

Title 7: Education K-12

Part 38: Agriculture Food and Natural Resources, Career Pathways

## Concepts of Agriscience

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**Program CIP:** 01.9999

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

research to the lives of the people of the state. The RCU works within the contexts of curriculum development and revision, research, assessment, professional development, and industrial training.

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Standards in the *Concepts of Agriscience Curriculum Framework and Supporting Materials* are based on the following documents:

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

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

**Applied Academic Credit Benchmarks**

*Mississippi Department of Education 2010 Mississippi Science Framework*

**21st Century Skills and Information and Communication Technologies Literacy Standards**

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

**National Educational Technology Standards for Students**

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### **ACT College Readiness Standards**



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

## Preface

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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

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## Agricultural and Environmental Science and Technology Research

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

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

## Employment Projections

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

## Industry Job Data – Employment Projections 2006 to 2016 for Mississippi

<b>Animal Breeders</b>	9,770	9,870	100	1.0	165
<b>Agricultural and Food Science Technicians</b>	260	310	50	19.2	10
<b>Agricultural Equipment Operators</b>	1,090	1,190	100	9.2	40
<b>Agricultural Sciences Teachers, Postsecondary</b>	190	240	50	26.3	20
<b>Conservation Scientists</b>	790	890	100	12.7	30
<b>Custodial and Caretaking Supervisors and Workers</b>	46,920	54,110	7,190	15.3	2,320
<b>Environmental Engineers</b>	270	320	50	18.5	10
<b>Environmental Engineering Technicians</b>	50	100	50	100.0	0

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

*Note: Compiled by Mississippi Department of Employment Security and Labor Market Information Department 2009)*

## Occupational Employment and Wage Estimates for Mississippi, May 2006

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

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

### Curriculum Content

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

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

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

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

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## Program Description

Concepts of Agriscience is the foundation course for the Agricultural and Environmental Science and Technology program. All students must complete Concepts of Agriscience before being allowed to enroll in the advanced courses of the program. The course serves as an introduction to the sciences, technologies, and applied practices of the progressive agriculture/agriscience industry. Emphasis is on an active learning environment enriched with technology and science-based applications. The course focuses on providing an opportunity for students to explore the different fields of the agricultural sciences and develop foundation skills and knowledge needed for advancement in other courses and programs. Concepts of Agriscience may be taught to students in grade 9 or 10. The course carries one Carnegie unit of credit that can count as a science elective credit for high school graduation.

## Industry Certification

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

## Articulation

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 paths of study. The second course may be one of the following:

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

The MS-CPAS2 blueprint can be found at <http://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

Concepts of Agriscience may be taken by any student enrolled in grade 9 or 10. It is suggested that students enrolling in the course possess at least a C average in previous science courses and a TABE reading score at the eighth-grade level or higher.

## Applied Academic Credit

Content of the Concepts of Agriscience course has been aligned to the *2010 Mississippi Science Curriculum Framework*. Students who complete Concepts of Agriscience will receive one elective science credit that will count toward high school science graduation requirements.

## Licensure Requirements

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

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

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

## Professional Learning

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

## Course Outlines

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

### Concepts of Agriscience (One Carnegie Unit) - Course Code: 991000

1	Introduction to Agricultural and Environmental Science and Technology *	5
2	Leadership and Human Relations *	10
3	Supervised Agricultural Experience *	5
4	Science of Agricultural Animals	25
5	Science of Agricultural Plants	25
6	Science of Agricultural Environment	25
7	Science of Agricultural Mechanization	15
<b>Total Hours</b>		<b>110</b>

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

# Using This Document

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## **Unit Number and Title**

### **Suggested Time on Task**

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

### **Competencies and Suggested Objectives**

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

### **Suggested Teaching Strategies**

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

### **Suggested Assessment Strategies**

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

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

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

### **References**

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

# Concepts of Agriscience

## Unit 1: Introduction to Agricultural and Environmental Science and Technology

5 Hours

Competency 1: Examine the nature of the agriculture and natural resources industry. AS.01, BS.01, FPP.01

### Suggested Enduring Understandings

1. Agriculture in the United States has evolved from subsistence farming into a diverse industry involving the production, marketing, and processing of food and fiber and the conservation and use of natural resources.
2. Advances in technology and techniques have allowed American agriculture to produce more products on reduced acreages and with reduced labor requirements.
3. Agriculture and natural resources in the United States today are responsible for producing a diverse number of products used for food, clothing, shelter, pharmaceutical, energy, and other needs.
4. Education and training opportunities for careers in agriculture and natural resources exist in community/junior colleges, technical institutes, and colleges and universities.
5. Globalization of agriculture has resulted in lowering costs of agricultural and natural resource products, increased competition for U.S. producers, and raised questions over product quality and safety.

### Suggested Essential Questions

1. How has the nature of agriculture and natural resources changed over the past century?
2. How have new technologies and practices affected agricultural and natural resources production?
3. What products are manufactured today from agriculture and natural resources enterprises?
4. What education and training opportunities exist in agriculture and natural resources?
5. How has the globalization of trade affected agriculture and natural resources industries in the United States?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Investigate the scope of the agricultural and natural resources industry. (DOK 1)	a. Have students brainstorm their perceptions of agriculture in the modern world. Through class discussion, expand the students' perceptions of agriculture from subsistence farming to a diverse industry involving the production, marketing, and processing of food and fiber products and the conservation and use of natural resources. Have students identify agricultural products that they use on a daily basis. <small>CS1, CS2</small>	a. Monitor the discussion to make sure that all students have a chance to participate.
b. Trace the development of agricultural sciences and technologies in	b. Pair students, and assign a specific agricultural science or technology such as machinery, chemicals, genetics, environmental services, natural resources, biotechnology, and so forth.	b. Use the <i>Agriculture Timeline Graphic Rubric (1.1)</i> to evaluate the

the United States. (DOK 1)	Have each pair research the topic and create a time line that shows at least three important events in the development of science or technology and describe how these developments have affected modern agriculture and natural resources practices. <small>CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, M5, R3, W1, W2, W4, W5</small>	students' performance on the development time line.
c. Associate the major areas of agriculture and natural resources with their products and practices. (DOK 1)	c. Assign each student one of the major areas of agriculture and natural resources. Have him or her prepare a graphic (PowerPoint slide, poster, etc.) that illustrates at least three major products or practices associated with this area. <small>CS1, CS2, CS4, T1, T3, T6</small>	c. Use the <i>Agriculture and Natural Resources Areas Graphic Rubric (1.2)</i> to evaluate the students' performance in creating the graphic.
d. Investigate education and training opportunities in agriculture and natural resources. (DOK 1)	d. Have students begin the process of exploring careers in the agriculture and natural resources industry by conducting searches and visiting Web sites of universities, colleges, community and junior colleges, and technical institutes that offer programs in agriculture and natural resources. Have students identify and compare the entrance requirements and estimated costs for at least one university program and one community/junior college program. <small>CS1, CS2, CS4 T1, T3, T6, R3, W4, W5</small>	d. Evaluate the students' table comparing entrance requirements and costs for accuracy and completeness.
e. Examine the scope of the agricultural and natural resources industry from a global perspective. (DOK 1)	e. Have students go to their local retailers and determine the country of origin for different food, clothing, and other agricultural products. Discuss the implications of global agriculture to the United States and to Mississippi including competition, product quality, and food safety. Use current news stories to illustrate these implications. <small>CS1, CS2, CS4, T1, T3, T6, R3, W4, W5</small>	e. Use a written test to evaluate student understanding.

**Competency 2:** Examine the relationships between the pure sciences, agriculture, and agriscience. AQ 1,

BIOI 1, BIOII 1, BO 1, ES 1, G 1, PS 1, ZO 1

**Suggested Enduring Understandings**

1. The applied agricultural sciences represent extensions of several of the pure sciences.
2. Both the pure sciences and the agricultural sciences depend upon the scientific method for conducting experiments.

**Suggested Essential Questions**

1. What is the relationship of the pure sciences to the applied agricultural sciences?
2. What is the scientific method?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
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a. Associate the pure sciences with agricultural and agriscience areas. (DOK 1)	a. Provide students with a listing of the pure sciences (biology, chemistry, physics, and mathematics) and the applied agricultural sciences (agronomy, soils, entomology, animals, plants, etc.). Define each science. Have students correctly identify which pure sciences are associated with each agricultural science. <small>CS2, R4, S2</small>	a. Use <i>Relationship of Pure Sciences to Agricultural Sciences Assignment (1.3)</i> to evaluate student performance.....
b. Develop a plan for conducting an experiment using the scientific method. (DOK 2)	b. Use the video <i>The Scientific Method</i> to define and illustrate the steps in the scientific method. Have students take notes on the major steps in the scientific method and transcribe them into their electronic notebooks or journals. Hold a classroom discussion to make sure that all students have correctly identified the basic steps in the scientific method. Have each student to develop a plan for an experiment illustrating each basic step. Have the students enter their plans in their electronic portfolios. <small>CS1, CS4, T1, T2, T6, M5, W2, S2</small>	b. Use the <i>Planning an Experiment Rubric (1.4)</i> to evaluate student performance.

**Competency 3: Apply standard agricultural and natural resources safety practices.**

**Suggested Enduring Understandings**

- Using proper safety precautions and equipment is the responsibility of every member of a work team or class. Safety precautions are learned and transfer to the workplace.
- Each student is responsible for understanding the safety rules and practices that must be followed in the AEST classroom and lab, including the use of personal protection devices.
- Information on the use, storage, and disposal of hazardous materials can be found on a material safety data sheet (MSDS), which an employer is required to have on hand.
- Workers should be fully aware of safety devices and warnings in the workplace and their meaning or operation.
- The use of personal protection devices and proper dress is critical to worker safety.
- There are four different types of fires, and each different type requires different methods of control.

**Suggested Essential Questions**

- What are the general safety standards that apply to work teams in the workplace?
- What are the specific safety rules and practices that must be followed when working in the AEST classroom and laboratory?
- What information can be obtained from an MSDS?
- What safety devices and warning devices are used in the Agriculture Mechanization laboratory? What do the warnings mean? How do the devices operate?
- What personal safety devices and clothing should be worn in the workplace or laboratory?
- What should be done if a fire breaks out in the lab or workplace?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Apply safety standards in the workplace. (DOK 1)	a. Invite a safety specialist to present a safety demonstration to the class regarding the importance of safety and standard safety	a. Evaluate the students' electronic

		precautions used in the workplace. Have students take notes during the presentation and transcribe them into their electronic journals or notebooks. Follow up the presentation with a class discussion to make sure that all students identified the major points. <small>CS2, CS4, TS1, T2, T6, R1, R5</small>	notebooks or journals to make sure that all major points are covered.
b. Apply safety standards in the agricultural classroom and laboratory. (DOK 3)	b. Provide students with written guidelines for safety in the AEST classroom and laboratory, including the use of personal safety equipment. Identify the location of safety equipment, and discuss procedures for dealing with accidents, injuries, spills, and so forth. <small>CS2, CS4, T6, R1, R2, R3</small>		b. Use a written test to determine the students' initial understanding of the safety standards that apply to the classroom and lab. Students will be constantly observed while in the laboratory area and periodically evaluated regarding the use of safety rules and equipment using the <i>Laboratory Safety Rubric (1.5)</i> .
c. Interpret information on a material safety data sheet (MSDS). (DOK 2)	c. Divide students into pairs, and assign each pair a specific chemical material. Have students locate an MSDS on the Internet and complete an assignment to interpret information related to the use of the material. <small>CS1, CS2, CS4, T1, T3, T4, T6, R1, R2, R5</small>		c. Use <i>Interpret a Hazardous Material Safety Data Sheet Assignment (1.6)</i> to evaluate student performance on this indicator.
d. Describe the use of general safety using hand equipment and indicators to include safety color codes, fire extinguishers, first aid kits, emergency exits, and so forth. (DOK 1)	d. Have students draw a diagram of the Agricultural Mechanization laboratory showing the location of all safety devices and equipment. Have students complete steps 6–8 in Activity 1 in the <i>Agriculture Mechanics</i> module. <small>CS1, CS2, CS4, T6</small>		d. Evaluate the drawing for accuracy and completeness. Use the quiz in the module to evaluate understanding of general safety equipment and color codes.
		Have students identify each tool by its correct name and classify it as being a layout tool, cutting	Use the Tool Test in the module to

		tool, boring tool, driving tool, turning tool, or holding tool. Have students complete Step 3 in Activity 3 of the <i>Agriculture Mechanics</i> module. <small>CS1, CS2, CS4, T2, T3, T6</small>	evaluate student understanding.		
e.	Apply safety precautions related to dress and personal protection devices. (DOK 2)	e.	Have students complete Step 3 in Activity 2 of the <i>Agriculture Mechanics</i> module and complete Section 1 of the <i>Safety Worksheet</i> in the module. <small>CS1, CS2, CS4, T6, R2, R5</small>	e.	Evaluate the <i>Safety Worksheet</i> for accuracy and completeness.
f.	Select procedures for dealing with the different classes of fire. (DOK 2)	f.	Have students complete Step 5 in Activity 2 of the <i>Agriculture Mechanics</i> module and complete Section 2 of the <i>Safety Worksheet</i> . <small>CS1, CS2, CS4, T6, R2, R5</small>	f.	Evaluate the <i>Safety Worksheet</i> for accuracy and completeness.

# Standards

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## **AFNR Industry Standards**

- AS.01 Examine the components, historical development, global implications, and future trends of the animal systems industry.
- BS.01 Recognize the historical, social, cultural, and potential applications of biotechnology.
- FPP.01 Examine components of the food industry and historical development of food products and processing.

## **Applied Academic Credit Standards**

### ***Aquatic Science***

- AQ 1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.

### ***Biology I***

- BIOI 1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.

### ***Biology II***

- BIOII 1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.

### ***Botany***

- BO 1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.

### ***Environmental Science***

- ES 1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.

### ***Genetics***

- G 1 Use critical thinking and scientific problem solving in designing and performing biological research and experimentation.

### ***Physical Science***

- PS 1 Demonstrate the proper use of scientific methods and investigative techniques.

### ***Zoology***

- ZO 1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.

## **21st Century Learning Standards**

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

CS5 Leadership and Responsibility

**National Educational Technology Standards for Students**

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

**ACT College Readiness Standards**

- M5 Graphical Representations
- R1 Main Ideas and Author’s Approach
- R2 Supporting Details
- R3 Sequential, Comparative, and Cause–Effect Relationships
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- S2 Scientific Investigation
- W1 Expressing Judgments
- W2 Focusing on the Topic
- W4 Organizing Ideas
- W5 Using Language

## Suggested References

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

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

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

Mississippi Department of Agriculture and Commerce. (2010). *Mississippi agriculture overview*. Retrieved June 8, 2010, from [http://www.mdac.state.ms.us/n\\_library/misc/ag\\_overview.html](http://www.mdac.state.ms.us/n_library/misc/ag_overview.html)

United States Department of Agriculture. (2010). *National agricultural statistics service (NASS)*. Retrieved June 8, 2010, from <http://www.nass.usda.gov/>

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

# Concepts of Agriscience

## Unit 2: Leadership and Human Relations

10 Hours

**Competency 1:** Develop life and career skills for success in the 21st century.

### Suggested Enduring Understandings

1. In addition to the technical skills required to obtain a job, people need essential life and career skills to succeed in a career including leadership, team-building, and human relations skills and work ethics and values.

### Suggested Essential Questions

1. What are the necessary life and career skills for success in the modern world?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify, describe, and apply essential life and career skills. (DOK 3)	a. Provide students with the listing of <i>21st Century Life and Career Skills (2.1)</i> found in this unit. Lead students in a discussion of how these skills apply to their current careers as students and will apply to their career success after school. Provide students with a copy of the rubric that will be used to evaluate each student's demonstration of life and career skills. Have students self-evaluate their current scores on this rubric and explain that they will be periodically (at least once a grading period) be graded on their ability to demonstrate these skills. <small>CS1, CS2, CS3, CS4, CS5</small>	a. Use <i>21st Century Life and Career Skills Rubric (2.2)</i> for assessing student ability to demonstrate the essential life and career skills.
b. Apply the concepts of team building and team member participation. (DOK 3)	b. Lead a classroom discussion on the basic concepts of team building and team member participation. Explain to the students that they will be working in pairs or on teams in many of the activities related to the AEST program. Provide students with a copy of the rubric that will be used periodically to evaluate their team-building and participation skills. <small>CS1, CS2, CS3, CS4, CS5</small>	b. Use the <i>Rubric for Assessing Team Building and Participation Skills (2.3)</i> to periodically evaluate the team-building and participation skills of all students.
c. Demonstrate basic parliamentary procedures. (DOK 3)	c. Ask students to identify situations in which they have seen parliamentary procedure used, and have them describe their experiences. Identify the purpose and form for a main motion, amendment, and privileged motion. Have students practice these steps in small groups and during FFA chapter and committee meetings. <small>CS5</small>	c. Use the <i>Scorecard for Assessing Parliamentary Procedures Skills (2.4)</i> to evaluate parliamentary procedure skills of students.

**Competency 2:** Explore the role of the FFA in promoting leadership, personal development, and human relations skills.

### Suggested Enduring Understandings

1. The FFA is an integral part of the Agricultural and Environmental Science and Technology program,

### Suggested Essential Questions

1. What is the role of the FFA in the AEST

promoting leadership, human relations, and technical skill attainment and providing recognition for accomplishments.

program?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Explore the history and nature of the FFA in promoting and developing leadership, personal development, and human relations skills. (DOK 1)	a. Using the history of the FFA, the FFA creed, the FFA opening and closing ceremony, and other FFA activities, identify and discuss with the students the role of the organization in developing leadership, personal development, and human relations skills. <small>CS1, CS2, CS3, CS4, CS5</small>	a. Monitor discussion to ensure that all students are participating and attentive.
b. Identify career-related values and ethics promoted through the FFA. (DOK 1)	b. Have students read the FFA creed and complete an assignment to identify and describe in their own words the values and ethics represented in the creed. Have students share and critique their completed assignments. Hold a class discussion to identify key values and ethics promoted through the FFA. Have students record these values and ethics in their electronic journals. <small>CS1, CS2, CS3, CS4, CS5, T1, T2, T5, T6, E1, E2, E3, E4, E5, E6, W1, W2, W3, W4, W5</small>	b. Evaluate the summaries in the electronic journals for completeness and accuracy.
c. Identify benefits of FFA membership. (DOK 1)	c. Have an officer of the local FFA chapter speak to the class on the benefits of membership. Have the students take notes on the presentation. Following the presentation, lead a class discussion to identify and summarize the benefits. Have students transcribe the findings into their electronic notebooks or journals. <small>CS1, CS2, CS3, CS4, CS5, T2, T5, T6, E1, E2, E3, E4, E5, E6, W1, W2, W3, W4, W5</small>	c. Evaluate the students' electronic notebooks or journals for completeness and accuracy.
d. Select FFA activities that promote personal development and leadership skills. (DOK 1)	d. Have students search the FFA Web site ( <a href="http://www.ffa.org">http://www.ffa.org</a> ) and identify and describe an activity or program in which they would like to participate. Have students continue their research to learn what skills and knowledge they must master to participate. Have students complete an assignment on selecting personal development and leadership activities. <small>CS1, CS2, CS3, CS4, CS5, T3, T4, T6</small>	d. Have students peer review and comment on the completed attachment, <i>Select a Personal/Leadership Activity Assignment (2.5)</i> .

**Competency 3: Examine the concept of leadership.**

**Suggested Enduring Understandings**

1. Leadership is the ability to influence people to accomplish goals and objectives of an organization.
2. Leadership skills can be learned.

**Suggested Essential Questions**

1. What is leadership?
2. What are the traits of successful leaders?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
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a. Explain the role of effective leadership. (DOK 1)	a. Have students name people in their lives that they perceive as leaders and describe ways in which these people exhibit leadership. From this discussion, draw out a definition of leadership and the characteristics of leaders. Have students write a summary of findings in their own words and transcribe into their electronic journals or notebooks. <small>CS5, T2, T6, E1, E2, E3, E4, E5, E6, W1, W2, W3, W4, W5</small>	a. Evaluate electronic journals or notebooks for completeness and accuracy.
b. Have students self-evaluate their personal leadership traits and develop a plan for improvement. (DOK 2)	b. Provide the students with a survey instrument that lists major traits and characteristics of successful leaders. (See the <i>Leadership Characteristics Survey [2.6]</i> .) Define and discuss these traits and characteristics. Have students rate their ability to exhibit these characteristics and identify three that they will work on improving over the course of the school year. <small>CS1, CS2, CS3, CS4, CS5</small>	b. Have students peer review other students' surveys and offer comments and recommendations on improvement practices.

**Competency 4:** Describe the role of work ethics and values in establishing and building a successful career.

**Suggested Enduring Understandings**

1. Work ethics and values are essential for success in all career fields.

**Suggested Essential Questions**

1. What is the role of work ethics and values in establishing and building a successful career?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Define and describe universally accepted work ethics and values as applied to agricultural and natural resources careers. (DOK 1)	a. Invite a human resources person from a local industry or business to speak to the class regarding the importance of universally accepted work ethics such as attendance, promptness, responsibility, trustworthiness, loyalty, and so forth. Have students summarize the key points from the presentation and transcribe into their electronic notebooks or journals. <small>CS1, CS2, CS3, CS4, CS5, T2, T6, E1, E2, E3, E4, E5, E6, W1, W2, W3, W4, W5</small>	a. Evaluate electronic notebooks/ journals for accuracy and completeness.
b. Practice work ethics and values in the agriscience classroom and lab. (DOK 2)	b. Students will be evaluated on their practice of work ethics and values periodically through the activities and assignments made in the remainder of the course. <small>CS1, CS2, CS3, CS4, CS5</small>	b. Use the <i>Sample Rubric for Evaluating Work Ethics and Values (2.7)</i> to evaluate student work ethics and values periodically, or add indicators of work ethics and values to other rubrics used in the course.

# Standards

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## **21st Century Learning Standards**

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

## **National Educational Technology Standards for Students**

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

## **ACT College Readiness Standards**

- E1 Topic Development in Terms of Purpose and Focus
- E2 Organization, Unity, and Coherence
- E3 Word Choice in Terms of Style, Tone, Clarity, and Economy
- E4 Sentence Structure and Formation
- E5 Conventions of Usage
- E6 Conventions of Punctuation
- W1 Expressing Judgments
- W2 Focusing on the Topic
- W3 Developing a Position
- W4 Organizing Ideas
- W5 Using Language

## Suggested References

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

CORD Communications. (2003). *Necessary skills now: Facilitator's guide*. Waco, TX: Author.

Morgan, E., Lee, J., & Wilson, E. (2004). *Agriscience explorations*. Upper Saddle River, NJ: Prentice Hall.

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National FFA Organization. (2010). *Local program success guide*. Retrieved June 8, 2010, from [http://www.ffa.org/documents/lps\\_guide.pdf](http://www.ffa.org/documents/lps_guide.pdf)

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

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

# Concepts of Agriscience

## Unit 3: Experiential Learning (SAE)

5 Hours

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

### Suggested Enduring Understandings

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

### Suggested Essential Questions

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

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Update and revise long-range and short-term goals of the experiential learning program. (DOK 3)	a. Students can do a scavenger hunt activity using <i>Experiential Learning Scavenger Hunt (3.2)</i> . Based on the summary and analysis of the students' previous experiential learning activities, have students reflect and revise or amend their experiential learning long-range and short-term goals for the coming year. The goals should be added to the students' electronic portfolios. <small>CS1, CS2, CS4, T1, T3, T4, T6, W1, W2, W4, W5</small>	a. Use an experiential learning planning rubric and record-keeping rubric to evaluate the students' goals. (See the <i>Rubric for Experiential Learning Planning and Record Keeping [3.1]</i> .)
b. Update, revise, and implement the experiential learning plan/training agreement for the coming year. (DOK 3)	b. Based on the revised goals, have students update, amend, and revise their experiential learning plans/training agreements to reflect growth in skill and proficiency levels. The updated plans should be added to the students' electronic portfolios. Students can use <i>Experiential Learning Goals and Plans (3.3)</i> as a guide. <small>CS1, CS2, CS4, T1, T3, T4, T6, W1, W2, W4, W5</small>	b. Use an experiential learning planning rubric and record-keeping rubric to evaluate the students' goals. (See the <i>Rubric for Experiential Learning Planning and Record Keeping [3.1]</i> .)

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

### Suggested Enduring Understandings

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

### Suggested Essential Questions

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

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

<p>related income, expenses, activities, skills, and supplementary improvement projects. (DOK 3)</p>	<p>electronically throughout the year. M1, M2, W4</p>	<p>CS2, CS4, T3, T4, T6,</p>	<p><i>Keeping (3.1)</i> to evaluate the students' goals.</p>
<p>b. Prepare an annual summary report. (DOK 3)</p>	<p>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</p>	<p>b. Use the <i>Rubric for Experiential Learning Planning and Record Keeping (3.1)</i> to evaluate the students' summaries.</p>	

# Standards

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## **AFNR Industry Standards**

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

## **21st Century Learning Standards**

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

## **National Education Technology Standards for Students (NETS)**

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

## **ACT College Readiness Standards**

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

## Suggested References

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

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# Concepts of Agriscience

## Unit 4: Science of Agricultural Animals

25 Hours

**Competency 1:** Explore the animal agriculture industry and enterprises. AS.01, AS.02, BIOI 5, ZO 1

### Suggested Enduring Understandings

1. Domesticated animals continue to provide services to humanity in a number of ways including providing meat and dairy products, wool, labor and service, and companionship.
2. The production, processing, and marketing of animals and animal products are a major industry in the United States.
3. Agricultural producers are concerned about the treatment of animals and take necessary actions to prevent animals from abuse or neglect.

### Suggested Essential Questions

1. What benefits does humanity obtain from domesticated animals?
2. What processes are used in the production, processing, and marketing of animals and animal products?
3. How is the agricultural animal industry reacting to the animal rights and welfare issue?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Associate the different classes of domestic animals with ways that each benefits humanity (beef and dairy cattle, horse, swine, poultry, catfish, goats, and sheep). (DOK 1)	a. Have the students construct a chart showing the different classes of domesticated animals, examples of species that fall into each class, and the benefits of each class to humanity. (See the <i>Domesticated Animals Benefits [4.1]</i> assignment in this unit for an example of a chart.) Have students save the chart in their electronic journals. In Activity 1 of the <i>Animal Science</i> and <i>Aquaculture</i> modules, have students watch the introductory video and read the material on the different classes of domestic animals. <small>CS1, CS2,, CS4, T1, T3, T6, W4</small>	a. Evaluate the charts for completeness and accuracy.
b. Explore the production, processing, and marketing of major animal enterprises (beef and dairy cattle, horse, swine, poultry, catfish, goats, and sheep). (DOK 2)	b. These activities deal with beef and dairy cattle, horse, swine, poultry, aquaculture, sheep, and alternative animal production practices. Have students answer the questions in the module related to each enterprise and record their answers in their electronic journals. Have students complete activities 6, 7, and 8 in the <i>Animal Science</i> module and Activity 7 of the <i>Aquaculture</i> module. <small>CS1, CS2, CS4, T1, T3, T6</small>	b. Evaluate the students' electronic journals for accuracy and completeness.
c. Compare the concepts of animal rights and animal welfare as related to agricultural animal enterprises. (DOK 2)	c. Have the students read the chapter on animal welfare in the text. Have the students write a letter to an animal welfare organization that has objected to conditions regarding production practices such as confinement, use of drugs, debeaking, and so forth. (See the <i>Letter of Concern Regarding Production Practices [4.2]</i> in this unit for an example of such a letter.) The letter should report in factual terms the advantages and benefits of these practices. <small>CS1, CS2,</small>	c. Use <i>Sample Rubric for Evaluating a Response to a Letter of Concern (4.3)</i> to evaluate the student mastery.

## Competency 2: Investigate the anatomy and physiology of animals. AS.02, BIOI 2, BIOI 3, BIOII 2, ZO 2, ZO 3

### Suggested Enduring Understandings

1. The basic building block of an animal's body is the cell.
2. Through the process of mitosis, cells divide and reproduce to produce an animal.
3. An animal's body is composed of a number of specialized cells that form tissues, organs, and systems to perform specific functions for growth and reproduction.
4. Reproduction begins with the creation of an embryo. Mammalian embryos develop inside the mothers' bodies. Avian embryos develop outside of the mothers' bodies.

### Suggested Essential Questions

1. What are the functions of the different parts of a cell?
2. How does mitosis allow cells to divide and reproduce?
3. What are the components and functions of the major systems of an animal's body?
4. How is the reproduction process in mammals and birds similar yet different?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Diagram the major components of an animal cell, and list their functions. (DOK 1)	a. Have the students draw a typical animal cell showing its major parts and describing each part's function or purpose. Have students complete Activity 3 in the <i>Animal Science</i> module. <small>CS1, CS2, CS4, T1, T3, T6, W1, W2, W3, W4, W5</small>	a. Evaluate student drawings for accuracy and completeness.
b. Explain animal growth and reproduction by cell mitosis and meiosis. (DOK 2)	b. Have the students draw diagrams of the process of meiosis and scan them into their electronic notebooks. Using the Microslide viewer and prepare slides provided as part of the <i>Animal Science</i> module, have students view the process of mitosis and meiosis. Have them record their observations in their electronic journals. <small>CS1, CS2, CS4, T1, T3, T6</small>	b. Evaluate journals for accuracy and completeness. Evaluate the accuracy and completeness of the students' drawings of the process of meiosis.
c. Identify the basic anatomical and physiological features of animals and catfish including respiration, digestion, and reproductive processes. (DOK 1)	c. Have students make a table that identifies each body system and its components and explains its function and purpose. Have students complete Step 3 in Activity 4 of the <i>Animal Science</i> module and Activity 7 of the <i>Aquaculture</i> module. <small>CS1, CS2, CS4, T1, T3, T6</small>	c. Evaluate the students' work on the <i>Major Animal Body Systems, Components, and Functions (4.4)</i> and <i>Anatomical Comparison Assignment (4.5)</i> .
d. Compare the reproduction process in mammals, poultry, and catfish. (DOK 2)	d. Have students complete Step 4 in Activity 5 of the <i>Animal Science</i> module and Activity 7 of the <i>Aquaculture</i> module. As students read the material, have them answer the questions in Quiz 2 of the <i>Animal Science</i> module and the <i>Developmental</i>	d. Evaluate accuracy of answers to Quiz 2.

**Competency 3: Describe important elements of digestion and nutrition in animals.** <sup>AS.04, ZO 2, ZO 3</sup>

**Suggested Enduring Understandings**

1. While the end result of digestion is the absorption of nutrients by the bloodstream, the process differs from one species to another. Because of these differences, the ration fed to an animal must be altered.
2. Six different classes of nutrients are needed by an animal for optimum growth and development.
3. A variety of feedstuffs is used in developing animal rations.

**Suggested Essential Questions**

1. How does the digestive process differ from one species of animal to another?
2. What are the six essential nutrients, and how are they used for growth and development?
3. What are the most commonly used feedstuffs for animal rations, and with which species is each associated?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
<p>a. Compare and contrast the digestive systems and processes in cows and sheep, horses, swine, chickens, and catfish. (DOK 2)</p>	<p>a. Have students develop a chart or table that names the different types of digestive systems and the animals associated with each system. The table should also show similarities and contrasts between the different systems related to ration development and nutritional needs. Have students complete steps 2 and 3 of Activity 5 in the <i>Animal Science</i> module and Activity 6 of the <i>Aquaculture</i> module. <sup>CS1, CS2, CS4, T1, T2, T4</sup></p>	<p>a. Evaluate the charts for accuracy and completeness.</p>
<p>b. Associate each of the six major classes of nutrients with their roles and functions. (DOK 1)</p>	<p>b. Have students list the six major classes of nutrients and describe their roles and functions in an animal's growth and development. The six major classes are as follows:</p> <ul style="list-style-type: none"> <li>• Proteins</li> <li>• Carbohydrates</li> <li>• Vitamins</li> <li>• Fats</li> <li>• Water</li> <li>• Minerals</li> </ul> <p>Have students record their findings in their electronic journals. Have students complete Step 3 of the <i>Animal Science</i> module and Activity 6 of the <i>Aquaculture</i> module. <sup>CS1, CS2, CS4, T1, T2, T4</sup></p>	<p>b. Evaluate the student notebooks or journals for completeness, accuracy, and grammar.</p>

<p>c. Classify and discuss the use of feedstuffs as roughages, concentrates, and processed feeds. (DOK 1)</p>	<p>c. Have students identify common feedstuffs associated with each class of nutrient and the different species with which each common feedstuff is used. Students will record their findings in their electronic journals or notebooks. Have students complete Activity 6 of the <i>Aquaculture</i> module. <sup>CS1, CS2, CS4, T1, T2, T4</sup></p> <p><b>Roughage Examples:</b> Hay, cottonseed hulls, and silage</p> <p><b>Concentrate Examples:</b> Corn, soybeans, and oats</p>	<p>c. Evaluate the student notebooks or journals for completeness, accuracy, and grammar.</p>
<p>d. Select nutritional practices in aquatic production based on types of food, metabolic rates, and nutritional requirements. (DOK 2)</p>	<p>d. Have students complete the steps in Activity 6 that relate to the nutritional requirements for aquatic species. Based on the information from the module, have students complete an exercise to select the most appropriate feed for a given species and conditions. (See the <i>Select an Appropriate Nutritional Practice [4.8].</i>)</p>	<p>d. Evaluate student assignment for accuracy and completeness.</p>

**Competency 4: Examine the role of genetics and breeding in animal production.** <sup>AS.06, BIOI 2, BIOI 4, BIOI 5, BIOII 3, G 1, G 2, G 3, ZO 3</sup>

**Suggested Enduring Understandings**

1. Many traits and characteristics of an animal are passed to the animal through the genetic makeup of the animal's parents.
2. Sperm and eggs are created through a process called meiosis in which each sperm and each egg receive one half of the chromosomes from the parent.
3. Selective breeding is a process by which desirable characteristics are increased and undesirable characteristics are decreased.

**Suggested Essential Questions**

1. How are traits passed from the parent to the offspring?
2. Why does an egg or sperm cell contain only half of the parent's chromosomes?
3. What is the process of selective breeding?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
<p>a. Explain basic concepts of heredity and genetics. (DOK 1)</p>	<p>a. Have students read the chapter on Animal Genetics from the text and complete the <i>Worksheet on Basic Principles of Heredity and Genetics (4.5)</i>. <sup>CS1, CS2, CS4, T1, T3, T5</sup></p>	<p>a. Evaluate student performance on the assignment on basic principles of heredity and genetics.</p>
<p>b. Describe the processes</p>	<p>b. Have the students complete Step 4 of Activity 4 in</p>	<p>b. Evaluate student</p>

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of selective breeding including artificial insemination and embryo transfer. (DOK 3)

the *Animal Science* module. As the students proceed through this step, have them complete Quiz 2 in the module. CS1, CS2, CS4, T1, T3, T5

responses to questions in Quiz 2 of the *Animal Science* module.

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# Standards

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## **AFNR Industry Standards**

- AS.01. Examine the components, historical development, global implications, and future trends of the animal systems industry.
- AS.02. Classify animals according to hierarchical taxonomy and agricultural use.
- AS.04. Apply principles of animal nutrition to ensure the proper growth, development, reproduction, and economic production of animals.
- AS.05. Evaluate and select animals based on scientific principles of animal production.

## **Applied Academic Credit Standards**

### ***Biology I***

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

### ***Biology II***

- BIOII 2 Describe and contrast the structures, functions, and chemical processes of the cell.
- BIOII 3 Investigate and discuss the molecular basis of heredity.
- BIOII 5 Develop an understanding of organism classification.

### ***Genetics***

- G 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- G 2 Analyze the structure and function of the cell and cellular organelles.
- G 3 Apply the principles of heredity to demonstrate genetic understandings.
- ZO 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- ZO 2 Develop an understanding of levels of organization and animal classification.
- ZO 3 Differentiate among animal life cycles, behaviors, adaptations, and relationships.

## **21st Century Learning Standards**

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

## **National Educational Technology Standards for Students**

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

## **ACT College Readiness Standards**

- W1 Expressing Judgments
- W2 Focusing on the Topic
- W3 Developing a Position
- W4 Organizing Ideas
- W5 Using Language

## Suggested References

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# Concepts of Agriscience

## Unit 5: Science of Agricultural Plants

25 Hours

**Competency 1:** Explore the anatomical and physiological processes of plants. PS.01, BO 1, BO 2, BO 3, BO 4, BIOI 1, BIOI 2, BIOI 4, CHI 4

### Suggested Enduring Understandings

1. Flowering plants are composed of a system of roots, stems, leaves, and reproductive parts that function together to allow the plant to grow and produce food.
2. The processes of respiration, photosynthesis, and transpiration allow a plant to take in nutrients and water and transform these materials into energy, oxygen, and tissues.
3. Plant growth takes place through the processes of cell division, elongation, and differentiation.

### Suggested Essential Questions

1. How do the major parts of a flowering plant function together to cause the plant to grow, reproduce, and produce food?
2. How do the processes of respiration, photosynthesis, and transpiration work together in causing a plant to grow and reproduce?
3. How does a plant grow from a single cell to a complete plant?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Draw a diagram of a flowering plant, and label and describe the major parts (roots, stems, leaves, and flowers). (DOK 1)	a. Have the students prepare a chart showing the major parts of a flowering plant and describe each part's structure and function. Have students scan their charts and enter into their electronic journals. Have students complete activities 2 and 3 in the <i>Plant Science</i> module. <small>CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T6, R1, R2, R3, R4, R5</small>	a. Use the <i>Rubric for Evaluating Student Chart of Plant Parts and Functions (5.1)</i> to evaluate the students' charts.
b. Compare the process of respiration, photosynthesis, and transpiration. (DOK 2)	b. Have students prepare a chart showing the steps in the photosynthesis, respiration, and transpiration processes including the relationship and differences of each process to the others. (See <i>Chart for Comparing Photosynthesis, Respiration, and Transpiration [5.2]</i> .) Have students complete Activity 4 in the <i>Plant Science</i> module. <small>CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T6, R1, R2, R3, R4, R5</small>	b. Evaluate charts for accuracy and completeness.
c. Examine the process of plant growth to include cell division, cell elongation, and cell differentiation. (DOK 2)	c. Have students read the section in the text (Biondo & Lee, 2003) related to plant growth and development and cell division, elongation, and differentiation. Have the students summarize their findings in their electronic journals. <small>CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T6, R1, R2, R3, R4, R5, W1, W2, W3, W4, W5</small>	c. Evaluate student electronic journals for accuracy and completeness.

## Competency 2: Investigate common methods of plant reproduction.

PS.01, PS.02, PS.03, BS.02, BS.03, BIOI 1, BIOI 4, BO 3,

BO 5

### Suggested Enduring Understandings

1. Seeds are formed through a process of pollination in which pollen grains from the stamen fertilize ova in the pistil.
2. Each part of a seed plays an important role in the development of the young plant.
3. Seed germination is affected by a number of factors including temperature, moisture, light, and oxygen.
4. Plants require regular care for optimum growth and development.
5. Plants can be formed through asexual means such as cutting, layering, separation and division, tissue culture, and grafting.

### Suggested Essential Questions

1. What factors affect the process of seed formation?
2. How do the different parts of a seed contribute toward plant growth and development?
3. How can seed germination rates be improved?
4. What types of care are needed for optimum plant growth?
5. What are the differences between asexual and sexual reproduction in plants?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Analyze the process of seed formation to include pollination and fertilization. (DOK 1)	a. Have students complete steps 3–5 in Activity 9 of the <i>Plant Science</i> module. Have students answer the questions in Step 6 of the activity and place in their electronic journals. <small>CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, R1, R2, R3, R4, R5, W1, W2, W3, W4, W5</small>	a. Evaluate electronic journals for accuracy and completeness.
b. Identify the parts of a seed, and associate each part with its function. (DOK 1)	b. Have students read the section on <i>Seed Structures</i> in the text (Biondo & Lee, 2003). Have the students dissect a bean or other large seed and make a drawing of what they see, labeling each part and describing its function. Have students scan their drawings and enter into their electronic journals. <small>CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, R2, R4, R5</small>	b. Evaluate students' drawings and descriptions for accuracy and completeness.
c. Describe and apply factors essential to seed germination. (DOK 2)	c. Have students read the section on <i>Seed Germination</i> in the text (Biondo & Lee, 2003). Have students answer the questions on germination in the assignment <i>Seed Germination (5.4)</i> . Have students conduct germination tests under different temperature, light, oxygen, and moisture conditions and note differences. <small>CS1, CS2 CS3, CS4, CS5, R2, R4, R5</small>	c. Evaluate student assignments for accuracy and completeness.
d. Observe and record data related to plant growth and reproduction. (DOK 2)	d. Using the <i>Wisconsin Fast Plants</i> kit in the <i>Plant Science</i> module, have students plant, thin, and care for plants. Have students record data from their experiments using <i>Plant Growth (5.5)</i> . <small>CS1, CS2 CS3, CS4, CS5, T2, T3, T4, T6, S1, S2, S3, M1, M2, M7</small>	d. Evaluate student assignments for accuracy and completeness.
e. Identify the five methods of asexual	e. Through illustrations, students will identify the following methods of asexual reproduction:	e. Paper and pencil test

reproduction.  
(DOK 2)

- Cutting
- Layering
- Separation and division
- Tissue culture
- Grafting

**Competency 3: Apply classification methods to plants.** PS.01, BIOII 5, BO 3

**Suggested Enduring Understandings**

1. Life cycle is defined as the length of time over which a plant grows to maturity and is able to reproduce itself.
2. The scientific classification of plants allows each animal to receive a specific formal name and shows relationships between and among different species.

**Suggested Essential Questions**

1. What are the three most common life cycles in plants?
2. What is the scientific classification system, and why is it needed?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Classify plants based on life cycle. (DOK 1)	a. Have students complete Activity 2 in the <i>Horticulture</i> module. CS1, CS2, CS4, T1, T2, T3, T6, R4	a. Use the quiz at the end of the activity to evaluate the students' mastery of this indicator.
b. Examine the use of scientific classification systems in horticulture. (DOK 2)	b. Have students complete Activity 3 in the <i>Horticulture</i> module. Students will review scientific names of ornamental plants that can grow in the local area. Have students analyze the major components of a scientific name and explain why the scientific name process is necessary in their electronic journals. CS1, CS2, CS4, T1, T2, T3, T6, S1, W1, W4	b. Use the quiz at the end of the activity as well as evaluating student journal entries for accuracy and completeness.

**Competency 4: Apply principles of plant nutrition.** PS.02, BIOI 2, CHI 1, BO 4

**Suggested Enduring Understandings**

1. Sixteen essential nutrients are necessary in varying amounts for optimum growth and development in plants.

**Suggested Essential Questions**

1. What are the essential nutrients required for optimum plant growth and development?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Differentiate between the major plant nutrients (macronutrients) and the minor nutrients	a. Have students construct and complete a chart showing all 16 of the essential plant nutrients and classifying them as organic, primary, secondary, and micronutrients. (See <i>Plant Nutrient Chart [5.3]</i> .) The chart should also show the chemical symbol for each	a. Evaluate the charts for accuracy and completeness.

(micronutrients). (DOK 1)	nutrient, functions of each nutrient (how it is used by the plant), and signs of nutrient deficiency. <small>CS1, CS2 CS3, CS4, CS5, T3, T6, W4</small>	
b. Identify the chemical symbols of the 16 essential plant nutrients. (DOK 1)	b. Have students construct and complete a chart showing all 16 of the essential plant nutrients and classifying them as organic, primary, secondary, and micronutrients. (See <i>Plant Nutrient Chart [5.3]</i> .) The chart should also show the chemical symbol for each nutrient, functions of each nutrient (how it is used by the plant), and signs of nutrient deficiency. <small>CS1, CS2 CS3, CS4, CS5, T3, T6, W4</small>	b. Evaluate the charts for accuracy and completeness.

**Competency 5: Investigate the chemical properties of soils.** PS.02, NRS.01, NRS.02, ESS.02, CHI 5

**Suggested Enduring Understandings**

1. An accurate soil test is important in determining the need for additional fertilizer and other soil amendments.
2. As the pH of a soil changes, the availability of existing nutrients in the soil changes.

**Suggested Essential Questions**

1. How do I obtain a representative sample of soil from a given area for testing purposes?
2. How does the pH of a soil affect its productivity and fertility?
3. How do I correct deficiencies in soil fertility?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Develop a soil testing plan for a given field or area. (DOK 2)	a. Have students complete Activity 7 in the <i>Soil Science</i> module. Following the instructions in the module, have the students prepare a sketch of a plot of land identifying prominent features and differences in soil type and slope. From this sketch, have the students mark 10–20 random spots where soil should be sampled. <small>CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, M5, S1</small>	a. Use the <i>Checklist for Evaluating a Sketch of a Land Plot (5.12)</i> to evaluate the sketches developed by the students. Essential elements should include a title block, a sketch of the area to be sampled, identifying landmarks and features, and changes in soil texture and surface slope. For small plots, 10 random spots should be marked. For larger plots, 20 random spots should be marked.

b. Take a soil sample for testing purposes. (DOK 2)	b. Have the student use their sketches to collect and process a soil sample for fertility testing purposes. The sample should be properly labeled and include a data sheet. <small>CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, S2, W4</small>	b. Use the <i>Checklist for Soil Sample Collection and Preparation (5.13)</i> to evaluate the students' ability to collect and process a soil sample.
c. Describe how soil pH affects productivity of a soil. (DOK 1)	c. Have the students read the section in the text (Burton, 2010) that deals with soil pH and pH adjustment. Have them discuss in their own words the concept of pH and how it affects soil productivity and nutrients. Have them summarize their findings in their electronic journals. Have the students complete Activity 9 in the <i>Soil Science</i> module that deals with fertility and productivity. <small>CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, R1, R2, R3, R4, R5, W1, W2, W3, W4, W5</small>	c. Evaluate electronic journals for completeness and accuracy.
d. Test a soil for pH and nutritional content, and make recommendations on amendments and fertilizers to be applied. (DOK 3)	d. Using the Rapitest soil testing kit, have the students conduct a test of a soil sample to determine pH and nitrogen, phosphorus, and potassium levels. Have students then make written recommendations as to fertilizers and other soil amendments that should be applied to the plot of land that was sampled. <small>CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, S2</small>	d. Observe students using the Rapitest kit to make sure they are following procedures. Evaluate their recommendations for accuracy.

**Competency 6:** Explore basic concepts of pest management to include insect damage, weed damage, and diseases. PS.03, BIOI 6, BIOII 4, ZO 2, ZO 3, ZO 4

**Suggested Enduring Understandings**

1. The control of insects, diseases, and weeds in field crops is a major concern to producers because these pests reduce yields and cause loss.

**Suggested Essential Questions**

1. What are the different types of field crop pests, and how does each type cause damage or loss to the crop?
2. What types of pest control methods exist, and what are their advantages and disadvantages?
3. How can producers develop the optimum plan for controlling pests in field crops?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify the different types of plant pests, and discuss how each class causes damage or loss to a crop. (DOK 1)	a. Have students construct a table that identifies the three major types of plant pests (insects, weeds, and diseases), and summarize the ways in which each type causes damage or loss to crops. (See <i>Plant Pests and the Damage They Cause Assignment [5.8]</i> in this unit.) Have students complete Activity 6 and Activity 7 in the <i>Crop Science</i> module. <small>CS1, CS2, CS4, T1, T2, T3, T6</small>	a. Evaluate charts for accuracy and completeness.

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|--|---|---|
| b. Compare the different types of pest control measures. (DOK 2) | b. Have students compare and contrast pest control strategies: regulatory control, host resistance, biological control, cultural control, physical and mechanical control, and chemical control. Develop an integrated pest management plan on a given crop to include three control practices. | b. Use the quizzes in Activity 8 to evaluate student performance. |
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Have students complete Activity 8 in the *Crop Science* module. CS1, CS2, CS4, T1, T2, T3, T6, S3

**Competency 7: Explore the uses of a greenhouse.** PS.02, BIOI 3, BO 5

**Suggested Enduring Understandings**

1. The design and construction of a greenhouse type should be based on the crops to be grown, cost of construction, and maintenance.
2. For optimum plant growth, the environment of a greenhouse (temperature, moisture/humidity, light intensity/duration, and ventilation) must be closely monitored and controlled.
3. A greenhouse manager is responsible for seeing that plants are properly cared for and that the environment inside the greenhouse is monitored and controlled.

**Suggested Essential Questions**

1. What are the characteristics of different greenhouse types?
2. What environmental factors inside a greenhouse must be controlled, and how is this control accomplished?
3. What are the primary duties of a greenhouse manager?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify and describe the characteristics of greenhouses: quonset, even span, and ridge and furrow. (DOK 1)	a. Have students complete Activity 3 of the <i>Horticulture</i> module. Have them answer questions found in the module related to the different types of greenhouses and greenhouse construction materials. Students should complete the <i>Survey of Horticultural Enterprises (5.9)</i> . <small>CS1, CS2, CS4, T1, T2, T3, T6, W1, W4</small>	a. Evaluate student answers for accuracy and completeness.
b. Investigate methods for controlling the environment in a greenhouse. (DOK 1)	b. Have students identify each of the major environmental factors (temperature, moisture/humidity, light, ventilation, etc.) that must be controlled in a greenhouse and write a short description of ways in which each is controlled. (See the <i>Greenhouse Environmental Control Assignment [5.10]</i> .) Have students enter their findings in their electronic journals. <small>CS1, CS2, CS4, T1, T2, T3, T6, W1, W4</small>	b. Evaluate student assignments for accuracy and completeness.
c. Explore greenhouse management activities. (DOK 1)	c. Have students watch the video <i>Introduction to Greenhouse Management</i> in Activity 3 of the <i>Horticulture</i> module. Have them make notes of the different duties and responsibilities of a manager and transcribe them into their electronic journals. <small>CS1, CS2, CS4, T1, T2, T3, T6, W1, W4</small>	c. Evaluate student journals for accuracy and completeness.

# Standards

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## **AFNR Industry Standards**

- PS.01 Apply knowledge of plant classification, plant anatomy, and plant physiology to the production and management of plants.
- PS.02 Prepare and implement a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.
- PS.03 Propagate, culture, and harvest plants.
- BS.02 Demonstrate laboratory skills related to biotechnology.
- BS.03 Demonstrate the application of biotechnology to Agriculture, Food, and Natural Resources (AFNR).

## **Applied Academic Credit Standards**

### ***Biology I***

- BIOI 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- BIOI 2 Describe the biochemical basis of life, and explain how energy flows within and between the living systems.
- BIOI 4 Analyze and explain the structures and function of the levels of biological organization.

### ***Botany***

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

### ***Chemistry I***

- CHI 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- CHI 4 Analyze the relationship between microscopic and macroscopic models of matter.

## **21st Century Learning Standards**

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

## **National Educational Technology Standards for Students**

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

## **ACT College Readiness Standards**

- M1 Basic Operations and Applications
- M2 Probability, Statistics, and Data Analysis
- M7 Measurement
- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R3 Sequential, Comparative, and Cause–Effect Relationships
- R4 Meaning of Words

- R5 Generalizations and Conclusions
- S1 Interpretation of Data
- S2 Scientific Investigation
- S3 Evaluation of Models, Inferences, and Experimental Results
- W1 Expressing Judgments
- W2 Focusing on the Topic
- W3 Developing a Position
- W4 Organizing Ideas
- W5 Using Language

## Suggested References

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

# Concepts of Agriscience

## Unit 6: Science of Agricultural Environment

25 Hours

**Competency 1:** Examine the importance of different kinds of natural resources and their relationship to different kinds of ecology. NRS.01, ES 3, BIOII 4

### Suggested Enduring Understandings

1. Some natural resources must be preserved for future generations while other natural resources must be managed and conserved.
2. Natural resources may be classified as exhaustible, non-exhaustible, and renewable.
3. In a food web, energy from the sun is passed along from plants to animals.
4. Water is constantly recycled through the hydrologic cycle of evaporation and condensation.
5. Salt water can be converted to fresh water through a process called desalinization.
6. Understanding the chemical and physical properties of water is critical to aquacultural enterprises.
7. Aquacultural producers must constantly monitor water conditions for dissolved gases, pH, temperature, hardness, and nitrate levels.

### Suggested Essential Questions

1. What is the difference in conservation and preservation of natural resources?
2. What are the different classes of natural resources?
3. How is energy transmitted in a food web?
4. How is water recycled naturally?
5. How can saltwater be converted into fresh water?
6. How do the chemical and physical properties of water relate to aquacultural production?
7. What water quality tests are necessary for best growth and health of aquaculture species?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Compare and contrast the principles of conservation and preservation of natural resources. (DOK 2)	a. Have students prepare an essay in their electronic journals comparing and contrasting the issues of conservation and preservation including citing examples of resources that should be conserved or preserved. Have students complete steps 4–5 of Activity 1 in the <i>Natural Resources</i> module. <small>CS1, CS2, CS4, T2, T3, T6, R3, R5, W2, W4</small>	a. Evaluate the students' essays using the <i>Preservation versus Conservation Essay Rubric (6.1)</i> .
b. Classify natural resources as exhaustible, non-exhaustible, or renewable. (DOK 2)	b. Provide students with a list of common natural resources, and have them classify each as being exhaustible, non-exhaustible, or renewal. Have students write a one- to two-sentence statement justifying their classification. (See the <i>Exhaustible or Non-Exhaustible [6.2]</i> .) Have students complete Step 3 of Activity 2 in the <i>Natural Resources</i> module. <small>CS2, CS3, CS6, T2, T3, T4, T6, R3, R5, W2, W4</small>	b. Evaluate the student assignments for clarity, completeness, and accuracy.
c. Describe the flow of energy in a food web	c. Have students prepare a diagram showing the flow of energy within the ecosystem. The diagram	c. Evaluate illustrations for accuracy and

within an ecosystem. (DOK 2)	should illustrate the processes of synthesis, photosynthesis, respiration, and decomposition as related to organisms that are producers, transformers, and decomposers. Have students complete Step 4 of Activity 2 in the <i>Natural Resources</i> module. <small>CS2, CS3, CS6, T2, T3, T4, T6, W4</small>	completeness.
d. Describe the hydrologic cycle. (DOK 1)	d. Have students create an illustration of the water cycle showing the relationships among meteoric water, surface water, and groundwater. Have students scan their illustrations into their electronic journals. Have students complete Step 6 in Activity 3 of the <i>Natural Resources</i> module. <small>CS2, CS3, CS6, T2, T3, T4, T6, R3, R5, W4</small>  Have students complete Step 7 in Activity 3 of the <i>Natural Resources</i> module. <small>CS2, CS3, CS6, T2, T3, T4, T6, S2</small>	d. Evaluate illustrations for accuracy and completeness.  Use the <i>Checklist for Desalination Laboratory Exercise (6.3)</i> to evaluate student mastery.
e. Describe the chemical and physical properties of water in its different states. (DOK 2)	e. Have students complete Activity 2 in the <i>Aquaculture</i> module. As students complete the activity, have them summarize important chemical and physical characteristics of water including units of measure, pH, temperature, salinity, dissolved gases, hardness, and nitrate levels in their electronic journals. <small>CS1, CS2, CS4, T1, T3, T6, S2, W4</small>	e. Evaluate student journals for accuracy and completeness.
f. Test a water sample for pH, dissolved oxygen, hardness, and nitrate levels. (DOK 3)	f. Have students use the information and instructions in activities 3, 4, and 5 and the water testing kit to obtain data related to temperature, dissolved oxygen, pH, hardness, and nitrate levels of an aquarium. Have students record their findings on the <i>Water Quality Log</i> sheet. Have students describe why water quality can vary over time in their electronic journals. <small>CS1, CS2, CS4, T1, T3, T6, S2, W4</small>	f. Evaluate each student's <i>Water Quality Log</i> for accuracy and completeness. Observe students' laboratory procedures and rate using the <i>Rubric for Evaluation of Water Quality Exercise (6.10)</i> .

## Competency 2: Explore principles of wildlife conservation.

NRS.02, NRS.04, BIOI 6, ES 5

### Suggested Enduring Understandings

- Wildlife is one of the natural resources that must be managed and conserved but can be renewed indefinitely.

### Suggested Essential Questions

- How can wildlife be managed and conserved as a renewable resource?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Examine basic principles of wildlife conservation. (DOK 1)	a. Have students write a short essay on how modern wildlife management practices have helped maintain and restore wildlife species in the United States. Have students complete Activity 5 of the <i>Natural Resources</i> module.	a. Evaluate the students' essays for accuracy and completeness.

Resources module. CS2, CS3, CS6, T2, T3, T4, T6, R3, R5, W2, W4

Important practices that should be included in the essay include game refuges, habitat development, hunting regulations, and artificial restocking.

**Competency 3: Explore energy conservation and alternative energy sources.** ESS.05, ES 2, PS 6

**Suggested Enduring Understandings**

1. As nonrenewable energy sources become increasingly scarce, alternative sources of energy will become more and more important.

**Suggested Essential Questions**

1. What are the most common sources of alternative energy?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Explore alternative energy sources. (DOK 2)	a. Have students complete Step 4 in Activity 7 and Step 3 in Activity 8. Based on the information found in these two activities, have students write an essay describing alternative energy sources, including their applicability in the local community. <small>CS2, CS3, CS6, T2, T3, T4, T6, R3, R5, W2, W3, W4</small>	a. Use the <i>Alternative Energy Essay Rubric (6.4)</i> to evaluate the student assignment.

**Competency 4: Examine principles of waste management.** ESS.03, ESS.04, ESS.05

**Suggested Enduring Understandings**

1. Waste management practices are different for the different types of waste materials.
2. Household waste can be managed more effectively to reduce the amount of waste that must be disposed and to protect the environment.

**Suggested Essential Questions**

1. What are the three major types of waste materials?
2. How can household waste be managed more efficiently?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe the three major types of waste materials (industrial, construction, and domestic). (DOK 1)	a. Have students read the chapter on <i>Waste Management</i> in the text (Camp & Daugherty, 2003). Have students complete the <i>Types of Waste and Waste Products (6.5)</i> assignment. <small>CS2, CS3, CS6, T2, T3, T4, T6, R2, R3, R4, R5, W2, W4</small>	a. Evaluate the assignments for accuracy and completeness.
b. Develop a household waste management plan. (DOK 2)	b. Have students complete Step 5 in Activity 2, Step 6 in Activity 8, and Step 2 in Activity 9. Have students complete the <i>Reducing, Reusing, and Recycling</i> assignment in Activity 9. <small>CS2, CS3, CS6, T2, T3, T4, T6, S2, S3</small>	b. Evaluate the student assignments for accuracy and completeness.

**Competency 5: Explore forest management and production practices.**

NRS.02, NRS.03, BIO1 3, BO 4, BO 5, ES 2, ES 3, PS 5,

ZO 2, ZO 3

**Suggested Enduring Understandings**

1. Reforestation is important from both an environmental and an economical standpoint.
2. Tree growth is measured in terms of diameter and height.
3. Silvicultural practices such as thinning are necessary for optimum growth of timber.
4. Fire results from a combination of heat, oxygen, and fuel, and by controlling just one of these factors a fire can be extinguished.
5. Common pests of forests and trees include insects and diseases.
6. Standing timber is sold either using an estimate of the stumpage or by the weight of timber harvested.

**Suggested Essential Questions**

1. What are the advantages and disadvantages of the different methods of reforestation?
2. How is tree growth measured?
3. What are the different methods for thinning a stand of timber?
4. What is the fire triangle, and how can it be used to control fire?
5. What are the common pests of forests?
6. How is standing timber sold?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Explore concepts of forestry and forestry management to include reforestation methods and silviculture practices in managing and harvesting forests. (DOK 2)	a. Provide the students with the <i>Reforestation Exercise Scenario (6.7)</i> , and have them write a letter to the timber owner explaining the different options for reforestation and making a recommendation on which method would be most appropriate. Have students complete Activity 6 in the <i>Forestry</i> module. <small>CS1, CS2, CS4, T2, T3, T4, T6, R3, W1, W4, W5</small>	a. Evaluate the students' letters using the <i>Reforestation Exercise Rubric (6.8)</i> .
b. Identify and describe the use of common forest products made from hardwood and softwood trees. (DOK 1)	b. As students participate in the activity, have them build a list of common hardwood and softwood species that are common to Mississippi. For each species, have students classify it as hardwood or softwood, summarize its characteristics, and identify its most common uses. (See the <i>Wood Products and Characteristics [6.6]</i> assignment.) Have them place this assignment in their electronic journals. Have students complete Activity 8 in the <i>Forestry</i> module. <small>CS1, CS2, CS4, T2, T3, T4, T6, R1, R5</small>	b. Evaluate the assignments for accuracy and completeness.
c. Draw and explain the fire triangle. (DOK 1)	c. Have students draw a fire triangle and describe ways in which components can be removed from the triangle to extinguish a fire. Have students scan their work and place in their electronic journals. Have students complete steps 4–5 of Activity 9 in the <i>Forestry</i> module. <small>CS1, CS2, CS4, T2, T3, T4, T6, R3, W1, W4, W5</small>	c. Evaluate journal entries for accuracy and completeness.

**Competency 6: Demonstrate an understanding of the impact of soil as a natural resource.**

CHI 1, E 4, E 5, ES 3,

**Suggested Enduring Understandings**

1. Soil is the most important natural resource that must be protected and conserved.
2. Soil is a naturally occurring substance that is formed over centuries through chemical and physical weathering processes.
3. Soil texture refers to the amount of sand, silt, and clay particles that are present in the soil.
4. Native soils are composed of different layers of materials.

**Suggested Essential Questions**

1. Why is soil an important natural resource?
2. How is soil formed?
3. How do I determine the texture of a soil?
4. What are the different layers of the soil profile?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Associate the definition of soil with its importance. (DOK 2)	a. Have students write short paragraphs for electronic journals that summarize the definition of soil and describe three reasons why soil is important to society. Have students complete Activity 1 in the <i>Soil Science</i> module. <small>CS 1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, R1, R2, R4, R5, W4, W5</small>	a. Use the quiz at the end of Activity 1 to evaluate students' understanding as well as evaluating the journals for accuracy and completeness.
b. Describe the process of soil formation including the effects of chemical and physical weathering. (DOK 1)	b. Summarize the important concepts associated with each of the factors associated with soil formation, and place these in the electronic journals. Have students complete steps 1–5 of Activity 1 in the <i>Soil Science</i> module. <small>CS 1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, R1, R2, R4, R5, W4, W5</small>	b. Evaluate the students' journals for accuracy and completeness.
c. Classify the texture of a soil. (DOK 2)	c. Have students complete Activity 4 of the <i>Soil Science</i> module, including the exercise on determining the general texture of a soil. Have students answer the questions in the <i>Summarize</i> section of the activity and record their answers in their electronic journals. <small>CS 1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, R1, R2, R4, R5, W4, W5</small>	c. Evaluate the students' journals for accuracy and completeness.
d. Identify the different layers of a typical soil profile, and describe their importance. (DOK 1)	d. Have the students complete Activity 3 of the <i>Soil Science</i> module, including the exercise on making a drawing of a soil profile. Have students record their answers to the questions in the <i>Summarize</i> section of the activity in their electronic journals. <small>CS 1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, R1, R2, R4, R5, W4, W5</small>	d. Evaluate the students' journals for accuracy and completeness.

**Competency 7: Investigate the use of the land capability classification system.** NRS.01, NRS.02, ESS.03, E 3, ES 3**Suggested Enduring Understandings**

1. One important concept of soil conservation is that land can be classified according to its highest productive use.
2. Factors that determine the highest productive

**Suggested Essential Questions**

1. What is the meaning of the term *highest productive use*?
2. What factors determine the highest

use of a given plot of land include soil texture, slope, fertility, erosion potential, and internal drainage.

productive use of a plot of land?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
<p>a. Describe the concepts of land classification and highest productive use. (DOK 1)</p>	<p>a. In their electronic journals, have students summarize the important concepts regarding land classification and highest productive use. Have the students complete Activity 10 in the <i>Soil Science</i> module. <small>CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6, R1, R2, R3, R4, R5, W1, W2, W3, W4, W5</small></p>	<p>a. Evaluate the students' electronic journal entries for accuracy and completeness.</p>
<p>b. Identify and describe factors that contribute to land capability. (DOK 1)</p>	<p>b. Using the material on <i>Land Capability Classes</i> in the text (Plaster, 2003), have the students construct a chart showing the relationship of slope, internal drainage, erosion potential, and fertility to each of the eight land capability classes. (See <i>Land Capability Classification Chart [6.11]</i>.) <small>CS1, CS2, CS3, CS4, CS5 T2, T3, T4, T6, W4</small></p>	<p>b. Evaluate the charts for accuracy and completeness.</p>

# Standards

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## **AFNR Industry Standards**

- NRS.01 Recognize the important interrelationships between natural resources and humans necessary to conduct management activities in natural environments.
- NRS.02 Apply scientific principles to natural resource management activities.
- NRS.03 Apply knowledge of natural resources industries to production practices and processing procedures.
- NRS.04 Demonstrate techniques used to protect natural resources.
- ESS.03 Apply scientific principles to environmental service systems.
- ESS.04 Operate environmental service systems to manage a facility environment.
- ESS.05 Examine the relationships between energy sources and environmental service systems.

## **Applied Academic Credit Standards**

### ***Biology I***

- BIOI 3 Investigate and evaluate the interaction between living organisms and their environment.
- BIOI 6 Demonstrate an understanding of principles that explain the diversity of life and biological evolution.

### ***Biology II***

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

### ***Earth and Space Science***

- E 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- E 4 Demonstrate an understanding of earth systems relating to weather and climate.
- E 5 Apply an understanding of ecological factors to explain relationships between earth systems.

### ***Environmental Science***

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

### ***Physical Science***

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

## **21st Century Learning Standards**

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

## **National Educational Technology Standards for Students**

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

## **ACT College Readiness Standards**

- R2 Supporting Details
- R3 Sequential, Comparative, and Cause–Effect Relationships
- R4 Meaning of Words

- R5 Generalizations and Conclusions
- S2 Scientific Investigation
- S3 Evaluation of Models, Inferences, and Experimental Results
- W2 Focusing on the Topic
- W3 Developing a Position
- W4 Organizing Ideas

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# Concepts of Agriscience

## Unit 7: Science of Agricultural Mechanization

15 Hours

**Competency 1:** Examine the applications of mechanical technology in agriscience. PST.01, PST.02

### Suggested Enduring Understandings

1. Discoveries and inventions related to agricultural power, structures, and technology have contributed directly to the increase in productivity, efficiency, and quality of agricultural products and enterprises.
2. To be used properly, hand and power tools must be identified and classified as to their use.

### Suggested Essential Questions

1. How has mechanization contributed to increased productivity, efficiency, and quality of agricultural enterprises?
2. What are the common hand and power tools used in agriculture mechanization and their classes?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe how mechanical inventions and other discoveries in agriculture have contributed to increased efficiency of production. (DOK 1)	a. Have students read the section on <i>The Mechanics in the World of Agriculture</i> in Unit 1 of the text (Herren, 2010). Based on their reading, have students identify at least five inventions or discoveries related to agriculture mechanization and in their own words describe how these discoveries have contributed to efficiency of agricultural enterprises. Have students enter their findings in their electronic journals. <small>CS1, CS2, CS4, T2, T3, T6</small>	a. Evaluate student journals for accuracy and completeness.

**Competency 2:** Explore basic principles of electricity. PST.01, PST.05, PHYI 3, PHYI 5, PS 2, PS 4

### Suggested Enduring Understandings

1. Electricity is the flow of electrons usually produced by either a magnetic force or chemical reaction. The flow of electricity is measured in volts, amperes or amps, and wattage or watts.
2. In order for electricity to flow, there must be a source, conductors, controllers, and a load that complete a path from the source to the load and back again.
3. Examples of electrical circuits used in buildings include lighting circuits and outlet circuits. Some circuits contain both lights and outlets.

### Suggested Essential Questions

1. What is electricity, and how is it measured?
2. What constitutes an electrical circuit?
3. What are some common circuits used for lighting and power in buildings?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Examine basic	a. Have students complete Step 3 in Activity 4 of the	a. Use the quiz in the

principles of electricity including magnetism, circuits, and units of measure. (DOK 1)	<i>Agriculture Mechanics</i> module. <small>CS1, CS2, CS4, T2, T6, R2, R4</small>	module to evaluate student understanding of electrical principles.
b. Draw a diagram of an electrical circuit showing components and common symbols. (DOK 1)	b. Using the information from Step 3, have the students draw a diagram of a simple series circuit for a light controlled by a switch. Have students label each part of the circuit and note its purpose or function. <small>CS1, CS2, CS4, CS6, T2, T6, R2, R4</small>  Have students complete activities 5–7 of the <i>Agriculture Mechanics</i> module to include installing a ground rod, circuit breaker, switches, receptacles, and light fixtures. As students complete each of the different circuits, have them sketch each circuit and scan their sketches into their electronic journals. <small>CS1, CS2, CS4, CS6, T2, T6, R2, R4</small>	b. Evaluate student drawing for accuracy and completeness.  Use the <i>Installing Electrical Devices and Circuits Rubric (7.1)</i> to evaluate student performance.

**Competency 3: Explore basic principles of plumbing systems.** PST.01, PST.03, PST.04

<p><b>Suggested Enduring Understandings</b></p> <ol style="list-style-type: none"> <li>1. Plumbing codes are enacted to ensure that plumbing systems provide safe and sanitary flow of fluids.</li> <li>2. Selection of a specific type of pipe for a specific plumbing system is based on cost, strength, and specific job requirements.</li> <li>3. Pipe fittings including valves are necessary to control the flow of fluids and make connections between different pipes.</li> </ol>	<p><b>Suggested Essential Questions</b></p> <ol style="list-style-type: none"> <li>1. How do plumbing code requirements relate to safety and sanitary conditions?</li> <li>2. How is a specific type of pipe selected?</li> <li>3. What fittings and valves are used to join pipe and control flow of liquids in a system?</li> </ol>
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Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe common plumbing code requirements. (DOK 1)	a. Have students complete Step 4 of Activity 9 of the <i>Agriculture Mechanics</i> module. Have them summarize their findings in their electronic journals. <small>CS1, CS2, CS4, CS6, T2, T6, R2, R4, W2, W4, W5</small>	a. Use the quiz in the module to evaluate students' understanding of code requirements.
b. Compare the advantages and disadvantages of PVC, C-PVC, polyethylene, and copper types of pipe. (DOK 2)	b. Have students read Chapter 2, <i>Materials</i> , in the text (American Association for Vocational Instructional Materials, 2004). Have them complete the <i>Advantages and Disadvantages of Different Types of Pipe (7.2)</i> . <small>CS1, CS2, CS4, CS6, T2, T6, R2, R4, W2, W4, W5</small>	b. Evaluate the assignments for accuracy and completeness.
c. Select pipe fittings for different applications. (DOK 2)	c. Based on the information provided in Chapter 2 of the text (American Association for Vocational Instructional Materials, 2004), have students complete the questions shown in the <i>Selecting Pipe</i>	c. Evaluate the assignments for accuracy and completeness.

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*Fittings (7.3).* CS1, CS2, CS4, CS6, T2, T6, R2, R4, W2, W4, W5

Examples of pipe fittings:

- Elbow
  - Coupling
  - T
  - Reducer
  - Check valve
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# Standards

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## **AFNR Industry Standards**

- PST.01. Use physical science principles and engineering applications with power, structural, and technical systems to solve problems and improve performance.
- PST.02 Design, operate, and maintain mechanical equipment, structures, biological systems, land treatment, power, and technology.
- PST.03 Service and repair mechanical equipment and power systems.
- PST.04 Plan, build, and maintain agricultural structures.
- PST.05 Apply technology principles in the use of agricultural technical systems.

## **Applied Academic Credit Standards**

### ***Physical Science***

- PS 2 Describe and explain how forces affect motion.
- PS 4 Develop an understanding of the atom.

### ***Physics I***

- PHY1 2 Develop an understanding of concepts related to forces and motion.
- PHY1 3 Develop an understanding of concepts related to work and energy.
- PHY1 5 Apply an understanding of magnetism, electric fields, and electricity.

## **21st Century Learning Standards**

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

## **National Educational Technology Standards for Students**

- T2 Communication and Collaboration
- T3 Research and Information Fluency
- T6 Technology Operations and Concepts

## **ACT College Readiness Standards**

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

## Suggested References

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

# Student Competency Profile

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Student Name: \_\_\_\_\_

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

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

## Unit 1: Introduction to Agricultural and Environmental Science and Technology

- \_\_\_\_\_ 1. Examine the nature of the agriculture and natural resources industry.
- \_\_\_\_\_ 2. Examine the relationships among the pure sciences, agriculture, and agriscience.
- \_\_\_\_\_ 3. Apply standard agricultural and natural resources safety practices.

## Unit 2: Leadership and Human Relations

- \_\_\_\_\_ 1. Develop life and career skills for success in the 21st century.  
Explore the role of the FFA in promoting leadership, personal development, and human
- \_\_\_\_\_ 2. relations skills.
- \_\_\_\_\_ 3. Examine the concept of leadership.  
Describe the role of work ethics and values in establishing and building a successful
- \_\_\_\_\_ 4. career.

## Unit 3: Experiential Learning (SAE)

- \_\_\_\_\_ 1. Explore concepts of experiential learning.
- \_\_\_\_\_ 2. Plan experiential learning experiences.
- \_\_\_\_\_ 3. Implement and evaluate a Supervised Agricultural Experience Program.

## Unit 4: Concepts of Animal Science

- \_\_\_\_\_ 1. Explore the animal agriculture industry and enterprises.
- \_\_\_\_\_ 2. Investigate the anatomy and physiology of animals.
- \_\_\_\_\_ 3. Describe important elements of digestion and nutrition in animals.
- \_\_\_\_\_ 4. Examine the role of genetics and breeding in animal production.

## Unit 5: Concepts of Plant Science

- \_\_\_\_\_ 1. Explore the anatomical and physiological processes of plants.
- \_\_\_\_\_ 2. Investigate common methods of plant reproduction.
- \_\_\_\_\_ 3. Apply classification methods to plants.
- \_\_\_\_\_ 4. Apply principles of plant nutrition.
- \_\_\_\_\_ 5. Investigate the chemical properties of soils.  
Explore basic concepts of pest management to include insect damage, weed damage,
- \_\_\_\_\_ 6. and diseases.
- \_\_\_\_\_ 7. Explore the uses of a greenhouse.

**Unit 6: Concepts of Environmental Science**

- \_\_\_\_\_ Examine the importance of different kinds of natural resources and their relationship to
- \_\_\_\_\_ 1. different kinds of ecology.
  - \_\_\_\_\_ 2. Explore principles of wildlife conservation.
  - \_\_\_\_\_ 3. Explore energy conservation and alternative energy sources.
  - \_\_\_\_\_ 4. Examine principles of waste management.
  - \_\_\_\_\_ 5. Explore forest management and production practices.
  - \_\_\_\_\_ 6. Demonstrate an understanding of the impact of soil as a natural resource.
  - \_\_\_\_\_ 7. Investigate the use of the land capability classification system.

**Unit 7: Concepts of Agricultural Mechanics**

- \_\_\_\_\_ 1. Examine the importance of mechanical technology in agriscience.
- \_\_\_\_\_ 2. Explore basic principles of electricity.
- \_\_\_\_\_ 3. Explore basic principles of plumbing systems.

## Appendix A: Suggested Rubrics, Checklists, and Activities

---

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

### Agriculture Timeline Graphic Rubric (1.1)

---

<i>The student did the following:</i>	<b>Excellent</b>	<b>Good</b>	<b>Needs Improvement</b>	<b>Unacceptable</b>
	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>
Correctly identified three major practices or technologies associated with agricultural enterprises				
Correctly placed the development of these practices on the time line				
Correctly identified how each technology or practice has affected agricultural productivity				

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Agriculture Natural Resources Areas Graphic Rubric (1.2)

<b>Content</b>	Covers all three areas clearly and accurately	Mostly clear, appropriate, and correct	Minor issues with clarity or correctness	Confusing, incorrect, or flawed
<b>Visual Aids</b>	Attractive and accurate	Mostly attractive and accurate	Minor issues with attractiveness or accuracy	Inaccurate and/or unattractive

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Relationship of Pure Sciences to Agricultural Sciences Assignment (1.3)

---

### Pure Sciences

- Biology – the study of living plants and animals
- Chemistry – the study of chemical elements and compounds
- Physics – the study of matter and energy and the interactions between the two
- Mathematics – the study of numbers and their relationships to measurement, properties, and quantities

For each of the applied agricultural sciences, indicate the degree of relationship to each of the pure sciences using the following scale:

3 – Highly related

2 – Related

1 – Limited relation

0 – No relation

**Entomology**

**Soil Science**

**Silviculture**

**Horticulture**

**Animal Nutrition**

**Agricultural Mechanization**

**Plant Pathology**

**Animal Genetics**

**Environmental Science**

Name:

Date:

Period:

## Planning an Experiment Rubric (1.4)

---

<b>The Question</b>	Student posed a specific question in clear, concise language that calls for scientific research.	Student posed a general question that implies the need for scientific research.	Student posed an ambiguous question that could be answered easily without using the scientific method.	Student posed a question that does not require scientific research.
<b>Background Research</b>	Student listed four or more possible sources.	Student listed three possible sources.	Student listed two possible resources.	Student listed only one possible resource.
<b>Hypothesis</b>	Student stated the hypothesis in a way that can be measured to answer the question and identified the independent and dependent variables.	Student stated the hypothesis in a measurable manner to answer the question.	Student stated the hypothesis in a somewhat measureable manner.	Student stated the hypothesis in a manner that could not be measured.
<b>Experimental Method Design</b>	Student clearly identified procedures and controls that would be used to conduct the experiment as well as data collection and analysis procedures.	Student identified general procedures, controls, and data collection and analysis procedures.	Student identified some of the general procedures, controls, and data collection and analysis procedures.	The student offered little or no explanation of procedures, controls, and data collection, and analysis procedures.
<b>Grammar, Spelling, Punctuation, and Accuracy</b>	No mistakes	One to two minor mistakes	Three to five minor mistakes or one major mistake	More than six minor mistakes and/or more than one major mistake

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Laboratory Safety Rubric (1.5)

---

Scoring Criteria				
<i>The student does the following:</i>	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Uses safety equipment				
Selects appropriate PPE				
Wears protective clothing				
Uses ANSI-approved eye protection devices				
Demonstrates fire extinguisher operation				
<i>Subtotal for safety equipment</i>				
<b>Maintains clean facility</b>				
Performs safety inspections				
Keeps traffic area free of debris				
Stores materials properly				
<i>Subtotal for facility cleanliness</i>				
<b>Models appropriate behavior</b>				
Lists safety rules				
Observes safety rules				
Follows written directions				
Follows oral directions				
Plans work in advance				
Observes surroundings				
Maintains appropriate records				

Uses proper lifting techniques				
<i>Subtotal for appropriate behaviors</i>				
<b>Observes safety signage</b>				
Interprets color coding				
Understands safety symbols				
Observes safety zones				
Locates fire extinguishers				
Locates first aid supplies				
<i>Subtotal for safety signage</i>				
<b>Selects and uses tools</b>				
Identifies proper tools				
Uses proper tools				
Rejects unsafe tools				
Carries tools properly				
Cleans tools after use				
Replaces tools upon completion				
Observes electrical safety				
<i>Subtotal for tool selection</i>				
<b>Exercises caution with hazardous chemicals</b>				
Observes label precautions				
Handles chemicals properly				
Provides adequate ventilation				
<i>Subtotal for chemical safety</i>				
<b>Summative Total</b>				

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

**Notes:**

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Interpret a Hazardous Material Safety Data Sheet Assignment (1.6)

---

Your instructor will furnish you with the name of a chemical that is commonly used in agricultural and natural resources occupations. You are to conduct a search of the Internet to locate a material safety data sheet (MSDS) for this material and use it to answer the following questions.

1. What is the Web address of the Internet site on which you found this information?
2. If you accidentally drank some of this material, what would be the first aid procedure you would do first?
3. What special precautions should be taken in storing this material?
4. What is the flash point of this material?
5. If you spilled a small amount of this product, how would you clean it up?
6. What immediate effects would likely happen if you spilled some of this material on your skin?

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## 21st Century Life and Career Skills (2.1)

---

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

### CSS1-21st Century Themes

#### **CS1 Global Awareness**

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

#### **CS2 Financial, Economic, Business, and Entrepreneurial Literacy**

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

#### **CS3 Civic Literacy**

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

#### **CS4 Health Literacy**

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

#### **CS5 Environmental Literacy**

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

CSS2-Learning and Innovation Skills

**CS6 Creativity and Innovation**

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

**CS7 Critical Thinking and Problem Solving**

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

**CS8 Communication and Collaboration**

1. Communicate Clearly
2. Collaborate with Others

CSS3-Information, Media, and Technology Skills

**CS9 Information Literacy**

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

**CS10 Media Literacy**

1. Analyze Media
2. Create Media Products

**CS11 ICT Literacy**

1. Apply Technology Effectively

CSS4-Life and Career Skills

**CS12 Flexibility and Adaptability**

1. Adapt to Change
2. Be Flexible

**CS13 Initiative and Self-Direction**

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

**CS14 Social and Cross-Cultural Skills**

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

**CS15 Productivity and Accountability**

1. Manage Projects
2. Produce Results

**CS16 Leadership and Responsibility**

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

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## 21st Century Life and Career Skills Rubric (2.2)

---

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

<b>Superior</b>	(18–20 points): The student consistently demonstrates all aspects of this skill in classroom and laboratory activities.
<b>Exceptional</b>	(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.
<b>Adequate</b>	(12–14 points): The student demonstrates knowledge of the skill during classroom and laboratory activities but lapses on three or more indicators from time to time.
<b>Improving</b>	(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.
<b>Minimal</b>	(0–8 points): The student consistently fails to demonstrate knowledge or application of the skill.

**Flexibility and  
Adaptability**

**Initiative and Self-  
Direction**

**Social and Cross-Cultural  
Skills**

**Productivity and  
Accountability**

**Leadership and  
Responsibility**

**TOTAL SCORE**

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Rubric for Assessing Team-Building and Participation Skills (2.3)

---

<i>The student does the following:</i>	<b>Excellent</b>	<b>Good</b>	<b>Needs Improvement</b>	<b>Unacceptable</b>
	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>
Actively participates in team discussions and activities				
Encourages other team members to participate in discussions and activities				
Works with other members to keep the activity on schedule and task				
Shares ideas and thoughts				
Offers constructive recommendations				
Credits others for their contributions and ideas				
Empathizes with other members				
Requests input from others to reach an agreement				
Expresses ideas and thoughts				
Actively listens to other team members				

**Notes:**

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Scorecard for Assessing Parliamentary Procedure Skills (2.4)

Sample Scorecard for Parliamentary Procedure Demonstration

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

Adapted from FFA CDE Handbook

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Select a Personal/Leadership Activity Assignment (2.5)

---

Which activity did you select?

Why did you select this activity?

When will this activity take place?

What skills and knowledge will you have to learn in order to be successful in this activity?

How will this activity contribute to your personal development and leadership ability?

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Leadership Characteristics Survey (2.6)

---

Rate your leadership ability using the following characteristics. A 5 indicates a high level of this characteristic, and a 1 indicates a low level.

1. Honesty/Integrity – Personally holding a high moral standard and expressing the truth
2. Visionary/Forward looking – The ability see clearly into the future and communicate this vision to others
3. Competence – Knowledge of the organization, its goals, strengths, and limitations
4. Inspiring – The ability to get other people excited about your ideas and plans
5. Intelligence – The ability to locate knowledge and apply it to the current situation
6. Dedication/Commitment – The ability to concentrate and keep on, even if the situation is difficult
7. Openness – The ability to freely express your thoughts and to listen to the thoughts of others
8. Humility – A feeling that as a leader you are no more important than anyone else
9. Willingness to share – The ability to give credit for success to others
10. Fair and equitable – The ability to make decisions and treat other people fairly

What can you do to improve your three weakest indicators?

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Sample Rubric for Evaluating Work Ethics and Values (2.7)

---

<i>Behavior/Skill</i>	<b>Excellent</b>	<b>Good</b>	<b>Needs Improvement</b>	<b>Unacceptable</b>
	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>
Punctuality (arrives on time)				
Preparation (completes pre-assignments and brings necessary materials)				
Respects other students/workers				
Listens to supervisor and follows directions				
Accepts responsibility for actions				
Demonstrates positive personality traits (kindness, trustworthiness, and honesty)				
Demonstrates productivity (patience, thoroughness, and hardworking)				
Demonstrates a concern for others				
Remains on task and allows others to remain on task				
Takes initiative as appropriate				

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## **Rubric for Experiential Learning Planning and Record Keeping (3.1)**

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

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Experiential Learning Scavenger Hunt (3.2)

---

Use the FFA SAE Best Practices Guide (<http://www.ffa.org/documents/lpsguide.pdf>) to find the answers to the following questions:

1. Find the name of the agency that sponsored an SAE for a student in Food Science Quality Assurance.
2. Find three things that the student who worked in a veterinary hospital learned.
3. Find the name of the career cluster for an SAE involving scouting field crops.
4. Find the species of trees that a student planted as part of a holiday tree or plant growing SAE.
5. Find how a student who planted a community garden paid for 50% of the cost of the garden.
6. Find how a student who had an SAE raising mice and gerbils solved the problem of space to grow the animals.
7. Find the SAE type for an SAE in which the student worked at a USDA research center conducting complex experiments with DNA.
8. Find the names of the two jobs held by the student who worked at a park riding stable.
9. Find how much the initial cost was for the student who started his or her own horseshoeing business.
10. Find the name of the breeds of goats that a student used in an SAE project involving dairy goats.

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Experiential Learning Goals and Plans (3.3)

---

For School Year 20\_\_ – 20\_\_

Student Name: *(Enter student name here.)*

Student Home Address: *(Enter mailing address, city, state, and zip here.)*

Agriculture Education Course Enrolled In: *(Enter course name here.)*

Grade in School: *(Enter grade.)*

My long-range goal is to:

*(Enter long-range goal here.)*

My short-range goals are to:

- *(Enter short-range goal #1 here.)*
- *(Enter short-range goal #2 here. Additional short-range goals may be added.)*

For my Supervised Agricultural Experience program for the school year 20\_\_ – 20\_\_ I plan to engage in the following enterprises and activities: *(Check all that apply.)*

\_\_\_\_ Exploratory

\_\_\_\_ Research/Experimentation and Analysis

\_\_\_\_ Ownership/Entrepreneurship

\_\_\_\_ Placement

\_\_\_\_ Supplementary Practice(s)

\_\_\_\_ Improvement Practice(s)

*(For each activity or enterprise planned, write a description that includes the name of the enterprise, the nature of the enterprise, number of hours worked, resources required, and expenses and income.)*

Name of Enterprise/Activity: *(Enter the name of the enterprise or activity here.)*

Nature of Enterprise/Activity: *(Enter a description of the nature of the enterprise.)*

Scope of Enterprise/Activity: *(Enter a description of the scope of the enterprise, including hours involved, number of units, etc.)*

Resources Required: *(Enter resources, materials, tools, and so forth that will be required to complete the enterprise.)*

Estimated Expenses and Income: *(Enter estimated expenses and income from the enterprise if applicable.)*

Skills to Be Learned: *(Enter a listing of major skills to be learned through the enterprise or activity here.)*

Responsibilities of Parties: *(Enter responsibilities of all parties involved in the enterprise or activity here.)*

- Student: *(Enter student responsibilities here.)*
- Parent: *(Enter parent responsibilities here.)*
- Employer/Supervisor/Mentor: *(Enter employer/supervisor/mentor responsibilities here.)*

Signatures:

\_\_\_\_\_

Student

\_\_\_\_\_

Date

\_\_\_\_\_

Instructor

\_\_\_\_\_

Date

\_\_\_\_\_

Parent

\_\_\_\_\_

Date

\_\_\_\_\_

Employer/Supervisor/Mentor

\_\_\_\_\_

Date

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Sample Experiential Learning Plan Rubric (3.4)

---

<b>Occupational Goals</b>	Detailed long-range and short-term goals are identified for reaching an occupational goal in the field of agriculture, food, and natural resources occupations are provided.	General long-range and short-term goals for reaching an occupational goal in the field of agriculture, food, and natural resources occupations are provided.	General long-range and short-term goals for reaching an occupational objective in fields outside of agriculture, food, and natural resources occupations are provided.	Only vague general statements concerning any occupational goal are provided.
<b>Enterprise/ Activity Description</b>	A detailed description of the nature and scope, resources, income and expenses, skills, and responsibilities is provided.	A general description of the nature and scope, resources, income and expenses, skills, and responsibilities is provided.	A limited description of the nature and scope, resources, income and expenses, skills, and responsibilities is provided.	A very limited description of the nature and scope, resources, income and expenses, skills, and responsibilities is provided. Some elements that would apply are not covered.
<b>Responsibilities</b>	Responsibilities of all parties are detailed and complete. Quantifiable indicators are defined.	Responsibilities of all parties are detailed, and general indicators of performance are listed.	Responsibilities of all parties are stated in broad general terms.	Responsibilities of some applicable parties are not listed.

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Experiential Learning Record Book Rubric (3.5)

---

<b>Income and Expense Records</b>	Detailed records of income and expenses are kept in an accurate and timely manner.	Records of income and expenses are accurately kept, but there may be lapses in time.	Records of income and expenses are accurate, but specific details may be missing.	Records of income and expenses are kept but in an inaccurate manner.
<b>Inventory</b>	Detailed inventories of all assets are kept in an accurate and timely manner.	An accurate inventory is kept, but there may be lapses in entries.	An inventory of major equipment is kept and maintained, but inventories of materials and supplies are not present.	A very limited inventory is kept, or there are major inaccuracies in the inventory.
<b>Calendar/ Journal</b>	A detailed calendar or journal of activities is kept in an accurate and timely manner.	A calendar or journal is kept in a timely manner describing activities in general associated with the SAE.	A calendar or journal of activities is kept, but there may be slight lapses in time.	The calendar or journal of activities lacks detail or has large lapses of time.
<b>Other Records</b>	All other records that apply to the specific SAE are kept in a detailed, accurate, and timely manner.	All other records are kept in an accurate and timely manner describing general activities.	Other records are kept in a timely manner but may reflect minor inaccuracies or lapses of time.	Other records are not complete or kept in an accurate and timely manner.

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Domesticated Animals Benefits (4.1)

---

Based on your readings, identify the different classes of domesticated animals, name at least three species in each class, and describe at least one benefit of the class to humanity.



Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## **Letter of Concern Regarding Production Practices (4.2)**

---

Using the letter shown below, write a letter of response that states the positive benefits of the practices detailed.

To: Brown County Farmers Association

From: Citizens Against Cruelty to Animals (CACA)

Subject: Statements of Concern about Local Production Practices

We the members of the Citizens Against Cruelty to Animals (CACTA) are concerned about the treatment of animals on your members' farms and ranches. Specifically, we are concerned about the following practices:

- Castration of young bull calves and piglets
- Branding of any animal using hot or cold irons
- Dehorning of cattle and calves
- Close confinement of chickens
- Use of any medication or drugs on animal health

We ask that you inform your members of these concerns and adopt a resolution that prohibits any member from following these practices. We feel that all animals have the right to exist with humans in a free and natural state.

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Sample Rubric for Evaluating a Response to a Letter of Concern (4.3)

---

	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
<b>Information and Content</b>	Accurate and detailed in documenting why practices are necessary	Information provided is accurate.	Information provided is accurate but needs to be more detailed.	Information is inaccurate and lacks meaningful detail.
<b>Organization</b>	Letter is well organized and logical.	Letter is organized.	Letter has some organization.	Letter is not organized.
<b>Style and Tone</b>	Letter is positive, courteous, and interesting to read.	Letter responds to concerns with facts.	Letter responds to concerns but shows some negative emotions.	Letter is very emotional, discourteous, or lacks facts related to concerns.
<b>Grammar, Spelling, and Punctuation</b>	No mistakes are present in grammar, spelling, and punctuation.	Only one to two minor mistakes are present.	Only three to four minor mistakes are present.	A major mistake is present.
<b>Layout/Design</b>	Letter follows established rules for business letter format.	Letter follows rules with only one to two minor exceptions.	Design is unattractive and only partially follows format.	Letter does not follow format.



Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## **Major Animal Body Systems, Components, and Functions (4.4)**

---

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

--

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Worksheet on Basic Principles of Heredity and Genetics (4.5)

---

1. The passing of a trait or characteristic of a parent animal to an offspring is called \_\_\_\_\_.
2. What percent of an animal's characteristics comes from the father? \_\_\_\_\_%
3. All of the characteristics of an animal are determined by a complex set of molecules, genes, and nucleotides called \_\_\_\_\_.
4. A specific trait in an animal such as eye or skin color is determined by a unit of DNA called a \_\_\_\_\_.
5. A pair of genes that produce the same trait is \_\_\_\_\_, while a pair of genes that can produce different traits is \_\_\_\_\_.
6. As an embryo develops, the cells begin to change into specialized cells that form muscle, bone, nerves, and other tissues. This process is called \_\_\_\_\_.
7. If a producer were interested in producing calves that were naturally hornless, what type of bull should be used? \_\_\_\_\_
8. Describe how a recessive gene can be used to obtain a specific trait in a breed of animal.
9. If you mate a homozygous (PP) bull to a heterozygous (Pp) cow, what are the resulting genotypes? (P=polled; p=horned) \_\_\_\_\_
10. If you mate a homozygous (PP) bull to a heterozygous (Pp) cow, what percentage of the calves would be polled? (P=polled; p=horned) \_\_\_\_\_

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Anatomical Comparison Assignment (4.6)

---

Compare the anatomical features of a catfish, poultry, and mammals using the chart below. Show how each species is alike and how each differs.

**Skeleton and Skin**

**Respiratory System**

**Digestive System**

**Reproduction System**

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Select an Appropriate Nutritional Practice (4.8)

---

For each of the scenarios below, select the most appropriate practice, and state why you selected it.

- You have a small 2-acre pond stocked with catfish weighing about 1/2 lb each. It is in the summer, and the water temperature is 75° F. Which of the following practices would be most appropriate?
  - a. Feed sinking feed using a demand feeder.
  - b. Feed floating feed using a blower type feeder.
  - c. Feed meal using a blower type feeder.
  - d. Feed floating feed by hand.

Justify your answer in the space below:

- You have a large 20-acre pond stocked with catfish weighing about 1 lb each. It is in the winter time, and the water temperature is at 52° F. Which of the following practices would be most appropriate?
  - a. Feed sinking feed by hand.
  - b. Feed sinking feed using a blower type feeder.
  - c. Feed meal using a blower type feeder.
  - d. Feed floating feed by hand.

Justify your answer in the space below:

- You have a large 20-acre pond stocked with catfish weighing about 1 lb each. It is in the summer time, and the water temperature is at 76° F. Which of the following practices would be most appropriate?
  - a. Feed sinking feed by hand.
  - b. Feed sinking feed using a demand type feeder.
  - c. Feed floating feed using a blower type feeder.
  - d. Feed floating feed by hand.

Justify your answer in the space below:

*Note: This is a supplemental worksheet based on regional instructional needs.*

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Calculate Feed Rates (4.9)

---

Using the information shown in the scenarios below, calculate the feed rate for each situation.

### Scenario 1

- Total weight of fish in pond = 7,500 lb
- Feed rate = 2.5% of total weight

Daily feeding rate = \_\_\_\_\_ lb

### Scenario 2

- Total estimated number of fish in pond = 15,000
- Average weight = 1 lb
- Feed rate = 3.0% of total weight

Daily feeding rate = \_\_\_\_\_ lb

### Scenario 3

- Total estimated number of fish in pond = 25,000
- Average weight = 3/4 lb
- Feed rate = 2.5% of total weight

Daily feeding rate = \_\_\_\_\_ lb

*Note: This is a supplemental worksheet based on regional instructional needs.*

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## **Rubric for Evaluating Student Chart on Plant Parts and Functions (5.1)**

---

Rate each factor below using the following scale:

5 – Excellent (100%)

4 – Very Good (90–99%)

3 – Good (80–89%)

2 – Acceptable (70–79%)

1 – Needs Improvement (<70%)

- \_\_\_\_\_ 1. Drew a diagram of a plant and labeled the four major parts (roots, stem, leaves, and flowers)
- \_\_\_\_\_ 2. Described structure and function of roots
- \_\_\_\_\_ 3. Described structure and function of stems
- \_\_\_\_\_ 4. Described structure and function of leaves
- \_\_\_\_\_ 5. Described structure and function of complete flowers

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## **Chart for Comparing Photosynthesis, Respiration, and Transpiration (5.2)**

---

For each process, identify or describe the following:

**Inputs**

**Outputs**

**Lighting**

**Contributing Factors**

**Primary Difference**



Name: \_\_\_\_\_  
Date: \_\_\_\_\_  
Period: \_\_\_\_\_

## Seed Germination (5.4)

---

1. You are planning on raising tomato bedding plants from a packet of seed that has an 85% germination rate. You plant one seed per container for 100 containers, and only 60 seeds emerge. What are three factors that could have caused this decrease in germination?
  - a.
  - b.
  - c.
2. You want to raise 50 cabbage bedding plants in Styrofoam cups. If the germination rate for cabbage seed is 50%, how many cups would you need to prepare to have 50 cups of bedding plants?

\_\_\_\_\_

3. State three advantages of using seed for plant reproduction.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

4. State the differences in scarification and stratification of seeds and the reasons why these processes are used.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Plant Growth (5.5)

---

Record your observations on plant growth on this sheet.

Date planted: \_\_\_\_\_ Number of seed planted: \_\_\_\_\_

Date first plants emerged: \_\_\_\_\_ Total number of plants that emerged: \_\_\_\_\_

Average height of plants after 5 days: \_\_\_\_\_

Average height of plants after 10 days: \_\_\_\_\_

Number of plants surviving after 10 days: \_\_\_\_\_

What factors could have contributed to the loss of plants during the growing period?

What factors could have improved the growth rate of plants over the growing period?

What important concepts or knowledge did you learn from this experiment?

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Crop Production Plan (5.6)

---

1. What crop did you select for your plan? Why did you select this crop?
2. What type of climate is required for this crop? (Growing season, rainfall/water requirements, temperature range, etc.)
3. What soil conditions are needed to grow this crop? (Soil texture, depth, permeability, fertility, etc.)
4. What cultural practices will you use in growing this crop? (Seedbed preparation, planting method, fertilization and pest control, etc.)
5. How much labor will be required to grow this crop?
6. What machinery and equipment will be required to grow and harvest this crop?
7. What is the demand for this crop?
8. What is the expected yield for this crop?
9. What are the expected production costs of this crop?

10. When and how will this crop be harvested?
  
11. How will this crop be marketed?
  
12. How much money will you make from this crop?

*Note: This worksheet can be used for supplemental material.*

Name: \_\_\_\_\_  
Date: \_\_\_\_\_  
Period: \_\_\_\_\_

## **Rubric for Evaluating Crop Production Plan Assignment (5.7)**

---

Evaluate each of the questions for the Crop Production Plan Assignment using the following scale: 5 – Excellent (contains detailed accurate and complete information); 4 – Very Good (contains information that is accurate and complete but general in nature); 3 – Good (very general in nature with some minor inaccuracies or incomplete items); 2 – Marginal (has limited information but is still mostly accurate and complete); and 1 – Unacceptable (very limited or no information with major inaccuracies).

*Note: This worksheet can be used for supplemental material.*

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## **Plant Pests and the Damage They Cause (5.8)**

---

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Survey of Horticultural Enterprises (5.9)

---

List the name, location, and nature of horticultural enterprises in your community.



Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## **Greenhouse Environmental Control Assignment (5.10)**

---

Write a short paragraph that summarizes how the following environmental factors are controlled in a greenhouse:

**Temperature (Heating and Cooling):**

**Light Intensity and Duration:**

**Moisture/Humidity:**

**Ventilation:**

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Using Scale in Horticultural Drawings (5.11)

---

Answer the following questions:

1. If a flower bed is to be 12 ft wide by 24 ft long, what would the dimensions of this bed on a drawing using a scale of  $1'' = 4'$ ?
2. A home site lot is 160 ft wide and 240 ft long. What would be the dimensions of a drawing of this lot on a drawing using a scale of  $1'' = 20'$ ?
3. An area to be sodded is 60 ft wide and 180 ft long. What would be the dimensions of this area using a scale of  $1'' = 20'$ ?
4. A flower bed has dimensions of 2 in. in width and 6 in. in length on a drawing using a scale of  $1'' = 5'$ . What would be the actual dimensions of the bed?
5. The backyard of a lot has dimensions of 4 in. in width and 8 in. in length using a scale of  $1'' = 20'$ . What would be the actual dimensions of the yard?

*Note: This worksheet can be used for supplemental material.*

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Checklist for Evaluating a Sketch of a Land Plot (5.12)

---

Place a check by each step that was accomplished in completing this exercise.

- \_\_\_\_\_ 1. The student provided a title block containing a description of the plot and the student's name.
- \_\_\_\_\_ 2. The sketch included prominent features of the plot, including changes in soil surface texture, slope, and major landmarks.
- \_\_\_\_\_ 3. The student marked 10 random spots where soil should be sampled for small plots (< 1 acre) or 20 random spots where soil should be sampled for large areas.

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## **Checklist for Soil Sample Collection and Preparation (5.13)**

---

Place a check by each step that the student successfully completed.

- \_\_\_\_\_ 1. The student collected samples at the proper depth (4–6 in.) according to the sketch that was prepared.
- \_\_\_\_\_ 2. The student allowed the samples to dry and then crushed and mixed them together.
- \_\_\_\_\_ 3. The student packages a 1-pt box of the mixed samples and correctly labeled it for soil testing.
- \_\_\_\_\_ 4. The student completely and accurately filled out the Soil Sample Information Sheet for submission to the MSU Soil Testing Laboratory.

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Preservation versus Conservation Essay Rubric (6.1)

Evaluate the student's essay on conservation versus preservation using the following rubric indicators and scale:

<b>Writing Quality</b>	There is a strong writing style and ability to express concepts learned. Excellent spelling, grammar, syntax, spelling, and so forth	There are a good writing style and ability to express concepts learned. Very good grammar, syntax, spelling, and so forth	There is a writing style that conveys meaning adequately. Some minor grammatical, syntax, and spelling errors	There is difficulty in expressing concepts. There is limited syntax. There are noticeable grammatical and spelling mistakes.
<b>Content</b>	A clear and complete comparison and contrast of the issues is presented. All major points are covered in detail.	A very good comparison of the issue is recorded. Most major points are documented.	A good comparison of the issue is recorded. Some major points have been omitted.	Limited comparison of the issue is recorded. Very few major points are documented.
<b>Insight and Understanding</b>	Definite insights into the implications of the issue are recorded. Awareness of complexity of issues and situations is present.	Some insight into the issue is recorded. Some sense of complexity is present.	Insight is present from a more simplistic standpoint.	Only limited insight into the issue is recorded.
<b>Application</b>	Content of the essay is connected to the student's personal life and goals.	Content of the essay is connected to the field of agriculture.	Content of the essay is related to life in general.	Only limited connections are made between the content of the essay and the surrounding world.
				<b>Total Score:</b>



Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Exhaustible or Non-Exhaustible (6.2)

---

Classify each of the following natural resources as being exhaustible, non-exhaustible, or renewable. Write a one- to two-sentence statement that explains your reason for your selection.

**Soil**

**Fish and Wildlife**

**Coal**

**Forests**

**Surface Water**

**Iron Ore**

**Air**

**Ethanol**

**Petroleum**

**Sunlight**

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Checklist for Desalinization Laboratory Exercise (6.3)

---

Place a check by each step or indicator that the student successfully completed.

- \_\_\_\_\_ 1. The student mixed the saline solution and added to the flask following the instructions.
- \_\_\_\_\_ 2. The student assembled the apparatus according to the instructions.
- \_\_\_\_\_ 3. The student lit the burner and boiled the water for 10 minutes.
- \_\_\_\_\_ 4. The student collected the distilled water and measured its amount.
- \_\_\_\_\_ 5. The student observed all safety rules and procedures at all times.
- \_\_\_\_\_ 6. The student disassembled the apparatus and stored it according to instructions.

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Alternative Energy Essay Rubric (6.4)

<b>Content</b>	A clear and complete description of the major alternative energy sources is presented. All major points for each source are covered in detail.	A clear and complete description of the major alternative energy sources is presented. Most major points for each source are covered in detail.	A clear description of the major alternative energy sources is presented. Some major points for each source are not covered in detail.	A vague description of some of the major alternative energy sources is presented. Specific details are not covered.
<b>Writing Quality</b>	There is a strong writing style and ability to express concepts learned. Excellent spelling, grammar, syntax, spelling, and so forth	There is a good writing style and ability to express concepts learned. Very good grammar, syntax, spelling, and so forth	There is a writing style that conveys meaning adequately. Some minor grammatical, syntax, and spelling errors	There is difficulty in expressing concepts. There is limited syntax. There are noticeable grammatical and spelling mistakes.
<b>Insight and Understanding</b>	Definite insights into the implications of alternative energy are recorded.	Some insight into alternative energy is recorded.	Insight is present from a more simplistic standpoint.	Only limited insight into alternative energy is recorded.
<b>Application</b>	A detailed discussion of the applicability of each source of alternative energy to the local community is included.	A general discussion of the applicability of each source of alternative energy to the local community is included.	Discussion of the applicability of alternative energy sources to the state is included.	Only limited connections are made between alternative energy sources and the surrounding community.
				<b>Total Score:</b>



Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## **Types of Waste and Waste Products (6.5)**

---

**Sewage**

**Solid Waste**

**Poisonous Materials**

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Wood Products and Characteristics Assignment (6.6)

---

Classify each of the common types of wood below as hardwood or softwood, describe their main characteristics, and identify their most common uses.

**White Oak**

**Yellow Pine**

**Ash**

**Hickory**

**Sweetgum**

**Red Oak**

**Red Cedar**

Name: \_\_\_\_\_  
Date: \_\_\_\_\_  
Period: \_\_\_\_\_

## Reforestation Exercise Scenario (6.7)

---

Janet Ray has a 40-acre tract of timber that is about to be harvested. The land is covered in mostly pine and some oak with most of the trees being 10–16 in. in diameter. After the timber is harvested, she wants to get a new stand of hardwood trees growing as quickly as possible. Your assignment is to write Ms. Ray a letter describing the three most common methods of reforestation and listing the advantages and disadvantages of each method. You should conclude the letter with a recommendation that will allow the land to begin growing trees again as quickly as possible. Ms. Ray’s address is Janet Ray, 1333 Smith Road, Clark, MS 39777.

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Reforestation Exercise Rubric (6.8)

---

<b>Layout/Design</b>	Creatively designed, easily read, excellent business letter	Attractive, easy to read, good business letter	Appears busy or boring, difficult to read, needs improvement	Unattractive or inappropriate, very difficult to read, not acceptable
<b>Content Information</b>	Information is accurate and complete, very well written, and presented.	Well written and interesting to read	Some information is provided but is limited or inaccurate.	Poorly written, inaccurate, or incomplete
<b>Format</b>	Complete with all required parts	Some elements may be missing.	Most elements are missing or out of place.	Proper form for a letter is not used.
<b>Grammar, Punctuation, and Wording</b>	Excellent presentation, style, grammar, and punctuation	Fair presentation, style, grammar, and punctuation	Missing information, inaccurate punctuation, and/or grammar	Grammar, punctuation, and wording poor
<b>Recommendation</b>	<b>Recommendations are based on advantages stated in the letter and reflect industry practices.</b>	<b>Recommendations are based on advantages stated in letter.</b>	<b>Recommendations are not fully based on the content of the letter.</b>	Recommendation is not based on content and is incorrect.



Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## **Forest Insect Pests, Damage, and Control Assignment (6.9)**

---

For each class of forest pest, list one example and trees affected by the pest, describe the damage it causes, and summarize control measures.

**Boring  
Insects**

**Leaf-  
Feeding  
Insects**

**Sucking  
Insects**

**Gall Insects  
and Mites**

**Fungi**

**Bacteria**

**Parasitic  
Plants**

**Viruses**

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Rubric for Evaluation of Water Quality Exercise (6.10)

---

<b>Safety</b>	<b>25</b>
<ul style="list-style-type: none"><li>• Personal safety (glasses, clothing, etc.)</li><li>• Safe use of tool</li><li>• Safely performs the task</li><li>• Handles and disposes of hazardous materials properly</li></ul>	
<b>Performance of the Task</b>	<b>50</b>
<ul style="list-style-type: none"><li>• Follows the task instructions</li><li>• Performs the task efficiently</li><li>• Performs the task satisfactorily</li><li>• Records data accurately and correctly</li></ul>	
<b>Lab Maintenance</b>	<b>25</b>
<ul style="list-style-type: none"><li>• Area cleanup (clean and tidy)</li><li>• Area organization (before, during, and after the task)</li></ul>	
<b>Total</b>	<b>100</b>

**Comments for deductions:**

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Land Capability Classification Chart (6.11)

---

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

I

II

III

IV

V

VI

VII

VIII

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Installing Electrical Devices and Circuits Rubric (7.1)

---

Use the following scale to rate the student's ability to perform each task: 5 – Performs task consistently without need for oversight or direction, 4 – Performs task consistently with minimum oversight or direction, 3 – Performs tasks but requires a moderate amount of oversight or direction, 2 – Performs task with constant oversight or direction, and 1 – Cannot perform task.

1. Uses proper safety precautions, devices, and clothing
2. Uses the proper tool for the job in a safe and correct manner
3. Shares duties and responsibilities with his or her teammate
4. Uses time efficiently and stays on task
5. Installs electrical ground correctly and safely
6. Prepares cable for connection to devices
7. Attaches devices using proper procedure
8. Installs circuit breaker
9. Installs 120 and 240 outlets
10. Splices wires correctly
11. Installs a receptacle, single pole switch, and junction box
12. Tests circuits for ground and current

**Total Score:**

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## **Advantages and Disadvantages of Different Types of Pipe (7.2)**

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Selecting Pipe Fittings (7.3)

---

Answer each question by writing the name of the fitting and drawing a diagram showing how it is used.

1. What type of fitting would you use to connect two pieces of pipe in a straight line?
2. What type of fitting would you use to connect two pieces of pipe at a 90° angle?
3. What fitting would you use to connect two pieces of pipe so that they could be easily disconnected later?
4. Which fitting would you use to connect a 3/4-in. diameter pipe to a 1/2-ft diameter pipe?
5. Which fitting would you use to join three pieces of pipe?
6. Which valve would be most suitable for use in a location where you wanted to turn the flow of water or gas on and off with one 90° turn?
7. Which valve is most commonly used on faucets to allow for a gradual increase or decrease in flow?
8. Which valve is used to prevent the flow of water or gas from going in the wrong direction?

# Appendix B: 21st Century Skills Standards<sup>1</sup>

---

## CSS1-21st Century Themes

### **CS1 Global Awareness**

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

### **CS2 Financial, Economic, Business, and Entrepreneurial Literacy**

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

### **CS3 Civic Literacy**

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

### **CS4 Health Literacy**

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

### **CS5 Environmental Literacy**

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

## CSS2-Learning and Innovation Skills

### **CS6 Creativity and Innovation**

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

### **CS7 Critical Thinking and Problem Solving**

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

### **CS8 Communication and Collaboration**

1. Communicate Clearly
2. Collaborate with Others

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<sup>1</sup> *21st century skills*. (n.d.). Washington, DC: Partnership for 21st Century Skills.

### CSS3-Information, Media, and Technology Skills

**CS9 Information Literacy**

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

**CS10 Media Literacy**

1. Analyze Media
2. Create Media Products

**CS11 ICT Literacy**

1. Apply Technology Effectively

### CSS4-Life and Career Skills

**CS12 Flexibility and Adaptability**

1. Adapt to Change
2. Be Flexible

**CS13 Initiative and Self-Direction**

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

**CS14 Social and Cross-Cultural Skills**

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

**CS15 Productivity and Accountability**

1. Manage Projects
2. Produce Results

**CS16 Leadership and Responsibility**

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

# Appendix C: Mississippi Academic Standards

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## MISSISSIPPI SCIENCE FRAMEWORK COMPETENCIES

### Marine and Aquatic Science

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

- 1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
  - Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
    - Safety rules and symbols
    - Proper use and care of the compound light microscope, slides, chemicals, and so forth
    - 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, and theory development). (DOK 3)
  - Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, and creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
  - Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
  - Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
  - Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
- 2. Develop an understanding of physical and chemical properties of water and aquatic environments.**
  - Analyze the physical and chemical properties of water, and justify why it is essential to living organisms. (DOK 1)
  - Explain the causes and characteristics of tides. (DOK 1)
  - Research, create diagrams, and summarize principles related to waves and current characteristics and formation. (DOK 2)
  - Compare and contrast the physical and chemical parameters of dissolved O<sub>2</sub>, pH, temperature, salinity, and results obtained through analysis of different water column depths/zones. (DOK 2)
  - Investigate the causes and effects of erosion, and discuss conclusions. (DOK 2)
  - Describe and differentiate among the major geologic features of specific aquatic environments. (DOK 1)
    - Plate tectonics
    - Rise, slope, elevation, and depth
    - Formation of dunes, reefs, barrier/volcanic islands, and coastal/flood plains
    - Watershed formation as it relates to bodies of freshwater
  - Compare and contrast the unique abiotic and biotic characteristics of selected aquatic ecosystems. (DOK 2)
    - Barrier island, coral reef, tidal pool, and ocean
    - River, stream, lake, pond, and swamp
    - Bay, sound, estuary, and marsh
- 3. Apply an understanding of the diverse organisms found in aquatic environments.**
  - Analyze and explain the diversity and interactions among aquatic life. (DOK 3)
    - Adaptations of representative organisms for their aquatic environments

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

## **Biology I**

---

BI01 1	Apply inquiry-based and problem-solving processes and skills to scientific investigations.
BI01 2	Describe the biochemical basis of life, and explain how energy flows within and between the living systems.
BI01 3	Investigate and evaluate the interaction between living organisms and their environment.
BI01 4	Analyze and explain the structures and function of the levels of biological organization.
BI01 5	Demonstrate an understanding of the molecular basis of heredity.
BI01 6	Demonstrate an understanding of principles that explain the diversity of life and biological evolution.

- 1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
    - Safety rules and symbols
    - Proper use and care of the compound light microscope, slides, chemicals, and so forth
    - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
  - d. Formulate questions that can be answered through research and experimental design. (DOK 3)
  - e. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 2)
  - f. Construct and analyze graphs (e.g., plotting points, labeling x- and y-axis, and creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
  - g. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
  - h. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
  - i. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
- 2. Describe the biochemical basis of life, and explain how energy flows within and between the living systems.**
- a. Explain and compare with the use of examples the types of bond formation (e.g., covalent, ionic, hydrogen, etc.) between or among atoms. (DOK 2)
    - Subatomic particles and arrangement in atoms

- Importance of ions in biological processes
  - b. Develop a logical argument defending water as an essential component of living systems (e.g., unique bonding and properties including polarity, high specific heat, surface tension, hydrogen bonding, adhesion, cohesion, and expansion upon freezing). (DOK 2)
  - c. Classify solutions as acidic, basic, or neutral, and relate the significance of the pH scale to an organism's survival (e.g., consequences of having different concentrations of hydrogen and hydroxide ions). (DOK 2)
  - d. Compare and contrast the structure, properties, and principle functions of carbohydrates, lipids, proteins, and nucleic acids in living organisms. (DOK 2)
    - Basic chemical composition of each group
    - Building components of each group (e.g., amino acids, monosaccharides, nucleotides, etc.)
    - Basic functions (e.g., energy, storage, cellular, and heredity) of each group
  - e. Examine the life processes to conclude the role enzymes play in regulating biochemical reactions. (DOK 2)
    - Enzyme structure
    - Enzyme function, including enzyme-substrate specificity and factors that affect enzyme function (pH and temperature)
  - f. Describe the role of adenosine triphosphate (ATP) in making energy available to cells. (DOK 1)
    - ATP structure
    - ATP function
  - g. Analyze and explain the biochemical process of photosynthesis and cellular respiration, and draw conclusions about the roles of the reactant and products in each. (DOK 3)
    - Photosynthesis and respiration (reactants and products)
    - Light-dependent reactions and light-independent reactions in photosynthesis, including requirements and products of each
    - Aerobic and anaerobic processes in cellular respiration, including products each and energy differences
3. **Investigate and evaluate the interaction between living organisms and their environment.**
- a. Compare and contrast the characteristics of the world's major biomes (e.g., deserts, tundra, taiga, grassland, temperate forest, and tropical rainforest). (DOK 2)
    - Plant and animal species
    - Climate (temperature and rainfall)
    - Adaptations of organisms
  - b. Provide examples to justify the interdependence among environmental elements. (DOK 2)
    - Biotic and abiotic factors in an ecosystem (e.g., water, carbon, oxygen, mold, and leaves)
    - Energy flow in ecosystems (e.g., energy pyramids and photosynthetic organisms to herbivores, carnivores, and decomposers)
    - Roles of beneficial bacteria
    - Interrelationships of organisms (e.g., cooperation, predation, parasitism, commensalism, symbiosis, and mutualism)
  - c. Examine and evaluate the significance of natural events and human activities on major ecosystems (e.g., succession, population growth, technology, loss of genetic diversity, and consumption of resources). (DOK 2)
4. **Analyze and explain the structures and function of the levels of biological organization.**
- a. Differentiate among plant and animal cells and eukaryotic and prokaryotic cells. (DOK 2)
    - Functions of all major cell organelles and structures (e.g., nucleus, mitochondrion, rough ER, smooth ER, ribosomes, Golgi bodies, vesicles, lysosomes, vacuoles, microtubules, microfilaments, chloroplast, cytoskeleton, centrioles, nucleolus, chromosomes, nuclear membrane, cell wall, cell membrane [active and passive transport], and cytosol)
    - Components of mobility (e.g., cilia, flagella, and pseudopodia)
  - b. Differentiate between types of cellular reproduction. (DOK 1)

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

## Biology II

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

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

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

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

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

### 3. Investigate and discuss the molecular basis of heredity.

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

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

## **Botany**

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

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

- a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
  - Safety rules and symbols
  - Proper use and care of the compound light microscope, slides, chemicals, and so forth

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

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

## Chemistry I

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

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

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

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

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

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

- Formulas and calculations of the molecular (molar) masses
  - Empirical formula given the percent composition of elements
  - Molecular formula given the empirical formula and molar mass
5. **Compare factors associated with acid/base and oxidation/reduction reactions.**
- a. Analyze and explain acid/base reactions. (DOK 2)
    - Properties of acids and bases, including how they affect indicators and the relative pH of the solution
    - Formation of acidic and basic solutions
    - Definition of pH in terms of the hydronium ion concentration and the hydroxide ion concentration
    - The pH or pOH from the hydrogen ion or hydroxide ion concentrations of solution
    - How a buffer works and examples of buffer solutions
  - b. Classify species in aqueous solutions according to the Arrhenius and Bronsted–Lowry definitions respectively, and predict products for aqueous neutralization reactions. (DOK 2)
  - c. Analyze a reduction/oxidation reaction (REDOX) to assign oxidation numbers (states) to reaction species, and identify the species oxidized and reduced, the oxidizing agent, and reducing agent. (DOK 2)

## Organic Chemistry

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

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

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

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

- a. Apply International Union of Pure and Applied Chemistry (IUPAC) nomenclature, and differentiate the structure of aliphatic, aromatic, and cyclic hydrocarbon compounds. (DOK 1)
  - Structures of hydrocarbon compounds
  - Isomerism in hydrocarbon compounds
- b. Relate structure to physical and chemical properties of hydrocarbon. (DOK 1)
- c. Apply principles of geometry and hybridization to organic molecules. (DOK 2)
  - Lewis structures for organic molecules
  - Bond angles
  - Hybridization (as it applies to organic molecules)
- d. Write, complete, and classify common reactions for aliphatic, aromatic, and cyclic hydrocarbons. (DOK 1)
- e. Construct, solve, and explain equations representing combustion reactions, substitution reactions, dehydrogenation reactions, and addition reactions. (DOK 2)
- f. Classify functional groups (e.g., alcohols, ethers, aldehydes, ketones, carboxylic acids, esters, amines, amides, and nitriles) by their structure and properties. (DOK 2)

- Structural formulas from functional group names and vice versa
- Chemical and physical properties of compounds containing functional groups
- Equations representing the transformation of one functional group into another

**3. Discuss the versatility of polymers and the diverse application of organic chemicals.**

- 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
- 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
- Research and summarize the diversity, applications, and economics of industrial chemicals (solvents, coatings, surfactants, etc.). (DOK 3)

## **Earth and Space Science**

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- 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.**

- Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
  - Safety rules and symbols
  - Proper use and care of the compound light microscope, slides, chemicals, and so forth
  - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers.
- 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, and 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 the history and evolution of the universe and earth.**

- 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
- Differentiate methods used to measure space distances, including astronomical unit, light-year, stellar parallax, Cepheid variables, and the red shift. (DOK 1)

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

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

## **Environmental Science**

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

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

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

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

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

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

## **Genetics**

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

1. **Use critical thinking and scientific problem solving in designing and performing biological research and experimentation. (L, P, E)**

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

2. **Review the structure and function of the cell as it applies to genetics. (L)**

- a. Cite evidence to illustrate how the structure and function of cells are involved in the maintenance of life. (DOK 2)
- b. Describe how organic components are integral to biochemical processes. (DOK 2)
- c. Differentiate among the processes by which plants and animals reproduce. (DOK 1)
- Cell cycle and mitosis
  - Meiosis, spermatogenesis, and oogenesis
- d. Explain the significance of the discovery of nucleic acids. (DOK 1)
- e. Analyze and explain the structure and function of DNA and RNA in replication, transcription, translation, and DNA repair. (DOK 2)
- f. Cite examples to compare the consequences of the different types of mutations. (DOK 1)
- g. Draw conclusions about the importance and potential impacts of the process of gene transfer used in biotechnology. (DOK 3)

3. **Analyze the structure and function of DNA and RNA molecules. (L, P)**

- a. Cite evidence that supports the significance of Mendel's concept of "particulate inheritance" to explain the understanding of heredity. (DOK 1)
- b. Apply classical genetics principles to solve basic genetic problems. (DOK 2)

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

## Geology

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

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

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

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

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

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

## **Physical Science**

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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, and drawing conclusions
  - Recording outcomes and organizing data from a variety of sources (e.g., scientific articles, magazines, student experiments, etc.)
  - Critically analyzing current investigations/problems using periodicals and scientific scenarios
- d. Interpret and generate graphs (e.g., plotting points, labeling x- and y-axis, and creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
- e. Analyze procedures and data to draw conclusions about the validity of research. (DOK 3)
- f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
- g. Communicate effectively to present and explain scientific results, using appropriate terminology and graphics. (DOK 3)

### **2. Describe and explain how forces affect motion.**

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

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

- Average atomic mass from isotopic abundance
  - Solids, liquids, and gases
  - Periodic properties of elements (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, and atomic/covalent/ionic radius) and how they relate to position in the periodic table
5. **Investigate and apply principles of physical and chemical changes in matter.**
- 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, and acid/base reactions). (DOK 2)

## Physics I

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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.

- 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, and theory development). (DOK 3)
  - Organize data to construct graphs (e.g., plotting points, labeling x- and y-axis, and creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
  - Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
  - Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
  - Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBLs, etc.). (DOK 3)
- 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, and the special case of freefall). (DOK 2)
  - Analyze real-world applications to draw conclusions about Newton's three laws of motion. (DOK 2)
  - Apply the effects of the universal gravitation law to graph and interpret the force between two masses, acceleration due to gravity, and planetary motion. (DOK 2)
    - Situations where  $g$  is constant (falling bodies)
    - Concept of centripetal acceleration undergoing uniform circular motion
    - Kepler's third law
    - Oscillatory motion and the mechanics of waves

3. **Develop an understanding of concepts related to work and energy.**
- Explain and apply the conservation of energy and momentum. (DOK 2)
    - Concept of work and applications
    - Concept of kinetic energy, using the elementary work–energy theorem
    - Concept of conservation of energy with simple examples
    - Concepts of energy, work, and power (qualitatively and quantitatively)
    - Principles of impulse in inelastic and elastic collisions
  - Analyze real-world applications to draw conclusions about mechanical potential energy (the energy of configuration). (DOK 3)
  - Apply the principles of impulse, and compare conservation of momentum and conservation of kinetic energy in perfectly inelastic and elastic collisions. (DOK 1)
  - 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
  - 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.**
- 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.)
  - Differentiate and explain the Doppler effect as it relates to a moving source and to a moving observer. (DOK 1)
  - 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)
  - Use ray tracing and the thin lens equation to solve real-world problems involving object distance from lenses. (DOK 2)
  - Investigate and draw conclusions about the characteristics and properties of electromagnetic waves. (DOK 2)
5. **Apply an understanding of magnetism, electric fields, and electricity.**
- 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
  - 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)
  - 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.**
- 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
  - 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**

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

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

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

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

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

## **Zoology**

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

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

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

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

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

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

# Appendix D: ACT College Readiness Standards

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## English

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### E1 Topic Development in Terms of Purpose and Focus

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

### E2 Organization, Unity, and Coherence

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

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

- Revise sentences to correct awkward and confusing arrangements of sentence elements.
- Revise vague nouns and pronouns that create obvious logic problems.
- Delete obviously synonymous and wordy material in a sentence.
- Revise expressions that deviate from the style of an essay.
- Delete redundant material when information is repeated in different parts of speech (e.g., *alarmingly startled*).

- Use the word or phrase most consistent with the style and tone of a fairly straightforward essay.
- Determine the clearest and most logical conjunction to link clauses.
- Revise a phrase that is redundant in terms of the meaning and logic of the entire sentence.
- Identify and correct ambiguous pronoun references.
- Use the word or phrase most appropriate in terms of the content of the sentence and tone of the essay.
- Correct redundant material that involves sophisticated vocabulary and sounds acceptable as conversational English (e.g., *an aesthetic viewpoint* versus *the outlook of an aesthetic viewpoint*).
- Correct vague and wordy or clumsy and confusing writing containing sophisticated language.
- Delete redundant material that involves subtle concepts or that is redundant in terms of the paragraph as a whole.

#### **E4 Sentence Structure and Formation**

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

#### **E5 Conventions of Usage**

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

## **E6 Conventions of Punctuation**

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

## **Math**

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### **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.,  $90^\circ$ ,  $180^\circ$ , and  $360^\circ$ ).
- Use several angle properties to find an unknown angle measure.
- Recognize Pythagorean triples.\*
- Use properties of isosceles triangles.\*
- Apply properties of  $30^\circ$ - $60^\circ$ - $90^\circ$ ,  $45^\circ$ - $45^\circ$ - $90^\circ$ , 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**

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### **R1 Main Ideas and Author’s Approach**

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

### **R2 Supporting Details**

- Locate basic facts (e.g., names, dates, and events) clearly stated in a passage.
- Locate simple details at the sentence and paragraph level in uncomplicated passages.
- Recognize a clear function of a part of an uncomplicated passage.

- Locate important details in uncomplicated passages.
- Make simple inferences about how details are used in passages.
- Locate important details in more challenging passages.
- Locate and interpret minor or subtly stated details in uncomplicated passages.
- Discern which details, though they may appear in different sections throughout a passage, support important points in more challenging passages.
- Locate and interpret minor or subtly stated details in more challenging passages.
- Use details from different sections of some complex informational passages to support a specific point or argument.
- Locate and interpret details in complex passages.
- Understand the function of a part of a passage when the function is subtle or complex.

### **R3 Sequential, Comparative, and Cause—Effect Relationships**

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

### **R4 Meaning of Words**

- Understand the implication of a familiar word or phrase and of simple descriptive language.
- Use context to understand basic figurative language.
- Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in uncomplicated passages.
- Use context to determine the appropriate meaning of virtually any word, phrase, or statement in uncomplicated passages.
- Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in more challenging passages.
- Determine the appropriate meaning of words, phrases, or statements from figurative or somewhat technical contexts.
- Determine, even when the language is richly figurative and the vocabulary is difficult, the appropriate meaning of context-dependent words, phrases, or statements in virtually any passage.

### **R5 Generalizations and Conclusions**

- Draw simple generalizations and conclusions about the main characters in uncomplicated literary narratives.
- Draw simple generalizations and conclusions about people, ideas, and so forth in uncomplicated passages.

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

## Science

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### S1 Interpretation of Data

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

### S2 Scientific Investigation

- Understand the methods and tools used in a simple experiment.
- Understand the methods and tools used in a moderately complex experiment.
- Understand a simple experimental design.
- Identify a control in an experiment.
- Identify similarities and differences between experiments.
- Understand the methods and tools used in a complex experiment.
- Understand a complex experimental design.
- Predict the results of an additional trial or measurement in an experiment.

- Determine the experimental conditions that would produce specified results.
- Determine the hypothesis for an experiment.
- Identify an alternate method for testing a hypothesis.
- Understand precision and accuracy issues.
- Predict how modifying the design or methods of an experiment will affect results.
- Identify an additional trial or experiment that could be performed to enhance or evaluate experimental results.

### **S3 Evaluation of Models, Inferences, and Experimental Results**

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

## **Writing**

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### **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 and producers and consumers of animal products.**
  - AS.06.01. Demonstrate safe animal handling and management techniques.
  - AS.06.02. Implement procedures to ensure that animal products are safe.
- AS.07. Select animal facilities and equipment that provide for the safe and efficient production, housing, and handling of animals.**
  - AS.07.01. Design animal housing, equipment, and handling facilities for the major systems of animal production.
  - AS.07.02. Comply with government regulations and safety standards for facilities used in animal production.
- AS.08. Analyze environmental factors associated with animal production.**
  - AS.08.01. Reduce the effects of animal production on the environment.
  - AS.08.02. Evaluate the effects of environmental conditions on animals.

## **BIOTECHNOLOGY**

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

- BS.01. Recognize the historical, social, cultural, and potential applications of biotechnology.**
- BS.01.01. Distinguish major innovators, historical developments, and potential applications of biotechnology in agriculture.
  - BS.01.02. Determine regulatory issues, and identify agencies associated with biotechnology.
  - BS.01.03. Analyze the ethical, legal, social, and cultural issues relating to biotechnology.
- BS.02. Demonstrate laboratory skills as applied to biotechnology.**
- BS.02.01. Maintain and interpret biotechnology laboratory records.
  - BS.02.02. Operate biotechnology laboratory equipment according to standard procedures.
  - BS.02.03. Demonstrate proper laboratory procedures using biological materials.
  - BS.02.04. Safely manage biological materials, chemicals, and wastes used in the laboratory.
  - BS.02.05. Perform microbiology, molecular biology, enzymology, and immunology procedures.
- BS.03. Demonstrate the application of biotechnology to Agriculture, Food, and Natural Resources (AFNR).**
- BS.03.01. Evaluate the application of genetic engineering to improve products of AFNR systems.
  - BS.03.02. Perform biotechnology processes used in AFNR systems.
  - BS.03.03. Use biotechnology to monitor and evaluate procedures performed in AFNR systems.

#### **ENVIRONMENTAL SERVICE SYSTEMS**

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

- ESS.01. Use analytical procedures to plan and evaluate environmental service systems.**
- ESS.01.01. Analyze and interpret samples.
- ESS.02. Assess the impact of policies and regulations on environmental service systems.**
- ESS.02.01. Interpret laws affecting environmental service systems.
- ESS.03. Apply scientific principles to environmental service systems.**
- ESS.03.01. Apply meteorology principles to environmental service systems.
  - ESS.03.02. Apply soil science principles to environmental service systems.
  - ESS.03.03. Apply hydrology principles to environmental service systems.
  - ESS.03.04. Apply best management techniques associated with the properties, classifications, and functions of wetlands.
  - ESS.03.05. Apply chemistry principles to environmental service systems.
  - ESS.03.06. Apply microbiology principles to environmental service systems.
- ESS.04. Operate environmental service systems to manage a facility environment.**
- ESS.04.01. Use pollution control measures to maintain a safe facility environment.
  - ESS.04.02. Manage safe disposal of all categories of solid waste.
  - ESS.04.03. Apply the principles of public drinking water treatment operations to ensure safe water at a facility.
  - ESS.04.04. Apply principles of wastewater treatment to manage wastewater disposal in keeping with rules and regulations.
  - ESS.04.05. Manage hazardous materials to assure a safe facility and to comply with applicable regulations.
- ESS.05. Examine the relationships between energy sources and environmental service systems.**
- ESS.05.01. Compare and contrast the impact of conventional and alternative energy sources on the environment.
- ESS.06. Use tools, equipment, machinery, and technology to accomplish tasks in environmental service systems.**

- ESS.06.01. Use technological and mathematical tools to map land, facilities, and infrastructure.
- ESS.06.02. Maintain tools, equipment, and machinery in safe working order for tasks in environmental service systems.

### **FOOD PRODUCTS AND PROCESSING SYSTEMS**

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

**FPP.01. Examine components of the food industry and historical development of food products and processing.**

- FPP.01.01. Evaluate the significance and implications of changes and trends in the food products and processing industry.
- FPP.01.02. Work effectively with industry organizations, groups, and regulatory agencies affecting the food products and processing industry.

**FPP.02. Apply safety principles, recommended equipment, and facility management techniques to the food products and processing industry.**

- FPP.02.01. Manage operational procedures, and create equipment and facility maintenance plans.
- FPP.02.02. Implement Hazard Analysis and Critical Control Point (HACCP) procedures to establish operating parameters.
- FPP.02.03. Apply safety and sanitation procedures in the handling, processing, and storing of food products.
- FPP.02.04. Demonstrate worker safety procedures with food product and processing equipment and facilities.

**FPP.03. Apply principles of science to the food products and processing industry.**

- FPP.03.01. Apply principles of science to food processing to provide a safe, wholesome, and nutritious food supply.

**FPP.04. Select and process food products for storage, distribution, and consumption.**

- FPP.04.01. Utilize harvesting, selection, and inspection techniques to obtain quality food products for processing.
- FPP.04.02. Evaluate, grade, and classify processed food products.
- FPP.04.03. Process, preserve, package, and present food and food products for sale and distribution.

### **NATURAL RESOURCE SYSTEMS**

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

**NRS.01. Explain interrelationships between natural resources and humans necessary to conduct management activities in natural environments.**

- NRS.01.01. Apply knowledge of natural resource components to the management of natural resource systems.
- 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

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- 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.