix F:

National Educational Technology Standards for Students

- T1** Creativity and Innovation
- T2** Communication and Collaboration
- T3** Research and Information Fluency
- T4** Critical Thinking, Problem Solving, and Decision Making
- T5** Digital Citizenship
- T6** Technology Operations and Concepts

T1 Creativity and Innovation

Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students do the following:

- a. Apply existing knowledge to generate new ideas, products, or processes.
- b. Create original works as a means of personal or group expression.
- c. Use models and simulations to explore complex systems and issues.
- d. Identify trends and forecast possibilities.

T2 Communication and Collaboration

Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students do the following:

- a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media.
- b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats.
- c. Develop cultural understanding and global awareness by engaging with learners of other cultures.
- d. Contribute to project teams to produce original works or solve problems.

T3 Research and Information Fluency

Students apply digital tools to gather, evaluate, and use information. Students do the following:

- a. Plan strategies to guide inquiry.
- b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
- c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks.
- d. Process data and report results.

T4 Critical Thinking, Problem Solving, and Decision Making

Students use critical-thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. Students do the following:

- a. Identify and define authentic problems and significant questions for investigation.
- b. Plan and manage activities to develop a solution or complete a project.
- c. Collect and analyze data to identify solutions and/or make informed decisions.
- d. Use multiple processes and diverse perspectives to explore alternative solutions.

T5 Digital Citizenship

Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior. Students do the following:

- a. Advocate and practice safe, legal, and responsible use of information and technology.
- b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity.
- c. Demonstrate personal responsibility for lifelong learning.

- d. Exhibit leadership for digital citizenship.

T6 Technology Operations and Concepts

Students demonstrate a sound understanding of technology concepts, systems, and operations. Students do the following:

- a. Understand and use technology systems.
- b. Select and use applications effectively and productively.
- c. Troubleshoot systems and applications.
- d. Transfer current knowledge to learning of new technologies.