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Part 40: Agriculture Food and Natural Resources, Career Pathways

Science of Agricultural Environment

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

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

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

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

Applied Academic Credit Benchmarks

Mississippi Department of Education 2010 Mississippi Science Framework

21st Century Skills and Information and Communication Technologies Literacy Standards

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

National Educational Technology Standards for Students

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ACT College Readiness Standards



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

Preface

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

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

Research Synopsis

Agricultural and Environmental Science and Technology Research

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

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

Employment Projections

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

Industry Job Data – Employment Projections 2006 to 2016 for Mississippi

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

Occupational title	Employment, 2006	Projected employment, 2016	Change 2006–2016		Total Projected Avg. Annual Job Openings
			Number	Percent	
Animal Breeders	9,770	9,870	100	1.0	165
Agricultural and Food Science Technicians	260	310	50	19.2	10
Agricultural Equipment Operators	1,090	1,190	100	9.2	40
Agricultural Sciences Teachers, Postsecondary	190	240	50	26.3	20
Conservation Scientists	790	890	100	12.7	30
Custodial and Caretaking Supervisors and Workers	46,920	54,110	7,190	15.3	2,320
Environmental Engineers	270	320	50	18.5	10
Environmental Engineering	50	100	50	100.0	0

Occupational title	Employment, 2006	Projected employment, 2016	Change 2006– 2016		Total Projected Avg. Annual Job Openings
			Number	Percent	
Technicians					
Environmental Scientists and Specialists	420	470	50	11.9	10
Environmental Science and Protection Technicians	100	150	50	50.0	5
Farmworkers and Laborers, Crop, Nursery, and Greenhouse	5,160	5,810	650	12.6	225
Farmworkers, Farm and Ranch Animals	1,400	1,550	150	10.7	65
First-Line Supervisors / Managers of Farming, Fishing, and Forestry Workers	1,390	1,540	150	10.8	40
Food Processing Workers	14,920	18,320	3,400	22.8	680
Foresters	470	520	50	10.6	20
Forest and Conservation Technicians	390	440	50	12.8	15
Forest and Conservation Workers	880	980	100	11.4	30
Grounds Maintenance Workers	10,310	11,810	1,500	14.5	375
Logging Equipment Operators	3,910	4,210	300	7.7	100
Purchasing Agents and Buyers, Farm Products	80	130	50	62.5	5
Soil and Plant Scientists	430	480	50	11.6	10
Veterinarians	540	640	100	18.5	25
Veterinary Assistants and Laboratory Animal Caretakers	690	890	200	29.0	35
Veterinary Technologists and Technicians	440	540	100	22.7	15

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

Occupational Employment and Wage Estimates for Mississippi May 2006

Occupation	Employment, 2006	Avg. Hourly Wage	Average Annual Wage
Farmers and Ranchers	2,760	\$17.85	\$43,560.00
Farm Managers and Supervisors	2,640	\$23.23	\$48,360.00
Logging Equipment Operators	3,890	\$14.28	\$30,880.00
Landscaping Supervisors	2,990	\$17.93	\$40,240.00
Landscape Workers	8,560	\$10.22	\$23,010.00
Agricultural Scientists/Technicians	29,680	\$18.33	\$38,555.00

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

Curriculum Content

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

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

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

Theme	AEST	Ag and Nat. Resources	Horticulture/Landscape
Principles of Leadership, Personal Development, and Career Success	X	X	X
Principles of Plant Science and Production	X	X	X
Principles of Animal Science and Production	X	X	
Principles of Soil, Water, and Air Quality, Conservation, and Use	X	X	X
Principles of Agricultural Power, Structures, and Technological Systems	X	X	X
Principles of Management, Economics, and Marketing	X	X	X

Executive Summary

Program Description

Science of Agricultural Environment is an advanced level course for the Agricultural and Environmental Science and Technology Program. All students must complete *Concepts of Agriscience* before being allowed to enroll in the advanced courses of the program. The course focuses on the development of skills and knowledge related to the management, conservation, and responsible use of natural resources and on the protection and enhancement of the environment. Instruction is provided on soil, air, and water conservation and use; waste management; forest management; local and global environmental issues; and environmental stewardship. The course carries 1 Carnegie unit of credit that can count as a science elective credit for high school graduation. Students may also earn an additional ½ Carnegie unit by completing a successful supervised agricultural experience program.

Industry Certification

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

Articulation

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

High School Program	Community College Program	Community College Course
Agricultural & Environmental Science & Tech – 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	Ag Business & Mgmt Tech(Program CIP: 01.0304 –	AGT 2563 - Agricultural Machinery and Shop Management

Mechanization (CIP: 01.0201)	Field Crops)	
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Assessment

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

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

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

Student Prerequisites

Prior to enrolling in *Science of Agricultural Environment*, a student must have completed *Concepts of Agriscience*. *Science of Agricultural Environment* may be offered to students in grades 10–12.

Applied Academic Credit

Content of the *Science of Agricultural Environment* course has been aligned to the 2010 Mississippi Science Curriculum Framework. Students who complete *Science of Agricultural Environment* may receive one elective science credit that will count toward high school science graduation requirements. (See *Appendix A: High School Graduation Requirements in Mississippi Public Schools Accountability Standards* for the current school year for current status.)

Licensure Requirements

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

1. Hold a valid Mississippi Educator License with endorsement #301 – Vocational Agriculture Education Programs or #302 – Agriculture.
2. Possess a baccalaureate degree in an agricultural subject area.
3. Complete the 3-semester-credit-hour course devoted to the teaching of Agricultural and Environmental Science and Technology courses. The course, AIS 6113 - Methods of Teaching Agriscience, is currently offered by Mississippi State University.

4. Enroll immediately in the Vocational Instructor Preparation (VIP) program or the College and Career Readiness Education Program (CCREP).
5. Complete the individualized Professional Development Plan (PDP) requirements of the VIP or CCREP prior to the expiration date of the 3-year vocational license.
6. Successfully complete an MDE-approved computer literacy certification exam.
7. Successfully complete a certification for an online learning workshop, module, or course that is approved by MDE.

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

Professional Learning

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

Course Outlines

Course Description: Science of Agricultural Environment introduces and develops skills for students in environmental areas related to the use and management of natural resources in the food and fiber systems. New technologies being used to enhance human capabilities to monitor and protect the environment are introduced. The overall focus is on maintaining and protecting resources to assure quality human life. Important relationships of living organisms to land and soil, water, the atmosphere, waste management, forestry, and energy management are included. Stress is on understanding global environmental issues and developing appropriate attitudes of environmental stewardship.

Science of Agricultural Environment (One Carnegie Unit) - Course Code: 991002

Unit	Title	Hours
1	Introduction to the Science of Agricultural Environment*	7
2	Experiential Learning (SAE)*	5
3	Living Organisms and Ecology	15
4	Land and Soil Management	10
5	Water Quality Management	10
6	The Atmosphere and Environmental Quality	10
7	Forestry and the Environment	10
8	Wildlife and the Environment	10
9	Environmental Stewardship	20
10	Issues in a Global Environment	10
		107

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

Using This Document

Unit Number and Title

Suggested Time on Task

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

Competencies and Suggested Objectives

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

Suggested Teaching Strategies

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

Suggested Assessment Strategies

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

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

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

References

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

Science of Agricultural Environment

Unit 1: Introduction to the Science of Agricultural Environment

7 Hours

Competency 1: Examine the environment and how it is affected by human and agricultural activities.

NRS.01, NRS.03, NRS.04, ESS.01, ESS.02, ESS.05, BIOI 2, BIOI 3, ES 2, ES 3

Suggested Enduring Understandings

1. Natural resources are an integral part of our daily lives.
2. Environmental sustainability is critical in protecting resources for future use.
3. Natural resources are interdependent on one another.
4. The quality and protection of the environment is the responsibility of the agriculture industry.

Suggested Essential Questions

1. What are natural resources, and how are they classified?
2. What does sustainability mean, and how does it affect how we manage our use of the environment?
3. What is a food chain, and how is energy transferred through a food chain?
4. Why does the agriculture industry need to be concerned about environmental quality and protection?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify natural resources, and distinguish between renewable and nonrenewable resources. (DOK 2)	a. Conduct a survey on how students feel about protection of the environment and natural resource use. From the findings of the survey, identify natural resources that the students are aware of, and lead a discussion on how these and other natural resources are used. Define the terms renewable and nonrenewable resources, and classify each resource. Have students distinguish between renewable and nonrenewable resources and justify their decisions. Use the <i>Lecture Notes for Unit 1 (1.2)</i> as a guide. <small>E1, E2, E3, E4, CS2, CS3, CS4, T2, T3</small>	a. Grade students on completion of the survey using the <i>Rubric for Student Survey on Environmental Protection and Natural Resources Use (1.1)</i> .
b. Discuss the concept of sustainability in environmental and natural resource management. (DOK 2)	b. Define the term sustainability, and provide illustrations of its applications in the environment or in agricultural production. Have students write a paragraph in their own words summarizing the concept of sustainability. <small>E1, CS1, T2, T3, T4</small>	b. Use paper and pencil test questions to check students' understanding of the concept of sustainability. (See <i>Sample Test Questions (1.6)</i> for sample questions.)

c. Examine relationships of the ecosystem to energy transfer and food chains. (DOK 2)	c. Using class discussion and group assigned research, create a giant food web identifying the role of natural resources and various levels of the food chain throughout the web. Use <i>Construct a Food Web Activity (1.3)</i> as the activity guide. Lead a discussion on the process by which energy from the sun is transformed into other forms of energy through the food chain. <small>E1, E2, CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T4</small>	c. Use the <i>Rubric for Group Activity to Construct a Food Web (1.4)</i> to assess student mastery.
d. Assess the relationship of agriculture to the quality of the environment. (DOK 3)	d. Have students research and prepare a position paper that supports the role of agriculture and natural resources in promoting conservation and responsible use of natural resources and the environment. They can narrow their topic to a specific crop or animal or to a specific area of agriculture related to their chosen career objective. <small>CS1, CS2, CS4, CS5, T1, T2, T3, E1, E2, E3, E4, E5, E6</small>	d. Use the <i>Rubric for Position Paper on Conservation and Responsible Use of Natural Resources (1.5)</i> to assess student mastery. Use a pencil and paper test to assess student mastery. (See <i>Sample Test Questions (1.6)</i> for sample questions.)

Competency 2: Analyze issues affecting the global environment and how these relate to agriculture.
NRS.01, ESS.02, ES 2, ES 3, AQ 4, BIOI 1, BIOI 3

Suggested Enduring Understandings

1. As human population demands change and grow, the environment is impacted.
2. Agriculture production and its impact on the environment are affected as human population demands increase.
3. As the landscape changes to meet human needs, these changes can affect the environment.
4. Protecting our natural resources is everyone’s responsibility.

Suggested Essential Questions

1. What changes in population affect the environment?
2. How does agriculture affect the quality of the environment?
3. How do building roads, bridges, and buildings affect the landscape of an area?
4. What can individual homeowners, business people, and farmers do to protect the environment?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Examine trends and factors influencing population changes. (DOK 2)	a. Have students read the chapter 3, Human Population Growth, and chapter 4, Human Population Demands, from the text (Porter et. al., 2006). Lead a discussion on trends and factors that influence population changes. List major trends and factors, and have students	a. Use a student electronic notebook rubric to evaluate student journals

	take notes to be transferred to their electronic notebook. Have students prepare a graph comparing population growth rates in the United States to growth rates in other countries. <small>CS2, T3, M2, M3, M5, S1</small>	and portfolios. Use the <i>Rubric for Student Electronic Notebook (1.7)</i> to assess student mastery. Evaluate the graph assignment for accuracy of data and graphics.
b. Investigate the demands of human population on the environment and how these relate to agriculture. (DOK 1)	b. Use clips from the movie <i>Over the Hedge</i> to illustrate effects of population growth and lead a discussion on how this applies to humans. Have students use census data to create a graph illustrating changes in the population over the last 30 years. Compare general population growth to the growth rate for agricultural producers, and show that data on a poster. <small>CS2, CS4, T1, T3, M3, M5, S1</small>	b. Evaluate the graph and poster for accuracy of data and graphics.
c. Describe the effect of landscape degradation on the environment. (DOK 1)	c. Lead a discussion on the concept of landscape degradation. Have students identify sources of landscape degradation and discuss how they impact the environment and our natural resources. <small>CS2, CS4, T1, T3, M3, M5, S1</small>	c. Use a paper and pencil test to evaluate this indicator.
d. Examine natural resource conservation and interdependency. (DOK 2)	d. Define the terms conservation, preservation, and interdependency. Assign students to research and prepare a written report on agencies, such as the Nature Conservancy, and their efforts to preserve land and the environment. The report should cover the mission and purpose of the organization and cite examples of activities and projects that promote conservation and interdependency of resources. <small>CS1, CS2, T2, T3, T5, T6, R4, W2, W4</small>	d. Use the <i>Rubric for Written Report on Environmental Agencies (1.8)</i> to score the report on the agency and its work to conserve natural resources.

Competency 3: Demonstrate career and leadership skills required for employment in the environmental and natural resources industry. ^{ES 3}

Suggested Enduring Understandings

1. Leadership and human relations skills are key factors in being successful in any career.
2. Involvement in student youth organizations effectively prepares a student for furthering his or her education and employment.

Suggested Essential Questions

1. What leadership and human relations skills are necessary for success in any career?
2. What programs and/or activities does the FFA offer than can prepare students for personal growth and career success?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
<p>a. Demonstrate leadership, human relations, and workplace skills. (DOK 2)</p>	<p>a. Provide students with the listing of <i>21st Century Life and Career Skills (1.9)</i> found in this unit. Lead students in a discussion of how these skills apply to their current career interest as a student and how these skills will apply to their career success after school. Provide students with a copy of the rubric that will be used to evaluate each student's demonstration of life and career skills. Have students self-evaluate their current score on this rubric, and explain that they will be periodically (at least once a grading period) be graded on their ability to demonstrate these skills. <small>CS1, CS2, CS3, CS4, CS5, T4, R5, S3, W1</small></p>	<p>a. Use the <i>21st Century Life and Career Skills Rubric (1.10)</i> to assess student mastery.</p>
<p>b. Develop a plan for increasing leadership, human relations, and workplace skills through student and youth organizations. (DOK 3)</p>	<p>b. Have an officer of the local FFA chapter speak to the class regarding FFA activities and programs that develop leadership, human relations, and workplace skills (career development events, chapter activities, proficiency awards, degree programs, community service projects, etc.). Have students prepare a personal plan of activities for the coming year that identifies FFA and other youth organization activities that contribute to the development of leadership, human relations, and workplace skills. Have students keep records and documentation of their accomplishments to be incorporated into their SAE record book and electronic portfolio. <small>CS1, CS2, CS3, CS4, CS5, T1, T2, T4, T5, T6, E1, E2, W1, W2, W3, W4</small></p>	<p>b. Use the <i>Rubric for Personal Plans (1.11)</i> to evaluate the student's personal plan of activities.</p>

Competency 4: Identify general safety precautions for the laboratory and field.

Suggested Enduring Understandings

1. Safety policies and procedures are designed to protect people from injury and must always be followed.
2. Each person is responsible for his or her own personal behavior in a shop or laboratory setting and for using appropriate personal safety devices.

Suggested Essential Questions

1. What are the general safety standards that apply to people in the laboratory and field?
2. What are the specific safety rules and practices that must be followed when working in the AEST classroom and

laboratory?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe procedures for working in and maintaining a safe and orderly workplace. (DOK 1)	a. Provide students with a list of policies and rules related to behavior and activities in the Environmental and Natural Resources lab. (See sample set of rules in the <i>Rubric for Personal Plans (1.11)</i> . These rules are an example only and may be modified or replaced as necessary.) Lead a classroom discussion of these policies and activities, and question students to ensure they understand the importance of following all policies and rules. <small>CS1, CS2, CS4, CS5, T2, T4, M1, M7</small>	a. Describe procedures for working in and maintaining a safe and orderly workplace.
b. Describe personal behavior and personal safety requirements for the laboratory and field. (DOK 1)	b. Identify personal safety behaviors and devices used in the environmental and natural resources laboratory, and demonstrate their use. <small>CS1, CS2, CS4, CS5, T2, T4, M1, M7</small>	b. Describe personal behavior and personal safety requirements for the laboratory and field.
c. Identify common hazards found in laboratory and field work, and apply procedures to prevent injury. (DOK 1)	c. Assign students to groups of two or three to create a presentation on an assigned safety topic to identify and describe common hazards encountered in working in environmental laboratory and field work (poisonous plants, insects, and animals; heat and sun stroke, dehydration, getting lost, allergic reactions, hypothermia, etc). Discuss and demonstrate as practical, prevention, and treatment methods, including first aid. <small>CS1, CS2, CS4, CS5, T2, T3, T4, E1, E2, M1, M7, R3, R4, R5, S1, W4, W5</small>	c. Identify common hazards found in laboratory and field work, and apply procedures to prevent injury.
d. Describe procedures for working in and maintaining a safe and orderly workplace. (DOK 1)	d. Provide students with a list of policies and rules related to behavior and activities in the Environmental and Natural Resources lab. (See sample set of rules in the <i>Rubric for Personal Plans (1.11)</i> . These rules are an example only and may be modified or replaced as necessary.) Lead a classroom discussion of these policies and activities and question students to ensure they understand the importance of following all policies and rules. <small>CS1, CS2, CS4, CS5, T2, T4, M1, M7</small>	d. Describe procedures for working in and maintaining a safe and orderly workplace.

Competency 5: Explore career opportunities in environmental and natural resources areas.

BIOI 1, CHI 1,

PS 1

Suggested Enduring Understandings

1. Careers should be selected based on a student’s interests, skills, and job descriptions.
2. Various careers require different kinds of education and training.
3. Potential employers are out there. One just needs to know where to look.

Suggested Essential Questions

1. What skills and qualifications are required for a particular job?
2. What kinds of education and training are required for a particular job?
3. Where can jobs be found in an environmental career?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
<p>a. Analyze careers in environmental agriculture and the skills required by employees. (DOK 3)</p>	<p>a. Have students to research two different environmental careers and develop <i>Need to Know and How to Guide</i> for those particular careers (Job outlook, education, training and skills, work conditions, etc.). One of the careers included in the guide should be a possible job interest for the student. Have the student identify personal interests and how this career matches. The student should locate a local employer and find what characteristics, skills, and expectations the employer wants from a potential employee and highlight these skills in the guide. <small>CS1, CS2, CS3, Cs4, CS5, T1, T2, T3, T4, E1, E2, E3, W2, W3, W4, W5, W6</small></p>	<p>a. Use the <i>Need to Know and How to Guide Report Rubric (1.12)</i> to assess student mastery on the oral report on the job shadow/ interview experience.</p>
<p>b. Investigate education and training opportunities in environmental and natural resources. (DOK 2)</p>	<p>b. Invite a representative from a community college, technical institute, college, or university to serve as a resource person in class. Ask him or her to discuss the available educational opportunities in environmental and natural resource occupations, entry requirements, and estimated costs and returns. Have the students add their findings to the <i>Need to Know and How to Guide</i> created in the indicator above. <small>CS1, CS2, CS3, Cs4, CS5, T1, T2, T4, E1, E2, E3, W2, W3, W4, W5, W6</small></p>	<p>b. Use the <i>Need to Know and How to Guide Report Rubric (1.12)</i> to assess student mastery on the oral report on the job shadow/ interview experience.</p>
<p>c. Locate potential jobs and employers. (DOK 3)</p>	<p>c. Have students search for environmental and natural resources jobs using the Internet, local</p>	<p>c. Use the <i>Natural Resources Careers</i></p>

and state newspapers, and other sources. Have them develop a table comparing job descriptions, entry requirements, and salaries for different jobs in different areas of the nation. Have students summarize their findings in a chart and select the job that is a “best fit” for them. A written justification should be provided.

Research Rubric (1.13) to assess student mastery.

Standards

AFNR Industry Standards

- NRS.01 Recognize the important interrelationships between natural resources and humans necessary to conduct management activities in natural environments.
- NRS.03 Apply knowledge of natural resources industries to production practices and processing procedures.
- NRS.04 Demonstrate techniques used to protect natural resources.
- ESS.01 Use analytical procedures to plan and evaluate environmental service systems.
- ESS.02 Identify policies and regulations affecting environmental service systems to determine their impact on facility operation.
- ESS.05 Examine the relationships between energy sources and environmental service systems.

Applied Academic Credit Standards

Aquatic Science

- AQ 4 Draw conclusions about the relationships between human activity and aquatic organisms.

Biology I

- BIOI 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- BIOI 2 Describe the biochemical basis of life, and explain how energy flows within and between the living systems.
- BIOI 3 Investigate and evaluate the interaction between living organisms and their environment.

Chemistry I

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

Environmental Science

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

Physical Science

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

21st Century Learning Standards

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

National Educational Technology Standards for Students (NETS)

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

- T5 Digital Citizenship
- T6 Technology Operations and Concepts

ACT College Readiness Standards

- E1 Topic Development in Terms of Purpose and Focus
- E2 Organization, Unity, and Coherence
- E3 Word Choice in Terms of Style, Tone, Clarity, and Economy
- E4 Sentence Structure and Formation
- E5 Conventions of Usage
- E6 Conventions of Punctuation
- M2 Probability, Statistics, and Data Analysis
- M3 Numbers: Concepts and Properties
- M5 Graphical Representations
- M7 Measurement
- R3 Sequential, Comparative, and Cause–Effect Relationships
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- S1 Interpretation of Data
- S3 Evaluation of Models, Inferences, and Experimental Results
- W1 Expressing Judgments
- W2 Focusing on the Topic
- W3 Developing a Position
- W4 Organizing Ideas
- W5 Using Language

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Science of Agricultural Environment

Unit 2: Experiential Learning (SAE)

5 Hours

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

Suggested Enduring Understandings

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

Suggested Essential Questions

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

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Update and revise long-range and short-term goals of the experiential learning program. (DOK 3)	a. Based on the summary and analysis of the students' previous experiential learning activities, have students reflect and revise or amend their experiential learning long-range and short-term goals for the coming year. The goals should be added to the students' electronic portfolios. <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 (2.1).</i>)
b. Update, revise, and implement the experiential learning plan/training agreement for the coming year. (DOK 3)	b. Based on the revised goals, have students update, amend, and revise their experiential learning plan/training agreement to reflect growth in skill and proficiency levels. The updated plan should be added to the students' electronic portfolios. <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 (2.1).</i>)

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

Suggested Enduring Understandings

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

Suggested Essential Questions

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

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
<p>a. Update and maintain records of experiential learning related income, expenses, activities, skills, and supplementary improvement projects. (DOK 3)</p>	<p>a. Review requirements for record keeping for the different types of experiential learning. Have students maintain and update their records electronically throughout the year. <small>CS2, CS4, T3, T4, T6, M1, M2, W4</small></p>	<p>a. Use the <i>Rubric for Experiential Learning Planning and Record Keeping (2.1)</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. <small>CS2, CS4, T3, T4, T6, M1, M2, W4</small></p>	<p>b. Use the <i>Rubric for Experiential Learning Planning and Record Keeping (2.1)</i> to evaluate the students' summaries.</p>

Standards

AFNR Industry Standards

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

21st Century Learning Standards

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

National Education Technology Standards for Students (NETS)

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

ACT College Readiness Standards

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

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Science of Agricultural Environment

Unit 3: Living Organisms and Ecology

15 Hours

Competency 1: Investigate the role of living organisms in the environment. AS.02, AQ 1, AQ 2, AQ 3, BIOI 3, BIOI 6, BIOII 4, BIOII 5, BO 5, ES2, ES 3, ZO 3

Suggested Enduring Understandings

1. Organisms are classified using distinguishing characteristics that separate them into kingdoms.
2. Each of the five kingdoms that define the classification of an organism plays a significant role in maintaining the health of the environment.
3. Microorganisms that exist in the environment can be collected and identified.

Suggested Essential Questions

1. What characteristics are used to classify organisms in the environment?
2. What role does each of the five kingdoms of organisms play in maintaining the health of the environment?
3. How do you collect and examine microorganisms in the environment?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Classify living organisms in the environment. (DOK 1)	a. Have students identify the five kingdoms of organisms found in the environment: Monera, Protista, Fungi, Plantae, and Animalia. Students should be able to distinguish characteristics between each kingdom and identify organisms that are classified within each. <small>CS2, CS4, T2, T3, T4, R5</small>	a. Pencil and paper test
b. Examine the roles of living organisms in the environment. (DOK 2)	b. Lead a discussion with the students identifying the role that each of the five kingdoms of organisms plays in the environment. Have the students list the contributions and the negative impacts that each kingdom can have on the environment. <small>CS2, CS4, T2, T3, T4, R5</small>	b. Pencil and paper test
c. Collect and examine microbiological organisms in the local environment. (DOK 3)	c. Take a walk around the school campus or along a nearby creek, and evaluate the local environment, noting the presence of various organisms and a description of the habitat in which they are found. Collect specimens for evaluation and observation upon returning to the classroom. Prepare wet mount slides of various microorganisms collected in the exercise above or brought from the student's home, and examine them under a microscope. Identify each specimen, and preserve if	c. Use the <i>Microbe Collection and Wet Mount Slide Performance Rubric (3.1)</i> to assess student mastery.

possible. ^{CS2, CS4, CS5, T2, T3, T4, T6, R5, S2, S3}

Competency 2: Examine relationships of living organisms and the environment.

^{NRS.01, AQ 4, BIOI 3, BIOI 6, BIOII 4,}

^{BO 5, ES 2, ES 3, ZO 2, ZO 3, ZO 4}

Suggested Enduring Understandings

1. All organisms have unique life spans that progress through five common stages of life.
2. There are eight life processes, plus reproduction, that every organism must go through in order to complete the cycle of life.
3. Organisms have the ability to physically and genetically adapt to changes in their environment.

Suggested Essential Questions

1. What is a life span, and how does it vary among organisms?
2. What are the eight life processes essential for an organism to live?
3. Why is reproduction not an essential life process?
4. How can organisms change their bodies to adjust to changes in the environment?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
<p>a. Explain the concept of a life span and the stages of life. (DOK 2)</p>	<p>a. Explain the concept of life span, and highlight the five stages of life - beginning, growth, maturity, declining, and dying through the use of a PowerPoint presentation. Have students select from a list one species of local wildlife and investigate the life span of that species. Require the student to create a visual aid depicting the life span of that species to include the name of that animal at each stage of its life (fawn, yearling, doe, and buck). ^{E1, E2, R3, R4, R5, CS2, CS4, T1, T3}</p>	<p>a. Pencil and paper test</p> <p>Use the <i>Life Span Visual Report Rubric (3.2)</i> to assess student mastery.</p>
<p>b. Investigate the life processes essential for the living condition. (DOK 2)</p>	<p>b. Investigate the basic life processes (growth and repair, food acquisition and use, movement and locomotion, circulation, respiration, secretion, sensation, excretion, and reproduction). Have students associate the anatomy and physiology of living organisms to each life process through the use of student created posters and/or illustrations. Divide students into groups of two to three, and assign each a life process to research and prepare a presentation poster or illustration to share with the class. ^{E1, E2, W2, W3, W4, W5, CS 1, CS2, CS3, CS4, CS5, T1, T2, T3, T4, T6}</p>	<p>b. Use the <i>Rubric for Life Process Poster (3.3)</i> to assess student mastery.</p>
<p>c. Discuss how the anatomy and physiology of living organisms adapts</p>	<p>c. Use student input to define heredity and genetics. Relate the concepts of heredity and genetics to biodiversity: genetic diversity, species diversity, and ecological diversity.</p>	<p>c. Use the <i>Grading Checklist for Collection of Specimens and/or</i></p>

over time to the native environment. (DOK 3)

Have students identify diversity among similar organisms, through collections of insects, vertebrates, invertebrates, or plankton. Have students collect specimens or pictures of specimens from the local area that illustrate biodiversity. E1, E2, CS1, CS2, CS4, CS5, T2, T3, T4, T5, T6

Photographs that Illustrate Biodiversity (3.4) to assess student mastery.

Competency 3: Discuss the impact of agricultural pests and pest control measures on the environment.

AS.06, ESS.04, NRS.01, NRS.02, NRS.03, NRS.04, AQ 3, AQ 4, BIOI 3, BIOI 6, BIOII 4, BIOII 5, BO 8, ES 2, ES 3

Suggested Enduring Understandings

1. Pests in the environment can cause a lot of expensive damage to agricultural crops.
2. The method of controlling pests has a direct correlation to its impact on the environment.

Suggested Essential Questions

1. What types of damage can agricultural pests cause to the environment?
2. What methods of pest control can be used that will not damage or threaten the quality of the environment?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Analyze the economic impact of agricultural pests on the environment. (DOK 2)	a. Using a PowerPoint presentation, explain the economic impact of agricultural pests in the environment. Include pictures of insect damage in various stages on different aspects of the environment. <small>E1, E2, E3, E4, R1, R2, R3, R4, R5, S1, S2, W1, W2, W3, W4, W5, CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T4, T5, T6</small>	a. Pencil and paper test
b. Relate methods of controlling agricultural pests to impact on the environment. (DOK 3)	b. Have students select from a prepared list an agricultural pest that has an impact on the environment. The student is to research that pest and create an informational pamphlet highlighting the pest, its target, the effects of its impact on the environment, and methods of controlling or prevention of infestation. The pamphlet should include pictures or illustrations and pertinent information. <small>E1, E2, E3, E4, R1, R2, R3, R4, R5, S1, S2, W1, W2, W3, W4, W5, CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T4, T5, T6</small>	b. Use the <i>Rubric for Pest Pamphlet (3.5)</i> to assess student mastery.

Competency 4: Examine principles of ecology as related to environmental quality.

ESS.01, ESS.02, ESS.03, ESS.05, NRS.01, NRS.02, NRS.03, NRS.04, PS.01, PS.02, PST.02, AQ 1, AQ 2, AQ 3, AQ 4, BIOI 3, BIOI 6, BIO II 4, BIO II 5, BIO II 6, BO 5, ES 2, ES 3, ZO 2, ZO 3, ZO 4

Suggested Enduring Understandings

1. Many factors influence the organization of an ecosystem.
2. Although there are similarities, there are distinguishing differences between

Suggested Essential Questions

1. What factors affect the structure of an ecosystem?
2. What makes a wildlife ecosystem different from an agricultural

- agricultural ecosystems and wildlife ecosystems.
3. Environmental communities are defined in layers.
 4. Maintaining a functioning food chain within a food web is essential to the health of a habitat.
 5. Sustaining the environment is essential to conserving our natural resources.
- ecosystem?
 3. How are environmental communities defined?
 4. How is a food chain important to the health of a habitat?
 5. What is sustainability, and how does it help to protect the environment?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Develop a working definition of ecology. (DOK 1)	a. Use class discussion to formulate a definition of ecology using a Wiki through BlackBoard. Have students draw a diagram of the structure of an ecosystem, beginning with the community organization, and explain how habitats, niche, and structures are formed. Students should also distinguish between biotic and abiotic factors that influence an ecosystem. <small>E1, E2, E3, E4, E5, R1, R2, R3, R4, R5, CS2, CS4, T1, T2, T3, T4, T5, T6</small>	a. Use the <i>Grading Checklist for the Wiki on Ecology (3.6)</i> to assess student mastery.
b. Compare factors associated with agricultural and wildlife ecosystems. (DOK 2)	b. Using the Chapter 11 Microhabitats in an Ecosystem activity (Turner, 1997) as a guide, assign teams of two to three students to study a part of a designated habitat located on the school campus. Students are to make comprehensive observations of the organisms present in that habitat, recording observations of both the biotic and abiotic factors in the microhabitat. Upon completion of observations, have the students compile a list of all the organisms and diagram a food chain for the particular habitat. <small>S1, S2, S3, W1, W2, W3, W4, W5, CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T4</small>	b. Grade the Microhabitat Observation assignment from the lab manual (Turner, 1997).
c. Explain community organization and structure. (DOK 2)	c. Using the Owl Pellet Lab kit available from Carolina, complete the dissection of a Barn Owl Pellet. Have students identify the prey of the owl according to bones found in the pellet. View the video that accompanies the dissection lab. Diagram the food chain of the owl. Lead a class discussion on how natural selection and succession would impact the life and lifestyle of the Barn Owl. <small>S1, S2, S3, CS1, CS2, CS3, CS4, CS5, T2, T3, T4</small>	c. Use the <i>Grading Rubric for the Owl Pellet Dissection (3.7)</i> to assess student mastery.
d. Diagram the food chain and web for	d. Use the Adopt a Stream or Globe program for the class to adopt an area for clean up and	d. Use the <i>Grading Rubric for Stream</i>

organisms in a local agricultural or wildlife ecosystem. (DOK 1)	monitoring. <small>S1, S2, S3, CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T6</small>	<i>Monitoring (3.8)</i> to assess student mastery.
e. Identify the roles of natural selection and succession. (DOK 2)	e. Explain the terms natural selection and succession. Give examples of local animals or plants that have adapted to their environment to survive. <small>S1, S2, S3, R4, R5, CS2, T1, T2</small> Examine an area in the local community in terms of succession, such as a forested area or a portion of a stream in an area that is being developed. Determine the sequence of succession that is underway. Have the students prepare a diagram that illustrates succession in that particular area. <small>S1, S2, S3, R2, R3, R4, R5, CS2, CS4, T1, T2, T3, T4</small>	e. Pencil-paper test

Competency 5: Identify ecological diversity in agricultural and wildlife ecosystems. NRS.01, NRS.02, NRS.03, PS.01, AQ 3, AQ 4, BIOI 6, ES 2, ES 3, ES 4, BIOII 4

Suggested Enduring Understandings

1. Characteristics of the various biome that exist around the world are determined by their location in a climatic zone.
2. Homeostasis is essential to the survival of organisms around the world.
3. The birth rate and death rate of organisms within an ecosystem greatly influence the population ecology of an area.

Suggested Essential Questions

1. How do areas of latitude on the globe define climate zones and biomes?
2. What is homeostasis?
3. Why is population ecology essential to understanding the environment?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Distinguish between terrestrial and aquatic biomes, and give examples of each. (DOK 2)	a. Display a world map or globe, and explain how areas of latitude on the globe are used to define climatic zones on the earth. Further explain that within those zones, there are terrestrial and aquatic biomes, each further diversified and defined by distinctive characteristics. <small>M5, S1, S2, S3, CS2, CS3, T2, T3, T4</small> Divide students into groups of two or three, assigning each group a biome to research. Each group will write a report and create a replica of that biome to present to the class. Each report/replica should include a description of	a. Pencil and paper test Evaluate biome report for accuracy and completeness.

the biome, the organisms that live in that biome and their adaptations, and the limiting, abiotic, and biotic factors that characterize that biome.

R1, R2, R3, R4, R5, S1, S2, S3, CS1, CS2, CS3, CS4, CS5, T1, T2, T3, T4, T6

b. Explain the importance of homeostasis in the survival of organisms. (DOK 2)

b. Define homeostasis, and discuss the importance of homeostasis in the survival of organisms. ^{W2,}
W3, W4, W5, CS1, CS2, T1, T2, T3

b. Pencil and paper test

c. Describe population ecology, including natality and mortality. (DOK 1)

c. Explain the concepts of natality and mortality on population ecology. ^{W2, W3, W4, W5, CS1, CS2}

c. Pencil and paper test

Standards

AFNR Industry Standards

- PS.01. Apply knowledge of plant classification, plant anatomy, and plant physiology to the production and management of plants.
- PS.02. Prepare a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.
- AS.02. Classify animals according to hierarchical taxonomy and agricultural use.
- AS.06. Outline handling procedures for safety of animals, producers, and consumers of animal products.
- PST.02. Design, operate and maintain mechanical equipment, structures, biological systems, land treatment, power and technology.
- NRS.01. Recognize the important interrelationships between natural resources and humans necessary to conduct management activities in natural environments.
- NRS.02. Apply scientific principles to natural resource management activities.
- NRS.03. Apply knowledge of natural resources industries to production practices and processing procedures.
- NRS.04. Demonstrate techniques used to protect natural resources.
- ESS.01. Use analytical procedures to plan and evaluate environmental service systems.
- ESS.02. Identify policies and regulations affecting environmental service systems to determine their impact on facility operation.
- ESS.03. Apply scientific principles to environmental service systems.
- ESS.04. Operate environmental service systems to manage a facility environment.
- ESS.05. Examine the relationships between energy sources and environmental service systems.

Applied Academic Credit Standards

Aquatic Science

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

Biology I

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

Biology II

- BIOII 4 Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.
- BIOII 5 Develop an understanding of organism classification.
- BIOII 6 Examine the behavior of organisms.

Botany

- BO 5 Relate an understanding of plant genetics to its uses in modern living.

Chemistry I

- CHI 9 Apply understanding of the interactions of matter and energy.

Environmental Science

- ES 2 Develop an understanding of the relationship of ecological factors that affect an ecosystem.
- ES 3 Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.

Zoology

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

21st Century Learning Standards

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

National Education Technology Standards for Students (NETS)

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

ACT College Readiness Standards

- E1 Topic Development in Terms of Purpose and Focus
- E2 Organization, Unity, and Coherence
- E3 Word Choice in Terms of Style, Tone, Clarity, and Economy
- E4 Sentence Structure and Formation
- M5 Graphical Representations
- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R3 Sequential, Comparative, and Cause–Effect Relationships
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- S1 Interpretation of Data
- S2 Scientific Investigation
- S3 Evaluation of Models, Inferences, and Experimental Results
- W2 Focusing on the Topic
- W3 Developing a Position
- W4 Organizing Ideas
- W5 Using Language

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Turner, D. L. (1997). *Environmental science and technology activity manual*. Upper Saddle River, NJ: Pearson

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

Science of Agricultural Environment

Unit 4: Land and Soil Management

10 Hours

Competency 1: Examine the process of planning for urban and rural land use. NRS 01, BIOD 3, BO 4, BO 5, ES 2, ES 3, PS 1, PS 2, SP 1, SP 2

Suggested Enduring Understandings

1. Land is a valuable environmental resource, and great care should be taken in planning for its use and protection.
2. Skills can be learned in describing and measuring land, reading maps, and making maps.
3. Global positioning is a valuable technological tool used in managing land areas.
4. Basic surveying techniques can assist a landowner in managing his or her land.
5. Some land areas have to be designated for certain uses.

Suggested Essential Questions

1. How do landowners and managers plan for land use?
2. How is land described and measured?
3. How is global positioning used to monitor the environment?
4. How do you pace the boundary of a land area?
5. How is a land area zoned for use?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Explain the concepts of land and land use. (DOK 2)	a. Define land and discuss planning for land use in both rural and urban settings. Invite a representative from the USDA Natural Resources Conservation Service to speak to the class about the work he or she does and how land is classified according to use. <small>E1, R4, CS2, T2, T4</small>	a. Use the <i>Guest Speaker Evaluation Form (4.1)</i> to assess student mastery.
b. Apply skills in describing and measuring land, map reading, and map making. (DOK 3)	b. Guide students through activities on pacing, measurement of land area and land use zoning. Include activities on reading and interpreting legal land descriptions. Use materials from the activity manual (Fortenberry, 2003) and from the text (RCU, 1997). Using the classroom compass set and accompanying materials, lead students through a mapping and orientation exercise. <small>M1, M2, M3, M4, M5, M6, M7, M8, CS1, CS2, CS4, T4, T6</small>	b. Grade activity sheets on pacing, measuring land area, and reading and interpreting legal land descriptions.
c. Apply global positioning skills. (DOK 3)	c. Instruct students on basic concepts of global positioning systems. Have students mark waypoints and utilize GPS tracking to create a map of the school. <small>M1, M2, M3, M4, M5, M6, M7, M8, CS2, CS4, T4, T6</small>	c. Use the <i>Land Measuring Checklist (4.2) Part 1</i> to assess student mastery.

d. Practice basic surveying techniques such as pacing, locating corners and boundaries, reading a compass, sketching a plot, and estimating an area. (DOK 3)	d. Demonstrate and allow students to practice basic surveying techniques. Provide a boundary survey of a given tract of land, and have students identify markers and boundary lines, using GPS technology and compasses. <small>M1, M2, M3, M4, M5, M6, M7, M8, CS2, CS4, T4, T6</small>	d. Use the <i>Land Measuring Checklist (4.2) Part 2</i> to assess student mastery.
e. Describe concepts of land-use planning and zoning. (DOK 3)	e. Invite a representative of a local zoning agency to speak to the class on concepts and principles of land use and zoning. <small>M1, R1, R2, R3, CS4, T2, T4</small>	e. Unit test

Competency 2: Apply principles of soil and land management and use. NRS.01, NRS.04, AQ 2, AQ 3, BIOI 1, BIOI 2, BIOI 3, CHI 1, CHI 5, ORGC 2, ES 1, ES 2, ES 3

<p>Suggested Enduring Understandings</p> <ol style="list-style-type: none"> 1. Soil is made up of minerals, organic matter, and water and air and is formed over long periods of time as a result of rocks being broken down. 2. Organic matter in soils serves to enhance the fertility and productivity of a soil. 3. Soils in different locations vary in texture, depth, and pH. 4. The highest productive use of a piece of land is dependent on the texture, depth, and surface slope of the land. 	<p>Suggested Essential Questions</p> <ol style="list-style-type: none"> 1. What are the primary components of soil? 2. What is the role of soil organic matter? 3. What influences the chemical and physical makeup of soil? 4. How is the highest productive use of a soil determined?
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Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify the materials in soil and growing media. (DOK 1)	a. Have students bring approximately one pint of <i>dry</i> soil from their local area. Set up laboratory stations with the soil sample, wax paper or paper plates, and water. Have students conduct a “feel” test of the soil samples to determine the texture of the soil. Instruct students to feel of the dry soil to determine smoothness or grittiness of the soil. Have students make observations as to the color of the soil when it is dry and the amount of clods or peds in the soil. Instruct the students to wet the soil just	a. Use the <i>Reflective Writing Rubric (4.3)</i> to assess student mastery.

	<p>enough to make a mud ball. Have students work the wet soil in their hands, making observations about the texture, stickiness, and elasticity of the soil. Have evaluation sheets available for each soil sample for the students to complete after conducting the “feel” test. When students have conducted a test on each soil sample, discuss the characteristics and components of the soil samples, and identify the components that affect the texture of the soil. Instruct students to write a reflective summary of the soil feel test. <small>S1, S2, S3, CS1, CS 2. CS4, T3, T4</small></p>	
<p>b. Examine the role of soil organic matter. (DOK 2)</p>	<p>b. Lead a class discussion on the role of organic matter in the soil. Discuss the types of organic matter found in soil and the influence of that matter on soil fertility and productivity. Use the Nematode Study Kit to conduct a laboratory activity to extract nematodes from the soil. Use the results of that study to emphasize the importance of organic matter in the soil. <small>S1, S2, S3, CS 1, CS2, CS4, T2, T3</small></p>	<p>b. Grade Nematode Study Kit Laboratory Worksheets</p>
<p>c. Investigate the physical and chemical nature of soil using appropriate analyses. (DOK 2)</p>	<p>c. Conduct a mechanical analysis of soil to determine the percentages of sand, silt, and clay in selected soil samples. Use the soil textural classification triangle to identify the soil texture classification of the soil sample. Use practice problems of soil percentages to determine textural class prior to using actual mechanical analysis test results on the soil triangle. Give students the <i>Soil Texture Classification Assignment (4.5)</i> to complete for this activity. Measure the pH of the soil using a pH meter. <small>M1, M2, M3, M4, M5, M7, S1, S2, S3, CS1, CS2, CS4, T2, T3</small></p>	<p>c. Use the <i>Mechanical Analysis of Soil Rubric (4.4)</i> to assess student mastery.</p>
<p>d. Classify land as to its highest productive use. (DOK 2)</p>	<p>d. After reviewing land classification guidelines, use the evaluation forms in a Land Judging Reference guide to evaluate a chosen area of land. <small>S1, S2, S3, CS 1, CS2, CS3, CS4, CS5, T2, T3, T4</small></p>	<p>d. Evaluate student Land Judging Evaluation sheets.</p>

Competency 3: Assess the impact of agricultural, horticultural, and forestry practices on land and soil.

NRS.01, NRS.02, NRS.03, NRS.04, ESS.02, AQ 4, ES 3, SP 1, SP 2

Suggested Enduring Understandings

1. Soil erosion and soil degradation can be prevented by practicing effective methods of soil conservation.
2. It is important that the soil and land be protected from degradation and erosion because we need the soil we have to

Suggested Essential Questions

1. What are some methods of soil conservation?
2. Why is it important to protect the soil from degradation?

produce plants and trees for many years to come.

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify and select practices that promote soil conservation and prevent soil erosion and degradation. (DOK 2)	a. Assign groups of two or three students to research assigned topics in soil erosion and degradation. The students will write and present an oral report to present to the class, along with visual aids depicting the importance of protecting soil from degradation and erosion. The report will include information on practices that promote soil conservation and prevent erosion. <small>E1, E2, E3, E4, R1, R2, R3, R4, R5, CS1, CS2, CS4, T1, T2, T3, T4</small>	a. Use the <i>Rubric for Evaluating Oral Report on Soil Conservation and Degradation (4.6)</i> to assess student mastery. b. Unit test

Standards

AFNR Industry Standards

- NRS.01. Recognize the important interrelationships between natural resources and humans necessary to conduct management activities in natural environments.
- NRS.02. Apply scientific principles to natural resource management activities.
- NRS.03. Apply knowledge of natural resources industries to production practices and processing procedures.
- NRS.04. Demonstrate techniques used to protect natural resources.
- ESS.02. Identify policies and regulations affecting environmental service systems to determine their impact on facility operation.

Applied Academic Credit Standards

Aquatic Science

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

Biology I

- BIOI 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- BIOI 2 Describe the biochemical basis of life, and explain how energy flows within and between the living systems.
- BIOI 3 Investigate and evaluate the interaction between living organisms and their environment.

Botany

- BO 4 Draw conclusions about the factors that affect the adaptation and survival of plants.
- BO 5 Relate an understanding of plant genetics to its uses in modern living.

Chemistry I

- CHI 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- CHI 5 Compare factors associated with acid/base and oxidation/reduction reactions.

Chemistry II

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

Environmental Science

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

Physical Science

- PS 1 Apply inquiry-based and problem-solving processes and skills to scientific investigations.
- PS 2 Describe and explain how forces affect motion.

Spatial Information Science

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

21st Century Learning Standards

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

National Education Technology Standards for Students (NETS)

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

ACT College Readiness Standards

- E1 Topic Development in Terms of Purpose and Focus
- E2 Organization, Unity, and Coherence
- E3 Word Choice in Terms of Style, Tone, Clarity, and Economy
- E4 Sentence Structure and Formation
- E5 Conventions of Usage
- E6 Conventions of Punctuation
- M1 Basic Operations and Applications
- M2 Probability, Statistics, and Data Analysis
- M3 Numbers: Concepts and Properties
- M4 Expressions, Equations, and Inequalities
- M5 Graphical Representations
- M6 Properties of Plane Figures
- M7 Measurement
- M8 Functions
- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R3 Sequential, Comparative, and Cause–Effect Relationships
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- S1 Interpretation of Data
- S2 Scientific Investigation
- S3 Evaluation of Models, Inferences, and Experimental Results
- W1 Expressing Judgments
- W2 Focusing on the Topic
- W3 Developing a Position
- W4 Organizing Ideas
- W5 Using Language

Suggested References

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- Cooper, E. L., & Burton, L. D. (2008). *Agriscience fundamentals and applications* (4th ed.). Albany, NY: Delmar.
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Science of Agricultural Environment

Unit 5: Water Quality Management

10 Hours

Competency 1: Explore concepts of water usage and quality. NRS.01, NRS.02, NRS.03, AQ 1, AQ 2, AQ 3, AQ 4, ES 3

Suggested Enduring Understandings

1. The availability of water is dependent on its physical state.
2. Water is classified based upon its salt content.
3. Water is essential for all forms of life and is used for many purposes.
4. Water comes from sources below and on the surface of the earth.

Suggested Essential Questions

1. What is the chemical and physical makeup of water?
2. How does the salt content of water affect its usefulness?
3. Why is water so important?
4. What is the difference between surface and ground water?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe the nature and states of water. (DOK 1)	a. Identify the chemical makeup of water, and describe the characteristics of its three physical states (solid, liquid, and gas). Discuss how each physical state affects the availability of water for agricultural use. <small>R3, R4, R5, S1, S2 CS2, T3</small>	a. Use a pencil and paper test to evaluate student understanding.
b. Compare the classifications of water. (DOK 2)	b. Compare and contrast the three classifications of water: freshwater, brackish water, and saltwater. Assign students in groups of two or three to research three examples of fish species that live in each classification and give a general physical description of the type of fish. Students will present their findings to the class. <small>R3, R5, CS2, T2, T3</small>	b. Use the <i>Fish Research Group Project Rubric (5.1)</i> to assess student mastery.
c. Identify important uses of water. (DOK 1)	c. Discuss the major uses of water and its importance (daily living, support of life processes, impacts on climate, manufacturing, transportation, and recreation). Have students keep a daily diary for 1 week listing ways they come into contact with and use water and estimating the amount they used and identifying ways in which water could be conserved. Students can use the <i>Student Water Use Diary (5.2)</i> for this activity. <small>E1, E2, R3, R5, CS2, CS4, T2, T3, T4</small>	c. Have students peer review their daily diaries and comment on additional ways in which water could be conserved.
d. Identify sources of water. (DOK 1)	d. Describe the two major sources of water, surface, and ground water. Explain the path water follows throughout a watershed. Use the Ground Water simulation model to illustrate aquifers. Assign students to conduct	d. Use the <i>Reflective Writing Rubric on the Differences between Ground Water and Surface</i>

a reflective essay explaining their understanding of the differences between ground water and surface water. CS1, CS2, T3, S2, S3

Water (5.3) to evaluate the reflective writing exercise on student understanding of ground and surface water sources.

Competency 2: Describe important water management practices. NRS 04, AQ1, AQ 2, AQ 3, AQ 4, AQ 6, ES 1, ES 2, ES 3

Suggested Enduring Understandings

1. The amount of water on the earth never changes.
2. Flowing bodies of water have different characteristics than non-flowing bodies of water.
3. Water pollution originates from both known and unknown sources of contamination.
4. Water quality can be monitored by regularly testing the water for certain chemical indicators.
5. Potable water can be consumed by humans.

Suggested Essential Questions

1. How does the water cycle work?
2. What is the difference between flowing and non-flowing bodies of water?
3. What causes water pollution?
4. How do you test for the quality of water?
5. What is potable water?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Diagram and describe the water cycle. (DOK 2)	a. Provide the students a diagram of the water cycle, identify each part, and explain its role in the cycle. <small>S1, S2, S3, CS1, CS2, T3</small>	a. Pencil and paper test
b. Compare natural water bodies of flowing and non-flowing sources. (DOK 2)	b. Define stream, streamflow, and velocity. Determine how they relate to a river, creek, brook, and canal. Explain stream hydrology, stream structure, and stream channel. Identify non-flowing bodies of water (ocean, lake, pond, reservoir, slough, marsh, and estuary). Have students identify water sources in the local county and determine if they are flowing or non-flowing. <small>S1, S2, S3, CS1, CS2, T1, T2, T3, T4, T5, T6</small>	b. Pencil and paper test
c. Identify common causes of water pollution, and distinguish between point and nonpoint sources of pollution. (DOK 1)	c. Identify common kinds of water pollutants (sediment and suspended particles, pathogens, organic wastes, inorganic and organic substances, thermal pollution, urban refuse, agriculture sources, marine debris, oil pollution, etc.). Differentiate between point source and nonpoint source pollution. Have students list pollution on the school campus or in the community. Have them determine the source of	c. Grade student observation chart from the activity manual (Turner, 1997).

	the pollution. Have the students complete the <i>Oil Spills and the Environment</i> lab activity from the activity manual (Turner, 1997). Complete a chart of student observations of the oil spill on the habitat. <small>S2, S3, CS1, CS2, T3</small>	
d. Monitor the water quality in a selected body of flowing water. (DOK 2)	d. Use the Ecology Field Kit to monitor the water quality of a selected body of flowing water for a consistent period of time. Consult local Soil Conservation Office about Adopt a Stream projects in area. <small>S1, S2, S3, CS1, CS2, CS4, T2, T3, T4</small>	d. Use the <i>Stream Monitoring Activity Performance Rubric (5.4)</i> to assess student mastery.
e. Describe and analyze the qualities of potable water. (DOK 2)	e. Define potable water. Identify and describe major qualities associated with potable water (odor and taste, color, pH, alkalinity, hardness, dissolved solid materials and turbidity, heavy metal content, chemical and pesticide residue content, and coliform bacterial count). Use the water quality testing kit to test potability of water from local wells and springs. <small>R4, R5, S1, S2, S3, CS1, CS2, CS4, T2, T3, T4</small>	e. Use the <i>Water Quality Testing Laboratory Rubric (5.5)</i> to assess student mastery.

Competency 3: Describe how wastewater is treated to maintain water quality. NRS.05, AQ 3, AQ 4, ES 3

Suggested Enduring Understandings

1. Wastewater is produced by agricultural, industrial, and residential sources.
2. Wastewater can be hazardous to humans, animals, and the environment.
3. There are various methods and treatments for wastewater management that prevents it from being a hazard to the environment.

Suggested Essential Questions

1. Where does wastewater come from?
2. What makes wastewater so hazardous?
3. How is wastewater treated and handled?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify and describe the sources and types of wastewater. (DOK 2)	a. Ask students to list and classify different sources of wastewater (homes and businesses, manufacturing, agricultural, storm runoff). From their list, develop a working definition for wastewater, and classify each source as being spent, domestic, and sewage. <small>S1, S2, S3, CS1, CS2, T3</small>	a. Grade list and student definition of wastewater.
b. Identify and describe hazards that may be present in water. (DOK 2)	b. Identify and describe common hazards associated with waste water to include toxic waste, organic matter, infectious agents, and temperature. <small>S1, S2, S3, CS1, CS2, T3</small>	b. Pencil and paper test

<p>c. Describe methods and processes in wastewater treatment. (DOK 2)</p>	<p>c. Take a field trip to a local waste water treatment plant, and view the processes that occur in the treatment of waste water, or invite a representative from the plant to speak to the class on the process. Have students summarize their findings and record in their electronic journal or blog.</p> <p style="text-align: center;"><small>W1, W2, W3, W4, W5, S1, S2, S3, CS1, CS2, CS3, CS4, CS5, T2, T3, T4, T5, T6</small></p>	<p>c. Use the <i>Field Trip to Wastewater Treatment Plant Participation Checklist (5.6)</i> for the field trip or use the <i>Guest Speaker Evaluation Form (5.7)</i>.</p> <p>Evaluate student electronic blog or journal for accuracy and completeness.</p>
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Standards

AFNR Industry Standards

- NRS.01. Recognize the important interrelationships between natural resources and humans necessary to conduct management activities in natural environments.
- NRS.02. Apply scientific principles to natural resource management activities.
- NRS.03. Apply knowledge of natural resources industries to production practices and processing procedures.
- NRS.04. Demonstrate techniques used to protect natural resources.

Applied Academic Credit Standards

Aquatic Science

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

Environmental Science

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

21st Century Learning Standards

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

National Education Technology Standards for Students (NETS)

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

ACT College Readiness Standards

- E1 Topic Development in Terms of Purpose and Focus
- E2 Organization, Unity, and Coherence
- R3 Sequential, Comparative, and Cause–Effect Relationships
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- S1 Interpretation of Data
- S2 Scientific Investigation

- S3 Evaluation of Models, Inferences, and Experimental Results
- W1 Expressing Judgments
- W2 Focusing on the Topic
- W3 Developing a Position
- W4 Organizing Ideas
- W5 Using Language

Suggested References

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Mississippi Wildlife Federation. *Adopt a stream*. Retrieved June 11, 2010, from http://www.mswildlife.org/education/adopt_a_stream.html

Parker, R. (1995). *Aquaculture*. Albany, New York: Delmar Publishers.

Porter, L., Lee, J. S., Turner, D. L., & Hillan, M. (2003). *Environmental science and technology* (2nd ed.). Upper Saddle River, NJ: Pearson Education.

Turner, D. L. (1997). *Environmental science and technology activity manual*. Upper Saddle River, NJ: Pearson Education.

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

Science of Agricultural Environment

Unit 6: The Atmosphere and Environmental Quality

10 Hours

Competency 1: Examine the relationship of the atmosphere to the earth's environment. NRS .01, CH1 4, ES 1, ES 2, ES 3

Suggested Enduring Understandings

1. The atmosphere is a combination of gases, water vapor, and other materials that sustains life on earth.
2. The atmosphere can be divided into distinguishable layers with each layer playing a different function.

Suggested Essential Questions

1. What is the atmosphere made of?
2. What are the various layers of the atmosphere?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Define atmosphere, and describe its contents. (DOK 1)	a. Identify atmosphere, and describe the air, moisture, and particulates in it. <small>M2, M7, S1, CS2, T3</small>	a. Pencil and paper test
b. Diagram and describe the structure of the atmosphere. (DOK 2)	b. Have students draw and label the structure of the atmosphere. Identify the layers and describe their location, characteristics, and special functions. <small>M5, M6, M7, R5, S1, S2, S3, W1, CS1, CS2, CS4, T1, T2, T3, T4</small>	b. Use the <i>Checklist for Evaluating the Diagram of the Atmosphere (6.1)</i> to evaluate the diagram of the atmosphere.

Competency 2: Use weather and climate information in making decisions about the environment. ESS.03, ES 1, ES 2, ES 3

Suggested Enduring Understandings

1. The relationship between the weather and the environment is complex.
2. Climates can be defined using scientific factors such as latitude, longitude, and temperature.
3. The movement of the earth in orbit plays a major role in how weather patterns develop.
4. Weather maps are used to predict and analyze the weather.

Suggested Essential Questions

1. How do the weather and the environment impact each other?
2. How are climates defined?
3. How does the movement of the earth affect weather fronts?
4. What environmental factors are considered when analyzing the weather?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Distinguish between weather and environment. (DOK 2)	a. Compare and contrast weather and the environment. Include where weather forms, and describe the four common weather measurements: temperature, moisture, wind speed and direction, and pressure, including the units used to measure each. <small>CS2, T4, S1,S2, S3</small>	a. Pencil and paper test
b. Explore the relationship of latitude, longitude, and altitude to climate. (DOK 2)	b. Review the use of latitude and longitude measurements. Discuss the effects of latitude and longitude, altitude, moisture, and temperature measurements on climates. Have students use an online mapping site (Google Earth, TerraServer, etc.) or a mapping GPS to locate longitude and latitude of cities and classify them as being in the temperate and tropical regions. (See Attachment 6.2.) <small>CS1, CS2, T3, M1, M2, M3, M4, M5, M6, M7, S1, S2, S3</small>	b. Grade the assignment to locate longitude and latitude.
c. Discuss how the movement of the earth affects weather fronts, clouds, seasons, and storms. (DOK 2)	c. Describe how the rotation of the earth as it orbits the sun affects the weather, climate, and ecology of an area. Identify and describe weather elements such as fronts, clouds, fog, and storms. Invite a weatherperson as a guest speaker. Review weather safety. <small>CS 1, CS2, T3, M1, M2, M3, M4, M5, M6, M7, S1, S2, S3, E1, E2, E3, E4, E5, E6</small>	c. Pencil and paper test
d. Read and interpret weather measurements and maps. (DOK 3)	d. Have students collect 3 days of weather maps from local newspapers and bring in to class. Use Studying the Weather activity in the <i>Environmental Science and Technology Activity Manual</i> to read a weather map, collect and analyze data, and complete a data table. <small>CS 1, CS2, CS5, T3, T5, T6, M1, M2, M3, M4, M5, M6, M7, S1, S2, S3</small>	d. Grade the <i>Studying the Weather</i> activity from the activity manual (Turner, 1997).

Competency 3: Assess air quality and identify sources of air pollution. NRS.01, NRS.02, NRS.03, NRS.04, ES 1, ES 2, ES 3

Suggested Enduring Understandings

1. Air quality is affected by the amount of foreign material in the air.
2. Global pollution occurs through the movement of air.
3. Air pollution comes from many sources.
4. Air pollution can have a negative effect on the environment.
5. Air pollution levels can be detected in the air around you.

Suggested Essential Questions

1. How is air quality defined?
2. How does global pollution occur?
3. What causes air pollution?
4. What are the effects of air pollution on the environment?
5. How can air pollution be detected?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Define air quality, and relate quality to pollution and air quality standards. (DOK 1)	a. Define air quality, air pollution, and air quality standards. Show the relationship between each. <small>CS2, T2, T3, T4, E1, E2</small>	a. Instructors can use the <i>Environmental Science Weather Test (6.5)</i> or another pencil and paper test.
b. Explain the movement of air and global pollution. (DOK 2)	b. Explain the relationship of air movement and pollution globally. Explain how weather fronts play a role in the movement. <small>CS2, T3, S1, S2, S3</small>	b. Instructors can use the <i>Environmental Science Weather Test (6.5)</i> or another pencil and paper test.
c. Describe the major kinds and sources of air pollution. (DOK 2)	c. Describe gases, particulate matter, and metal materials as they relate to air pollution. Assign students to research the major kinds and sources of air pollution and report to the class with a PowerPoint presentation describing one of the major sources of air pollution, how it is created, and the effects on the environment. <small>CS1, CS2, CS3, T3, T2, T5, T6, E1, E2, E3, E4, E5, E6, S1, S2, S3</small>	c. Use the <i>Air Pollution Presentation Rubric (6.3)</i> to assess student mastery.
d. Identify the effects of air pollution on the earth's environment. (DOK 1)	d. Identify the effects of air pollution on human health problems, other animals, plants, and other organisms and climate. Include information from this indicator on the presentation. <small>CS3, T2, T3, S1, S2, S3</small>	d. Use the <i>Detecting Air Pollution Activity Presentation Rubric (6.4)</i> to assess student mastery.

Standards

AFNR Industry Standards

- NRS.01. Recognize the important interrelationships between natural resources and humans necessary to conduct management activities in natural environments.
- NRS.02. Apply scientific principles to natural resource management activities.
- NRS.03. Apply knowledge of natural resources industries to production practices and processing procedures.
- NRS.04. Demonstrate techniques used to protect natural resources.

Applied Academic Credit Standards

Chemistry I

- CHI 4 Analyze the relationship between microscopic and macroscopic models of matter.

Environmental Science

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

21st Century Learning Standards

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

National Education Technology Standards for Students (NETS)

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

ACT College Readiness Standards

- E1 Topic Development in Terms of Purpose and Focus
- E2 Organization, Unity, and Coherence
- E3 Word Choice in Terms of Style, Tone, Clarity, and Economy
- E4 Sentence Structure and Formation
- E5 Conventions of Usage
- E6 Conventions of Punctuation
- M1 Basic Operations and Applications
- M2 Probability, Statistics, and Data Analysis
- M3 Numbers: Concepts and Properties
- M4 Expressions, Equations, and Inequalities
- M5 Graphical Representations
- M6 Properties of Plane Figures
- M7 Measurement
- M8 Functions

- S1 Interpretation of Data
- S2 Scientific Investigation
- S3 Evaluation of Models, Inferences, and Experimental Results

Suggested References

Arms, K. (2005). *Holt environmental science*. Austin, TX: Holt.

Biondo, R. J., & Lee, J. S. (1997). *Introduction to plant and soil science and technology*. Upper Saddle River, NJ: Pearson.

Burton, D. (2009). *Environmental science, fundamentals, and applications*. Clifton Park, NJ: Delmar

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

Porter, L., Lee, J. S., Turner, D. L., & Hillan, M. (2003). *Environmental science and technology* (2nd ed.). Danville, Illinois: Interstate Publishers.

Turner, D. L. (1997). *Environmental science and technology activity manual*. Upper Saddle River, NJ: Pearson.

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

Science of Agricultural Environment

Unit 7: Forestry and the Environment

10 Hours

Competency 1: Examine basic principles of forest dendrology and mensuration. NRS.01, NRS.02, BIOI 3, BIOII 4, BO1, BO4, ES 1, ES 2, ES 3

Suggested Enduring Understandings

1. typical forest is structured into four layers: the canopy or overstory, the understory (saplings, shade tolerant trees, and tall shrubs, the shrub layer, the herb/fern layer, and the litter layer). Each layer plays a role in the growth and development of the total ecosystem.
2. In Mississippi, the different species of yellow pine as well as oak, hickory, and other hardwoods are economically important furnishing wood and pulp for many different wood products.
3. The number and size of the growth rings in a tree are indicators of the tree’s age and annual growth rate.
4. Timber cruising is a process by which a representative sample of trees on a plot is measured and the volume of pulpwood and saw timber is estimated.
5. Young tree seedlings must be planted in a manner that allows them to quickly establish a sound root system and begin to grow into merchantable timber. Important factors in planting young seedling include proper depth of plants, proper placement of the root system, and proper soil compaction.

Suggested Essential Questions

1. How do the layers of a forest function to protect and enhance the ecosystem?
2. What are the most economically important tree species in Mississippi, and how are products from these species used?
3. How can the number and size of the growth rings of a tree be used to determine age and growth rate of the tree?
4. How is an estimate of the volume of pulp and sawlog timber established?
5. What procedures are used in planting young trees for reforestation?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Examine the layered structure of forests and how these layers protect and enhance the ecosystem. (DOK 2)	a. Have students draw a picture of a forest illustrating how the layered structure of the forests and how these layers protect and enhance the ecosystem of the forest. <small>CS1, CS2, CS4, T1, T6, W1, W2, W4</small>	a. Use the <i>Picture Assessment Rubric (7.1)</i> to assess student mastery.
b. Identify locally important tree species by common name, type, physical characteristics, and use. (DOK 1)	b. Have students create a chart identifying major commercial forest trees that will include common names, types (hardwood or softwood), physical characteristics, and uses. Have students bring leaves from a tree near their homes and use the Web site,	b. Evaluate chart for accuracy and completeness.

Mississippi Tree Identification (http://mdg.ext.msstate.edu/Tom_Tree/tree_id_intro.html), to determine the common name of the tree. Students can use the *Tree Characteristics Chart (7.2)* for this activity.
CS1, CS2, CS4, T1, T6, W1, W2, W4

Examples:

- Pine (slash, loblolly, longleaf, shortleaf)
- Oak (red, pin, white, water)
- Ash (green, white)
- Hickory (bitternut, red, shagbark, mockernut)

<p>c. Analyze the growth rate and age of trees by examining the annual rings and accounting for variations in growth rate due to environmental factors. (DOK 3)</p>	<p>c. Using a cross section of a tree or log, illustrate and discuss the process for analyzing growth rate and age of trees. Provide guidelines for evaluating these factors including the effect of environmental conditions. <small>CS1, CS2, CS4, T1, T6, W1, W2, W4</small></p>	<p>c. Evaluate student activity sheet for accuracy and completeness.</p>
<p>d. Demonstrate procedures used in timber cruising, including estimation of standing tree volume using a tree scale stick, and measurement of tree height and diameter (DBH). (DOK 3)</p>	<p>d. Have a guest speaker (Forestry or Natural Resource Conservation Officer) discuss and demonstrate procedures for sampling and measuring trees in timber cruising including use of a scale stick to estimate tree diameter and height and use of volume table. Have students estimate volume of standing trees on or near the school campus and record and tabulate their findings. The instructor should use the <i>Volume Estimation Sheet for Sawlogs (7.3)</i>, the <i>Doyle Log Rule (Form Class 80) (7.4)</i>, the <i>Volume Estimation Sheet for Pulpwood (7.5)</i>, and the <i>Volume Estimation Sheet for Pulpwood (7.6)</i> for this activity. <small>CS1, CS2, CS4, T1, T3, T4, M1, M2, M7, S1</small></p>	<p>d. Use the <i>Volume Estimation Sheet for Sawlogs (7.3)</i> and the <i>Volume Estimation Sheet for Pulpwood (7.5)</i> to evaluate the results of the timber volume estimation activity.</p>
<p>e. Demonstrate proper procedures for planting trees. (DOK 2)</p>	<p>e. Have students read about planting trees based on the information on trees and shrubs found in the text (Burton & Cooper, 2007, pp. 491-492). After demonstrating the procedure, have students apply their knowledge by planting a tree on the school campus. <small>CS2, CS4, T6, R1, R2, R3, R4, R5</small></p>	<p>e. Use the <i>Tree Planting Checklist (7.7)</i> to assess student mastery.</p>

Competency 2: Discuss the relationship of forestry to environmental quality and economic development.

NRS.03, BIOI 3, BIOII 5, BO 2, BO 5, ES 1, ES 2, ES 3

Suggested Enduring Understandings

1. Wood products and by-products are used in many different ways to create consumer goods including lumber, paper and cardboard, posts and pilings, and foods and medicines.
2. Biodiversity is a term related to the presence of a number of species of plants and animals. Forests encourage biodiversity by providing food and shelter for these species.
3. Prevention of forest fires is preferable to control of fire. Prevention is achieved through a number of methods including prescribed burning and burn bans.
4. Fire can damage standing timber by killing or damaging trees, consuming nutrients from the litter on the forest floor, and increasing the possibility of soil erosion.
5. Reforestation is a major factor in the sustained use of forest land.

Suggested Essential Questions

1. How do forest products affect my life?
2. How do forests promote biodiversity?
3. What are some ways that forest fires can be prevented?
4. How does fire cause damage to the forest and the environment in general?
5. Why is reforestation important, and how is it accomplished?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify consumer goods derived from forest locally. (DOK 1)	a. Invite a representative of the wood products industry to speak to the class regarding the manufacture of wood products from timber. Have students take notes and summarize the major points of the presentation. Follow up with a class discussion to make sure that all major points are covered. Have students record the major points in their electronic notebooks or journals. <small>CS1, CS3, CS4, T1, T6, W2, W4, W5</small>	a. Evaluate using a paper and pencil test.
b. Describe the relationships between biodiversity and forests. (DOK 2)	b. Use a PowerPoint presentation to illustrate and discuss relationships between biodiversity and forests. Have students record the major points from the presentation in their electronic notebooks or journals. <small>CS2, CS4, T2, T6, W2, W4, W5</small>	b. Evaluate using a paper and pencil test.
c. Investigate methods for forest fire prevention. (DOK 3)	c. Invite a representative of the Mississippi Forestry Commission to speak to the class on prevention of forest fires. Have students take notes and summarize the major points of the presentation. Conduct a follow-up discussion to	c. Use the <i>Fire Prevention Poster Rubric (7.8)</i> to assess student

	make sure that all major points have been recorded. Divide the class into teams of two to four students, and have them prepare a poster on forest fire prevention. <small>CS2, CS4, T2, T6, W2, W4, W5</small>	mastery.
d. Discuss the different damages caused by forest fire. (DOK 3)	d. Have students search the Internet and other resources to locate examples of damage caused by forest fire. Hold a class discussion in which students share their findings. List major points on the whiteboard or LCD projector, and have students record them in their electronic journals or notebooks. <small>CS2, CS4, T2, T6, W2, W4, W5</small>	d. Evaluate using a paper and pencil test.
e. Discuss the methods and importance of reforestation. (DOK 2)	e. Use a PowerPoint presentation to illustrate and describe the methods of reforestation. Use oral questioning and discussion to evaluate student understanding. Have students record major points in their electronic notebooks or journals. <small>CS2, CS4, T2, T6, W2, W4, W5</small>	e. Evaluate using a paper and pencil test.

Standards

AFNR Industry Standards

- NRS.01. Explain interrelationships between natural resources and humans necessary to conduct management activities in natural environments.
- NRS.02. Apply scientific principles to natural resource management activities.
- NRS.03. Apply knowledge of natural resources industries to production and processing industries.
- NRS.04. Demonstrate techniques used to protect natural resources.

Applied Academic Credit Standards

Biology I

- BIOI 3 Investigate and evaluate the interaction between living organisms and their environment

Biology II

- BIOII 4 Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.
- BIOII 5 Develop an understanding of organism classification.

Botany

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

Environmental Science

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

21st Century Learning Standards

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

National Education Technology Standards for Students (NETS)

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

ACT College Readiness Standards

- M1 Basic Operations and Applications
- M2 Probability, Statistics, and Data Analysis

M7	Measurement
R1	Main Ideas and Author's Approach
R2	Supporting Details
R3	Sequential, Comparative, and Cause–Effect Relationships
R4	Meaning of Words
R5	Generalizations and Conclusions
S1	Interpretation of Data
W1	Expressing Judgments
W2	Focusing on the Topic
W4	Organizing Ideas
W5	Using Language

Suggested References

- Biondo, R. J. & Lee, J. S. (2003). *Introduction to plant & soil science & technology*. Lebanon, KY: Pearson.
- Biondo, R. J. (2003). *Activity manual for introduction to plant & soil science and technology*. Lebanon, KY: Pearson.
- Bioquest Curriculum Consortium. (n.d.). *Bioquest Tree Growth Study Kit*. [Interactive learning kit]. Beloit, WI: Author.
- Burton, L. D. (2008). *Introduction to forestry science* (2nd ed.). Clifton Park, NY: Delmar.
- Burton, L. D. and Cooper, E. L. (2007). *Agriscience: Fundamental & applications* (4th ed.). Clifton Park, NY: Delmar.
- CEV Video. (n.d.). *CEV pathway: Natural resources & environmental systems pathway* [DVD]. Lubbock, TX: Author.
- Herren, R. V. (2007). *The science of agriculture: A biological approach* (3rd ed.). Clifton Park, NY: Delmar.
- Mississippi State University Extension Service. *Mississippi tree identification*. Retrieved June 14, 2010, from http://mdg.ext.msstate.edu/Tom_Tree/tree_id_intro.html
- Reiley, H. E., & Shry, Jr., C. L. (2007). *Introductory Horticulture* (7th ed.). Clifton Park, NY: Delmar.
- Rolf, G. L., Edgington, J. M., Holland, I. I., & Fortenberry, G. (2008). *Forests & forestry* (6th ed.). Upper Saddle River, NJ: Pearson.

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Science of Agricultural Environment

Unit 8: Wildlife and the Environment

10 Hours

Competency 1: Examine the relationships of wildlife well-being and environmental quality. NRS.01, NRS.02,

NRS.05, AQ 3, AQ 4, BIOI 3, ES 2, ES 3, ZO2, ZO 3

Suggested Enduring Understandings

1. Mississippi is home to a diverse number of aquatic and terrestrial wildlife species.
2. All wildlife species require a habitat that provides food, water, shelter, and space for each species to survive and repopulate.
3. Wildlife species play an important role in human life and in maintaining our environment.
4. Wildlife habitat must be protected, managed, and improved so that this important national resource can be conserved, sustained, and renewed.

Suggested Essential Questions

1. What are the major species of wildlife in my community?
2. What habitat does my community offer to different wildlife species?
3. What are ways in which wildlife benefit humankind and the environment in general?
4. How can habitat for wildlife be managed and improved?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify the wildlife species found in the local area, and classify as terrestrial or aquatic. (DOK 2)	a. Introduce the unit by asking students to compare domesticated animals and wildlife animals. Have students brainstorm as many animals as possible and classify as terrestrial or aquatic wildlife that are found locally. Determine if the animals are vertebrates or invertebrates. Categorize the list of animals by mammals, fish, birds, reptiles, amphibians, insects, mollusks, worms, and arachnids. Have students summarize and incorporate into their electronic notebooks or journals. <small>CS2, CS4, T6</small>	a. Check student notebooks for accuracy and completeness.
b. Assess local wildlife habitat. (DOK 2)	b. Identify and describe habitat components for wildlife including food, water, shelter, and space requirements. Have students research an assigned wildlife animal species and compile a report or poster or make an oral report on the habitat needs of that species. Have students identify areas that provide suitable habitat for the species. <small>CS2, CS4</small>	b. Use the <i>Written Report Rubric (8.1)</i> , the <i>Poster Assessment Rubric (8.2)</i> , and the <i>Oral Report Rubric (8.3)</i> to assess student mastery.
c. Investigate the importance of wildlife to the	c. Explain the benefits of wildlife to the environment and humans through consumptive and non-consumptive uses.	c. Evaluate student performance using a written test.

environment and human well-being. (DOK 2)	Identify animal wildlife products used for food, clothing, ornamentation, medicine, and recreation. Students can make a list of animal and animal products used for each of these categories. ^{CS2, CS4}	
d. Recommend procedures for improving habitat for wildlife. (DOK 3)	d. Assign the class a project to evaluate a given area, and make recommendations on practices and activities that can enhance wildlife habitat. The project should involve on-site visits and result in a visual presentation (PowerPoint) of the findings and recommendations. ^{CS1, CS2, CS4, T1, T2, T3, T4, T6, S2, W2, W4, W5}	d. Use the <i>Group Work Assessment Rubric (8.4)</i> to assess student mastery.

Competency 2: Investigate approaches in protecting and managing wildlife species. ^{NRS.02, NRS.04, ES 3, ZO 3}

Suggested Enduring Understandings

1. Like any renewable natural resource, wildlife must be protected and conserved to maintain sustainability of each species.
2. Because of declining populations, some wildlife species are now protected by being classified as protected, threatened, or endangered.
3. Habitat management and limiting hunting seasons and bag limits are major tools in the conservation and protection of wildlife.

Suggested Essential Questions

1. Why are wildlife conservation and protection policies and programs needed?
2. What wildlife species are now considered to be nuisance, protected, threatened, endangered, or extinct? What is the difference in between these categories?
3. What are the major tools and practices for conserving, protecting, and managing wildlife?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Discuss the need for wildlife protection and conservation policies and how species are lost from the earth. (DOK 2)	a. Ask students why we have hunting seasons and bag limits on most game animals. Explain the difference between nuisance, protected, endangered, and extinct species. Have students research needs for wildlife protection and conservation policies and how animal species are protected from becoming endangered or extinct. Hold a class discussion on these topics. List important points on the whiteboard or LCD projector, and have students transcribe them into their electronic notebooks or journals. ^{CS1, CS4, T2, T6, R5, W2, W4, W5}	a. Use the <i>Group Work Assessment Rubric (8.4)</i> to assess student mastery.
b. Classify wildlife species based on threats to their continued existence.	b. Define the terms nuisance, protected, threatened, endangered, and extinct. From a list of species of Mississippi wildlife, have students research and classify each species. ^{CS1}	b. Evaluate student performance using a written test.

(DOK 2)	CS4, T2, T6, R5	c. Evaluate student performance using a written test and/or the <i>Guest Speaker Evaluation and Summary Form (8.5)</i> to assess student mastery.
c. Describe practices in conservation, protection, and management of wildlife. (DOK 2)	c. Define habitat management, and discuss habitat management practices that directly benefit wildlife. Invite a representative of the Mississippi Game and Fish Commission to speak to the class on state policies and practices that protect, conserve, and manage wildlife populations including game laws, hunting seasons and limits, habitat improvement programs, and so forth. Follow up with a review of major points from the presentation. Have students summarize these points and place in their electronic journals or notebooks. CS1, CS4, T6, W4, W5	

Standards

AFNR Industry Standards

- NRS.01. Explain interrelationships between natural resources and humans necessary to conduct management activities in natural environments.
- NRS.02. Apply scientific principles to natural resource management activities.
- NRS.04. Demonstrate techniques used to protect natural resources.
- NRS.05. Use effective methods and venues to communicate natural resource processes to the public.

Applied Academic Credit Standards

Aquatic Science

- AQ 3 Apply an understanding of the diverse organisms found in aquatic environments.
- AQ 4 Draw conclusions about the relationships between human activity and aquatic organisms.

Biology I

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

Environmental Science

- ES 2 Develop an understanding of the relationship of ecological factors that affect an ecosystem.
- ES 3 Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.

Zoology

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

21st Century Learning Standards

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

National Education Technology Standards for Students (NETS)

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

ACT College Readiness Standards

- R5 Generalizations and Conclusions
- S2 Scientific Investigation
- W2 Focusing on the Topic
- W4 Organizing Ideas
- W5 Using Language

Suggested References

- Burton, D. (2003). *Fish and wildlife: Principles of zoology and ecology*. Florence, KY: Cengage Learning.
- CEV Video. (n.d.). *CEV pathway: Natural resources & environmental systems pathway* [DVD]. Lubbock, TX: Author.
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For additional references, activities, and web resources, please refer to: Mississippi Agriculture Education B.R.I.D.G.E. Web site: <http://www.rcu.blackboard.com> (Available only to registered users).

Science of Agricultural Environment

Unit 9: Environmental Stewardship

20 Hours

Competency 1: Discuss concepts of sustainable agriculture. NRS.02, NRS.03, PS.02, PS.04, ES 2, ES 3, SP 2

Suggested Enduring Understandings

1. Sustainable agriculture is a process for producing agricultural products economically and efficiently while maintaining the quality of the life and the environment and conserving natural resources.
2. Practices that promote sustainable agriculture include reduced tillage, integrated pest management programs, precision agriculture practices, fertilizer management, and protection of the soil.

Suggested Essential Questions

1. What is the difference between traditional agriculture production and sustainable agriculture?
2. What are some key practices associated with sustainable agriculture, and how do they promote sustainability?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe the nature and importance of sustainable agriculture. (DOK 1)	a. Introduce the lesson by a short talk on the concept of sustainability. Have students read the <i>Sustainable Agriculture</i> in the text (Porter et al., 2003). Have students summarize the major points from the chapter and then hold a class discussion to ensure that all major points have been covered. Have students enter these major points into their electronic journals or notebooks. <small>CS1, CS2, CS4, T3, T6, R1, R2, R4, R5, W4, W5</small>	a. Evaluate using a paper and pencil test.
b. Identify and select practices that promote sustainability in agriculture, forestry, and natural resources. (DOK 2)	b. Have students research and prepare a report (either written or oral) on sustainable agriculture practices in the area where you live. In addition to the Internet, have students contact the Cooperative Extension Service, Soil and Water Conservation District, Natural Resource Conservation Service, or other sources for assistance. Identify local producers who use sustainable agriculture, and interview if possible. Take photographs to depict findings. <small>CS1, CS2, CS4, T3, T6, W4, W5</small>	b. Use the <i>Written Report Rubric (9.1)</i> or the <i>Oral Report Rubric (9.2)</i> to assess student mastery.

Competency 2: Explore the services of agencies and organizations that protect and maintain the environment. ESS.02, ES 2

Suggested Enduring Understandings

1. Many local, state, and federal agencies play an important role in protecting and

Suggested Essential Questions

1. What are some roles of governmental agencies and other organizations in

- maintaining the environment by providing education and assistance to producers, monitoring production practices, and assisting in environmental cleanup projects.
- Public laws and policies have been enacted to monitor and protect environmental quality and promote the conservation of natural resources.

- protecting the environment and conserving natural resources?
- How do public laws and governmental policies protect the environment and promote the conservation of natural resources?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
<p>a. Identify and describe the role of government and other agencies concerned with environmental quality and natural resource conservation. (DOK 1)</p>	<p>a. Have students search the Internet to find at least 10 government agencies or other organizations and briefly describe their functions in protecting the environment and/or conserving natural resources. From this search, lead a discussion to determine common roles shared by several agencies. Have students summarize their findings and record in their electronic journals or notebooks. Students should use the <i>Environmental and Natural Resources Agencies (9.3)</i> worksheet for this activity. <small>CS1, CS2, CS4, T3, T6, R1, R2, R4, R5, W4, W5</small></p>	<p>a. Evaluate student assignment for accuracy and completeness.</p>
<p>b. Investigate public laws and policies related to environmental quality and natural resource conservation. (DOK 2)</p>	<p>b. Assign each student a section of a public law or policy related to environmental quality or natural resource conservation. (See http://www.nrdc.org/reference/laws.asp for a list of U. S. environmental laws and treaties.) Have students develop a fact sheet from their findings and lead an informative <i>Did You Know</i> session with the class. The findings should be summarized and presented in written or oral reports. <small>CS1, CS2, CS4, T3, T6, R1, R2, R4, R5, W4, W5</small></p>	<p>b. Use the <i>Written Report Rubric (9.1)</i> or the <i>Oral Report Rubric (9.2)</i> to assess student mastery.</p>

Competency 3: Use appropriate procedures for management and disposal of solid waste. ESS.01, ESS.04, ES 3

Suggested Enduring Understandings

- Solid wastes come from many different sources and if not properly disposed can cause problems related to pests, public health and safety, and pollution of soil, air, and water.

Suggested Essential Questions

- What is solid waste, and how does it cause damage?
- How can solid waste be disposed?
- What is recycling?
- What is composting?

2. Solid waste can be disposed by recycling, composting, incineration, or burial in a sanitary landfill.
3. Recycling is the most environmentally friendly way of disposing of solid waste but is not practical for many forms of waste.
4. A recycling program must include methods for collecting, sorting, storing, and disposal/sale of products.
5. Composting is another environmentally friendly disposal method for non-hazardous organic materials (grass clippings, tree limbs, etc.).

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify sources of solid waste. (DOK 1)	a. Have students read the chapter on Solid Waste in the text (Porter et al., 2003). Use a local sanitarian or landfill operator and/or manager as a resource person in class. Have him or her describe the different types of solid waste and explain how each type is disposed of in the local area. Have students summarize the presentation then hold a class discussion to make sure that all major points are discussed using the <i>Guest Speaker Summary Form (9.4)</i> . <small>CS1, CS2, CS4, W4, W5</small>	a. Use the <i>Rubric for Student Electronic Notebook (9.9)</i> to assess student mastery.
b. Identify common hazards associated with improperly managed wastes. (DOK 1)	b. Discuss the three most common hazards associated with solid waste (pests, safety, and pollution of soil, air, and water resources). Have students associate these hazards with the list of solid wastes that was previously compiled. <small>CS1, CS2, CS4</small>	b. Evaluate student understanding using a written test.
c. Explain how solid waste materials should be managed and disposed. (DOK 2)	c. Discuss the most common means of solid waste management and disposal including recycling, incineration, and landfills. Have students develop a list of advantages and disadvantages of each method using the <i>Advantages and Disadvantages of Waste Disposal Methods (9.5)</i> . <small>CS1, CS2, CS4, W4, W5</small>	c. Use the <i>Rubric for Student Electronic Notebook (9.9)</i> to assess student mastery.
d. Develop a plan for recycling. (DOK 4)	d. Have students research and develop a list of items that can be recycled and identify local recycling centers that will accept these products. As a class project, have students develop a recycling program for the school that includes collection, management, and	d. Use the <i>Recycling Program Rubric (9.6)</i> to assess student mastery.

sale/disposal of recycled materials. (See the *School Recycling Guide* at <http://www.waste.ky.gov/NR/ronlyres/9098A F95-4D8E-41C6-BC49-8D9AD1E562F9/0/sr.pdf>.)

(Example: The National FFA Organization, <http://www.ffa.org>, has a program *FFA Recycles* that will accept inkjet and LaserJet ink cartridges and pay the FFA chapter for those cartridges.) ^{CS1, CS2, CS3, CS4, T6}

e. Explain the use of residential, agricultural, and industrial composting. (DOK 3)	e. Define composting and the necessary requirements for developing compost. Organize the class to develop a plan to compost school or local waste including constructing a compost bin, adding materials to it, and taking steps to promote composting in your local area. (See the <i>Connecticut School Composting Manual</i> .) The results of composting can be used in school landscaping projects. ^{CS1, CS2, CS3, CS4, CS5, T6}	e. Use the <i>School Composting Plan Rubric (9.7)</i> to assess student mastery.
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Competency 4: Select appropriate procedures for managing hazardous waste materials. ^{ESS.03, ESS.04, ES 3}

Suggested Enduring Understandings

1. Hazardous waste is any product that has the potential for harming human health or the environment in general.
2. Hazardous waste materials may cause harm by being ignited, reacting with other materials, corroding other materials, or being posing a health hazard to humans and animals.
3. Employers are required to have material safety data sheets available for employees that address the safe handling, storage, and disposal of any hazardous materials. The MSDS also contain information on the nature of the chemical substance, first aid measures, and steps to take in case of a spill.

Suggested Essential Questions

1. What is hazardous waste, and how does it cause harm?
2. Where can I obtain information about hazardous materials?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Explore the meaning of hazardous waste. (DOK 2)	a. Have students recall the different sources of waste (domestic, commercial, medical, municipal, industrial, construction and demolition, transportation, and agricultural)	a. Students will be graded by paper and pencil test.

and identify specific waste products produced by these sources. Invite a local emergency responder or waste management specialist to explain how waste is determined to be hazardous or non-hazardous and how hazardous wastes are now disposed in the local community. Have students recommend improvements in the practices used. Have students summarize and post the information gathered to the Blackboard class site. CS1, CS2, CS4, T1, T4, W4, W5

b. Classify hazardous waste materials. (DOK 1)

b. Begin by asking students to describe common hazards that they have encountered. Draw out a definition of hazard from the class. Have students read the chapter on hazardous waste in the text (Porter et al., 2003). Discuss and illustrate the different classes of hazardous materials (ignitibility, reactivity, corrosivity, and toxicity). CS1, CS2, CS4, T4, T6, R1, R4, R5

b. Evaluate student understanding using a paper and pencil test.

c. Discover information about hazardous materials. (DOK 2)

c. Assign each student a hazardous material commonly found in the home, workplace, and school (ex. motor oil, ammonium nitrate, sulfuric acid, glyphosate [Roundup], antifreeze/coolant, etc.). Have students locate a materials safety data sheet (MSDS) on the Internet and complete an assignment to answer questions in their own words concerning the material. Students should use the *Hazardous Materials Discovery Assignment (9.8)* for this activity. After reviewing the assignments for accuracy and completeness, post to the class' Blackboard site. CS1, CS2, CS4, T3, T6, R1, R4, R5, W4, W5

c. Evaluate student assignment for accuracy and completeness.

Standards

AFNR Industry Standards

- ESS.01. Use analytical procedures to plan and evaluate environmental service systems.
- ESS.02. Assess the impact of policies and regulations on environmental service systems.
- ESS.03. Apply scientific principles to environmental service systems.
- ESS.04. Operate environmental service systems to manage a facility environment.
- NRS.02. Apply scientific principles to natural resource management activities.
- NRS.03. Apply knowledge of natural resources industries to production and processing industries.
- PS.02. Prepare and implement a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.
- PS.04. Employ elements of design to enhance an environment.

Applied Academic Credit Standards

Environmental Science

- ES 2 Develop an understanding of the relationship of ecological factors that affect an ecosystem.
- ES 3 Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.

Spatial Information Science

- SP 2 Develop an understanding of geographic information systems.

21st Century Learning Standards

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

National Education Technology Standards for Students (NETS)

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

ACT College Readiness Standards

- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R4 Meaning of Words
- R5 Generalizations and Conclusions
- W4 Organizing Ideas
- W5 Using Language

Suggested References

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

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

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Porter, L., Lee, J., Turner, D., & Hillman J. (2003). *Environmental science & technology* (2nd ed.). Danville, IL: Interstate.

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Science of Agricultural Environment

Unit 10: Issues in a Global Environment

10 Hours

Competency 1: Analyze issues related to the global environment. ESS.03, BIOI 3, ES 3

Suggested Enduring Understandings

1. Global environmental issues affect the earth as a whole and all human beings. Global issues are not limited to one country or to one specific region.
2. Solutions to global environmental issues require the nations of the world to work together to identify the problem, collect information on its causes, and propose solutions that all nations can accept.

Suggested Essential Questions

1. What is the difference in a local environmental issue and a global environmental issue? Which issues are more of a threat?
2. How do nations work together to identify and address global issues?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Explain how global environmental issues are identified. (DOK 1)	a. Have students read the <i>Global Environment Issues</i> chapter in the text (Porter et al., 2003). Hold a class discussion on the definition of what an issue is to include discussing the difference between local issues (ex. maintaining water supply & quality, maintaining air quality, maintaining soil productivity and preventing soil degradation, etc.) and global issues (war and terrorism, landscape degradation, acid rain deposition, greenhouse gas emissions, global warming, etc.). Summarize important points from the discussion on the LCD projector or Smartboard, and have students record them in their electronic journals or notebooks. <small>CS1, CS2, CS4, T1, T2, T3, T4, T6, R1, R4, R5</small>	a. Students will be assessed using a paper and pencil test.
b. Describe the procedures used in solving environmental problems. (DOK 2)	b. Discuss the five questions used in dealing with solving environmental problems: What is the problem? What information is needed and available about the problem? What are the possible ways of solving the problem? What are the possible outcomes of solving the problem? What is the best solution to the problem? Use a scenario from the local area to pose a problem, and have the class work as a team to analyze it and present possible solutions. <small>CS1, CS2, CS4, T1, T2, T3, T4, T6, S1, S2</small>	b. Have students peer assess the results of their assignment.

Competency 2: Analyze issues that affect the global environment.

ESS.01, ESS.03, BIOI 3, CHI1 5, E4, ES 3, PSS

Suggested Enduring Understandings

1. Landscape degradation and defacement detracts from the aesthetic appearance and life-promoting qualities of the landscape.
2. Acid rain results from a number of factors including the burning of fossil fuels and results in damage to plants and animals, buildings and structures, and equipment.
3. The tropical rain forests play an important role in reducing carbon emissions in the atmosphere and lowering the carbon monoxide and carbon dioxide levels of the air.
4. Greenhouse gases such as methane, carbon dioxide, and nitrogen oxides along with an increase in ozone are suspected of causing a greenhouse effect that raises the temperature of the earth.

Suggested Essential Questions

1. How do landscape degradation and defacement affect the environment, and what can be done to avoid or minimize this threat?
2. What is acid rain, and what can be done to minimize its effects?
3. How do the tropical rain forests affect the environment?
4. What are the greenhouse gases, and how do they affect the environment?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
<p>a. Investigate the causes and effects of landscape degradation and defacement on the environment. (DOK 2)</p>	<p>a. Based on the knowledge they obtained by reading the <i>Global Environmental Issues</i> chapter in the text (Porter et al., 2003), have the students take pictures of examples of landscape degradation or defacement in the local area. Have students develop a PowerPoint presentation that identifies the problem, describe how it was caused, and suggest ways in which it can be minimized or avoided in the future. <small>CS1, CS2, CS4, T2, T3, T4, T6, R3, R4, R5, W1, W2, W4, W5</small></p>	<p>a. Use the <i>Rubric for PowerPoint Presentation on Landscape Degradation and Defacement (10.1)</i> to assess student mastery.</p>
<p>b. Evaluate the causes and effects of acid rain deposition on the environment. (DOK 2)</p>	<p>b. Hold a class discussion on the causes and effects of acid rain. Have students collect rainwater from their homes and analyze it using a pH meter. Have students graph their findings and speculate on why there is a variance. <small>CS1, CS2, CS4, T1, T2, T3, T4, T6, S1, S2, M1, M5, M7</small></p>	<p>b. Students will be assessed using a paper and pencil test.</p>
<p>c. Evaluate the causes and effects of tropical rain forest destruction on the environment. (DOK 2)</p>	<p>c. Have students research and write a paper describing the causes and effects of the tropical rain forest destruction on the environment. The paper should present recommendations on how future damage to the global environment can be prevented. <small>CS1, CS2, CS4, T1, T2, T3, T4, T6, R1, R2, R4, R5, W1, W2, W4, W5</small></p>	<p>c. Use the <i>Rubric for Tropical Rain Forest Paper (10.2)</i> to assess student mastery.</p>

- | | | |
|--|---|---|
| d. Evaluate the causes and effects of greenhouse gases on the environment. (DOK 3) | d. Use a PowerPoint presentation on the cause and effects of greenhouse gases on the environment. Divide the class into two groups with one group debating that global warming is a reality and the other group debating that it is a hoax. <small>CS1, CS2, CS4, CS5, T1, T2, T3, T4, T6, S1, S2, S3</small> | d. Students will be graded using a paper and pencil test. |
|--|---|---|

Competency 3: Investigate the design of alternative futures. ESS.01, BIOI 3, ES1, ES2, ES3

Suggested Enduring Understandings

1. By comparing past conditions to current conditions, scientists are able to establish trends that can be used to predict future environmental conditions.
2. Futuring is a process by which we can try to shape the future and have some control over our destiny. Futuring is accomplished through a process that predicts future conditions based on different alternatives.
3. Forecasting is the science of prediction of future events based on trends obtained from past and current data.
4. The local environment can be maintained and improved through careful planning.

Suggested Essential Questions

1. How are trends in environmental quality determined?
2. What is futuring, and how is it accomplished?
3. How is forecasting accomplished?
4. What is the process for developing an environmental improvement plan?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Explain the role of forecasting in the environment. (DOK 2)	a. Have students read Chapter 28 in the text (Porter et al., 2003). Lead a discussion with students regarding environmental planning and forecasting. <small>CS1, CS2, CS4, T2, T3, T4, T6, R1, R2, R4, R5</small>	a. Use the <i>Group Participation Rubric (10.3)</i> to assess student mastery.
b. Discuss how futuring is used to assure a desired environment. (DOK 2)	b. Through classroom discussion, have students develop a definition of futuring as related to environmental protection and enhancement. Have students research recent examples of futuring reports on the environment and include these in the discussion. <small>CS1, CS2, CS4, T1, T2, T3, T4, T6, R1, R2, R4, R5</small>	b. Students will be assessed using a paper and pencil test.
c. Develop a plan for assuring maintaining and improving environmental quality in the local area. (DOK 4)	c. Have students working as a class or in groups develop an environmental improvement plan for your local community or the area near your school that addresses a global issue. Use resource people in the community to help the planning. Be sure to include the following: current conditions, a concise statement of the issue or problem to be addressed, an overall	c. Use the <i>Environmental Plan Rubric (10.3)</i> to assess student mastery.

statement of the direction to go, objectives and goals, ways and means of achieving the objectives and goals, and a means for evaluating progress. Submit the final report to the class in a presentation. CS1, CS2, CS4, T1, T2, T3, T4, T6, W1, W2, W4, W5

Standards

AFNR Industry Standards

- ESS.01. Use analytical procedures to plan and evaluate environmental service systems.
- ESS.03. Apply scientific principles to environmental service systems.

Applied Academic Credit Standards

Biology I

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

Chemistry I

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

Earth Science

- E4 Demonstrate an understanding of Earth systems relating to weather and climate.

Environmental Science

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

Physical Science

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

21st Century Learning Standards

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

National Education Technology Standards for Students (NETS)

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

ACT College Readiness Standards

- M1 Basic Operations and Applications
- M5 Graphical Representations
- M7 Measurement
- R1 Main Ideas and Author's Approach
- R2 Supporting Details
- R3 Sequential, Comparative, and Cause–Effect Relationships
- R4 Meaning of Words

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

Suggested References

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

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

Energy, greenhouse gases, & farming. Retrieved June 14, 2010, from <http://www.climateandfarming.org/eghg-f.php>

Porter, L., Lee, J., Turner, D., & Hillman J. (2003). *Environmental science & technology* (2nd ed.). Danville, IL: Interstate.

Powers, L., & McCorley, R. (2000). *Ecological principles for agriculture*. Albany, NY: Delmar.

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

Student Competency Profile

Student Name: _____

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

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

Unit 1: Introduction to the Science of Agricultural Environment

- _____ 1. Examine the environment and how is it affected by human and agricultural activities.
- _____ 2. Analyze issues affecting the global environment and how these relate to agriculture.
_____ Demonstrate career and leadership skills required for employment in the environmental and natural resources industry.
- _____ 3. resources industry.
- _____ 4. Identify general safety precautions for the laboratory and field.
- _____ 5. Explore career opportunities in environmental and natural resources areas.

Unit 2: Experiential Learning (SAE)

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

Unit 3: Living Organisms and Ecology

- _____ 1. Investigate the role of living organisms in the environment.
- _____ 2. Examine relationships of living organisms and the environment.
- _____ 3. Discuss the impact of agricultural pests and pest control measures on the environment.
- _____ 4. Examine principles of ecology as related to environment quality.
- _____ 5. Identify ecological diversity in agricultural and wildlife ecosystems.

Unit 4: Land and Soil Management

- _____ 1. Examine the process of planning for urban and rural land use.
- _____ 2. Apply principles of soil and land management and use.
- _____ 3. Assess the impact of agricultural, horticultural, and forestry practices on land and soil.

Unit 5: Water Quality Management

- _____ 1. Explore concepts of water usage and quality.
- _____ 2. Describe important water management practices.
- _____ 3. Describe how wastewater is treated to maintain water quality.

Unit 6: The Atmosphere and Environmental Quality

- _____ 1. Examine the relationship of the atmosphere to the earth's environment.
- _____ 2. Use weather and climate information in making decisions about the environment.
- _____ 3. Assess air quality, and identify sources of air pollution.

Unit 7: Forestry and the Environment

- _____ 1. Examine basic principles of forest dendrology and mensuration.
- _____ 2. Discuss the relationship of forestry to environment quality and economic development.

Unit 8: Wildlife and the Environment

- _____ 1. Examine the relationships of wildlife well-being and environmental quality.
- _____ 2. Investigate approaches in protecting and managing wildlife species.

Unit 9: Environmental Stewardship

- _____ 1. Discuss concepts of sustainable agriculture.
- _____ 2. Explore the services of agencies and organizations that protect and maintain the environment.
- _____ 3. Use appropriate procedures for management and disposal of solid waste.
- _____ 4. Select appropriate procedures for managing hazardous waste materials.

Unit 10: Issues in a Global Environment

- _____ 1. Analyze issues related to the global environment.
- _____ 2. Analyze issues that affect the global environment.
- _____ 3. Investigate the design of alternative futures.

Appendix A: Suggested Rubrics, Checklist, and Activities

Name: _____

Date: _____

Period: _____

Rubric for Student Survey on Environmental Protection and Natural Resources Use (1.1)

On the questions below, indicate your understanding the Environmental Protection and Natural Resource Use by marking a 5 for a great understanding of the issue, a 4 for a good understanding of the issue, a 3 for a basic understanding of the issue, a 2 for a little understanding of the issue, and a 1 for no understanding of the issue.

	Great Understanding	Good Understanding	Basic Understanding	Little Understanding	No Understanding
1. The natural resources in our area are in need of protection.	5	4	3	2	1
2. The natural resources in our area are obviously used by people.	5	4	3	2	1
3. The natural resources in our area add beauty and quality of life to our community.	5	4	3	2	1
4. There is a great need for protection of our local natural resources.	5	4	3	2	1
5. I can contribute to protecting our local environment.	5	4	3	2	1
6. Our nation's natural resources are in jeopardy of being destroyed.	5	4	3	2	1
7. The availability of our nation's natural resources is affecting the price of fuel.	5	4	3	2	1
8. Our government works to protect our natural resources.	5	4	3	2	1
9. I can contribute to protecting our nation's natural resources.	5	4	3	2	1
10. Environmental protection laws are essential to preserving our nation's natural resources.	5	4	3	2	1

Name: _____

Date: _____

Period: _____

Lecture Notes for Unit 1 (1.2)

Vocabulary Words: Use the Environmental Science and Technology Text Book to define the terms for the week.

Air
Development
Domesticate
Environment
Fossil fuel
Inorganic substance
Landscape
Mineral
Natural resource
Non renewable
Renewable
Wildlife

In a group discussion, have students identify and describe the kinds of natural resources that exist:

Air – Mixture of gases surrounding the earth
Water – A colorless, transparent, natural compound found in oceans, lakes, icebergs, and vaporized in the air
Soil – Top layer of the earth's crust
Wildlife – Includes non-domesticated animals and plants and trees
Fossil Fuels – Energy-producing material made of dead and decaying plant material
Petroleum – Liquid form
Natural gas – Gaseous form
Coal – Solid form
Minerals – Inorganic substances, such as iron, gold, limestone, etc.
People

Discuss the differences between a resource being *renewable* or *nonrenewable*, exhaustible and non-exhaustible, and the importance of preserving, conserving, and protecting those resources.

Natural resources interaction:

Sustainability – All natural resources affect one another in both positive and negative ways, but they also **DEPEND** on one another for survival.

Name: _____

Date: _____

Period: _____

Construct a Food Web Activity (1.3)

1. Begin building a giant food web out of yarn or string and colored index cards. Create the center of the web using index cards of the same and putting each nonliving natural resource on a card and connecting them together.
2. Have students brainstorm a list of common wildlife animals that can be found in their county. Divide the list among student groups, and assign them the task of researching the animals on their list to find their eating habits and see whether they are omnivore (meat and plant eaters), carnivore (meat eater), or herbivore (plant eater) and to create a food chain on each animal.
3. When the groups have finished researching their assigned animals, instruct students to put the plant names each on a green card and build the level of the web around the nonliving natural resources. The next circle should be the herbivores identified on a yellow card, then the carnivores on a red card, and then the omnivores on a blue card. Instruct the students to connect the cards to one another using the yarn, thus creating a giant food web.
4. Display the web on a wall or bulletin board for future reference in class discussion.

Name: _____

Date: _____

Period: _____

Rubric for Group Activity to Construct a Food Web (1.4)

CATEGORY	4-Exceptional	3-Admirable	2-Acceptable	1-Amateur	SCORE
Content of Activity	Students exhibited exceptionally accurate detail including nonliving resources, plants, and animals and correctly assigned all species to appropriate categories.	Students included the most common nonliving resources, plants, and animals and correctly assigned all species to appropriate categories.	Students included 1–3 of the common nonliving resources, plants, and animals and correctly assigned all species to appropriate categories.	Students assigned only one common nonliving resource, plant, and animal to the web.	
Group Participation	All students participated in the activity.	3/4 of the students participated in the activity.	1/2 of the students participated in the activity.	Only one or two students actively participated.	
Shared Responsibility	Responsibility for task is shared evenly by all members of the group.	Responsibility is shared by most group members.	Responsibility is shared by 1/2 the group members.	One or two members bore the majority of the responsibility for accomplishing the task.	
Quality of Interaction	All members exhibited excellent listening and leadership skills.	Most students exhibited excellent listening skills.	The group demonstrated some ability to listen, interact, and discuss.	There was very little interaction or discussion. Some students were disinterested or distracted.	
Roles Within Group	Each student was assigned a clearly defined role; group members perform roles effectively.	Each student was assigned a role, but roles were not clearly defined or consistently adhered to.	Students were assigned roles, but roles were not consistently adhered to.	No effort was made to assign roles to group members.	
Total Score					

Name: _____

Date: _____

Period: _____

Rubric for Position Paper on Conservation and Responsible Use of Natural Resources (1.5)

CATEGORY	4-Exceptional	3-Admirable	2-Acceptable	1-Amateur	SCORE
Technical Content	The paper clearly stated more than five programs or activities in which the selected agricultural enterprise directly promoted the conservation and responsible use of natural resources.	The paper clearly stated more than four to five programs or activities in which the selected agricultural enterprise directly promoted the conservation and responsible use of natural resources.	The paper clearly stated more than three programs or activities in which the selected agricultural enterprise directly promoted the conservation and responsible use of natural resources.	The paper clearly stated two or fewer programs or activities in which the selected agricultural enterprise directly promoted the conservation and responsible use of natural resources.	
Organization	Content is extremely well organized in a logical format that is easy to follow and flows smoothly from one idea to another enhancing the effectiveness of the project.	Content is presented in a thoughtful, organized manner, and most transitions were easy to follow. Only a few ideas were unclear.	While content was somewhat organized, ideas were not presented coherently, and transitions were not always smooth.	The content was choppy and confusing. It was difficult to follow; transitions were abrupt and seriously distracted from theme and purpose.	
Content Accuracy	All content was completely accurate; all facts were precise and explicit.	Content was mostly accurate with only a few inconsistencies or errors in information.	Content was somewhat accurate, but there were more than a few inconsistencies or errors in information.	Content was grossly inaccurate to the point that the facts in this project were misleading to the audience.	
Research	Research on the project went above and beyond expectations. The student solicited material in addition to what was provided, brought in personal ideas and information to enhance project, and utilized more than six types of resources to make project effective.	The student did a very good job of researching, using materials provided to his or her full potential; the student used more than four types of research to enhance project (at least one source from information outside of the school).	The student used at least three references provided by the school in an acceptable manner but did not consult any additional resources.	The student did not use provided resources effectively and did little or no fact gathering on the topic.	
Creativity	The report demonstrated exceptional creativity and originality on the part of the student.	The report was cleverly presented in a thoughtful and interesting manner.	The student did add a few creative touches to enhance the report but mostly reported the information as provided.	The report showed little creativity or originality.	

Name: _____

Date: _____

Period: _____

Sample Test Questions (1.6)

Multiple Choice

- Naturally occurring resources that are found in nature are called:
 - natural resources.
 - renewable resources.
 - nonrenewable resources.
 - sustainable resources.
- Resources that can be replaced when they are used are called:
 - natural resources.
 - renewable resources.
 - nonrenewable resources.
 - sustainable resources.
- Resources that cannot be replaced when used are called:
 - natural resources.
 - renewable resources.
 - nonrenewable resources.
 - sustainable resources.
- Materials used to provide energy, created by the decomposition of dead plants and animals, are called:
 - air.
 - fossil fuels.
 - soil.
 - wildlife.
- There are three types of fossil fuels. The liquid form used to make gasoline and plastics is called:
 - coal.
 - natural gas.
 - peat.
 - petroleum.
- The solid form of fossil fuels that is used in factories and electricity generating plants is called:
 - coal.
 - natural gas.
 - oil.
 - petroleum.
- The gaseous fossil fuel used for heating and cooking food is called:
 - coal.
 - natural gas.
 - crude oil.
 - petroleum.

8. The energy in fossil fuels was put there when plants converted energy from the sun in to food. This process is called:
 - a. respiration.
 - b. chlorophyll.
 - c. photosynthesis.
 - d. transpiration.

9. The type of consumer that eats only meat is called a/an:
 - a. carnivore.
 - b. herbivore.
 - c. omnivore.
 - d. predator.

10. The type of consumer that eats only plants is called a/an:
 - a. carnivore.
 - b. herbivore.
 - c. omnivore.
 - d. predator.

11. The type of consumer that eats both plants and animals is called a/an:
 - a. carnivore.
 - b. herbivore.
 - c. omnivore.
 - d. predator.

12. This part of the food chain feeds on producers. It cannot make its own food. Most of these organisms eat only living tissue, but some eat both alive and dead tissue, such as the horse that eats grass and hay. This is called a:
 - a. producer.
 - b. consumer.
 - c. decomposer.
 - d. transformer.

13. This organism takes nutrients and energy from nonliving sources and makes them into its food. It is also called an autotroph. It does not depend on other organisms for food. What is it?
 - a. Producer
 - b. Consumer
 - c. Decomposer
 - d. Transformer

14. This organism breaks down the bodies of dead plants and animals. They normally only feed on dead tissue and break it down into inorganic substances. Some examples are bacteria and mushrooms. These organisms are called:
 - a. producers.
 - b. consumers.
 - c. decomposers.
 - d. transformers.

15. Wetlands are important in the environment to keep ground water supplies clean and available and provide a habitat for many species of wildlife. When laws are passed to help protect wetlands, this is called:
 - a. sustainable agriculture.
 - b. sustainable development.
 - c. sustainable resource use.

- d. sustainability.
16. When an area of farmland is taken out of production and cleared to build a subdivision of houses for people, environmental considerations must be taken in manufacturing and construction. This is called:
- a. sustainable agriculture.
 - b. sustainable development.
 - c. sustainable resource use.
 - d. sustainability.
17. If a housing development is being built in a forested area and consideration is given to cut down as few trees as possible and to keep the lake that exists in place by building around lake, this kind of relationship is called:
- a. design for the environment.
 - b. symbiotic relationship.
 - c. aesthetic relationship.
 - d. conservation relationship.
18. One of the requirements of an environment to remain healthy for the wildlife in that area is for there to be enough room for the animal to find food, find a mate, and establish a territory. This is called:
- a. food.
 - b. water.
 - c. space.
 - d. shelter.
19. All the parts of a particular environment are called:
- a. habitat.
 - b. ecosystem.
 - c. community.
 - d. territory.
20. The area an animal uses and protects as its own is called:
- a. habitat.
 - b. ecosystem.
 - c. community.
 - d. territory.

Name: _____

Date: _____

Period: _____

Rubric for Student Electronic Notebook (1.7)

Scoring Criteria				
<i>The student did the following:</i>	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Captured the main ideas from the presentation or lecture in handwritten form				
Accurately transcribed the main ideas into the proper electronic format				
Checked spelling and grammar				
Demonstrated comprehension of the writing process				
Summarized the important points and added personal reflections				

Name: _____

Date: _____

Period: _____

Rubric for Written Report on Environmental Agencies (1.8)

Date: _____

	Scoring Criteria			
<i>The student did the following:</i>	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Presented the mission and purpose of the agency in preserving land and environment and provided examples of projects designed to prevent landscape degradation				
Included all required parts from introduction to conclusion in smooth transition				
Provided interesting, supportive, and complete statements				
Demonstrated comprehension of the writing process				
Used correct spelling, grammar, punctuation, and sentence structure				
Prepared paragraphs that emphasize appropriate points				
Documented sources and references clearly and accurately				

Name: _____

Date: _____

Period: _____

21st Century Life and Career Skills (1.9)

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

CS1 Global Awareness

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

CS2 Financial, Economic, Business and Entrepreneurial Literacy

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

CS3 Civic Literacy

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

CS4 Health Literacy

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

CS5 Environmental Literacy

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

CSS2-Learning and Innovation Skills

CS6 Creativity and Innovation

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

CS7 Critical Thinking and Problem Solving

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

CS8 Communication and Collaboration

1. Communicate Clearly
2. Collaborate with Others

CSS3-Information, Media and Technology Skills

CS9 Information Literacy

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

CS10 Media Literacy

1. Analyze Media
2. Create Media Products

CS11 ICT Literacy

1. Apply Technology Effectively

CSS4-Life and Career Skills

CS12 Flexibility and Adaptability

1. Adapt to change
2. Be Flexible

CS13 Initiative and Self-Direction

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

CS14 Social and Cross-Cultural Skills

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

CS15 Productivity and Accountability

1. Manage Projects
2. Produce Results

CS16 Leadership and Responsibility

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

Name: _____

Date: _____

Period: _____

21st Century Life and Career Skills Assessment Rubric (1.10)

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

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

Skill	Comments	Score
Flexibility and Adaptability		
Initiative & Self-Direction		
Social & Cross-Cultural Skills		
Productivity & Accountability		
Leadership & Responsibility		
		TOTAL SCORE

Name: _____

Date: _____

Period: _____

Rubric for Personal Plans (1.11)

Scoring Criteria				
<i>The student did the following:</i>	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Identified areas where he or she felt a need to improve leadership and human relations skills				
Identified activities in FFA and other organizations that would aid in the development of these skills				
Kept records and documentation of leadership and human relations activities and incorporated these into the electronic portfolio				

Need to Know and How to Guide Report Rubric (1.12)

Criteria	Superior 5 Points	Exceptional 4 Points	Adequate 3 points	Marginal 2 points	Minimal 1 Point	Score
Written report addressed the topic	Provided specific details on the topic	Provided general details on the topic	Provided details on the topic	Provided minimal details on the topic	Provided limited information on the topic	
Presentation addressed the topic	Provided specific details on the topic	Provided general details on the topic	Provided details on the topic	Provided some details on the topic	Provided limited information on the topic	
Quality of the visual aid	Shows relevance to the topic by creatively displaying specific details related to the topic	Shows relevance to the topic by creatively displaying general details related to the topic	Shows relevance to the topic by displaying details related to the topic	Shows some relevance to the topic by displaying limited details related to the topic	Shows very little relevance to the topic	
Quality of written report	No errors in grammar, syntax, spelling, etc.	One to two minor errors in grammar, syntax, spelling, etc.	Two to four minor errors in grammar, syntax, spelling, etc.	More than four minor errors in grammar, syntax, spelling, etc.	Major errors in grammar, syntax, spelling, etc.	
TOTAL SCORE:						

Natural Resources Careers Research Rubric (1.13)

Criteria	Superior 5 Points	Exceptional 4 Points	Adequate 3 points	Marginal 2 points	Minimal 1 Point	Score
Table addressed the topic	Provided specific details on the topic	Provided general details on the topic	Provided details on the topic	Provided minimal details on the topic	Provided limited information on the topic	
Written Justification addressed the topic	Provided specific points supporting the job choice	Provided general points supporting the job choice	Provided points supporting the job choice	Provided some points supporting the job choice	Provided limited points supporting the job choice	
Quality of the visual aid	Shows relevance to the topic by creatively displaying specific details related to the topic	Shows relevance to the topic by creatively displaying general details related to the topic	Shows relevance to the topic by displaying details related to the topic	Shows some relevance to the topic by displaying limited details related to the topic	Shows very little relevance to the topic	
Quality of written report	No errors in grammar, syntax, spelling, etc.	One to two minor errors in grammar, syntax, spelling, etc.	Two to four minor errors in grammar, syntax, spelling, etc.	More than four minor errors in grammar, syntax, spelling, etc.	Major errors in grammar, syntax, spelling, etc.	
TOTAL SCORE:						

Name: _____

Date: _____

Period: _____

Rubric for Experiential Learning Planning and Record Keeping (2.1)

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

Microbe Collection and Wet Mount Slide Performance Rubric (3.1)

	Possible Points	Points Awarded
Safety <ul style="list-style-type: none"> • Personal safety (glasses, gloves, clothing, etc.) • Safe use of tools • Safely performs the task 	25	
Performance of the Task <ul style="list-style-type: none"> • Follows the instructions on preparing a Wet Mount Slide • Successfully finds image of specimen in microscope • Records data and information accurately • Identifies specimen classification 	50	
Lab Maintenance <ul style="list-style-type: none"> • Properly handled the microscope • Understood the mechanics of the microscope • Area cleanup (clean and tidy) • Area organization (before, during, and after the task) 	25	
Total	100	

Comments for deductions:

Life Span Visual Performance Rubric (3.2)

Criteria	Superior 5 Points	Exceptional 4 Points	Adequate 3 points	Marginal 2 points	Minimal 1 Point	Score
Selection of animal and depiction of life span	Selected an animal and included a depiction of the animal at each of the five stages of life	Selected an animal and included a depiction of the animal at four of the five stages of life	Selected an animal and included a depiction of the animal at three of the five stages of life	Selected an animal and included a depiction of the animal at two of the five stages of life	Selected an animal and included a depiction of the animal at one of the five stages of life	
Description of each life stage to include name and picture	Provided specific details on each of the life stages	Provided general details on each of the life stages	Provided details on at least four of the life stages	Provided some details on at least three of the life stages	Provided limited information on at least one of the life stages	
Content of visual aid	At least five pictures or graphics are detailing each life stage.	At least four pictures or graphics are detailing each life stage.	At least three pictures or graphics are detailing each life stage.	At least two pictures or graphics are detailing each life stage.	At least one picture or graphic is detailing each life stage.	
Quality of visual aid	No errors in grammar, syntax, spelling, etc.	One to two minor errors in grammar, syntax, spelling, etc.	Two to four minor errors in grammar, syntax, spelling, etc.	More than four minor errors in grammar, syntax, spelling, etc.	Major errors in grammar, syntax, spelling, etc.	
TOTAL SCORE						

Comments:

Rubric for Life Process Poster (3.3)

Criteria	Superior 5 Points	Exceptional 4 Points	Adequate 3 points	Marginal 2 points	Minimal 1 Point	Score
Description of life process	Description includes at least five characteristics of the life process.	Description includes at least four characteristics of the life process.	Description includes at least three characteristics of the life process.	Description includes at least two characteristics of the life process.	Description includes at least one characteristic of the life process.	
Association of life process to animal anatomy and physiology	Associates chosen life process to specific details of at least three different animals' anatomy and physiology	Associates chosen life process to general details of at least three different animals' anatomy and physiology	Associates chosen life process to details of at least two different animals' anatomy and physiology	Associates chosen life process to minimal details of at least two different animals' anatomy and physiology	Associates chosen life process to a few details of at least one animal's anatomy and physiology	
Content of visual aid	At least five pictures or graphics are detailing the life process in each animal.	At least four pictures or graphics are detailing the life process in each animal.	At least three pictures or graphics are detailing the life process in each animal.	At least two pictures or graphics are detailing the life process in each animal.	At least one picture or graphic is detailing the life process in each animal.	
Quality of visual aid	No errors in grammar, syntax, spelling, etc.	One to two minor errors in grammar, syntax, spelling, etc.	Two to four minor errors in grammar, syntax, spelling, etc.	More than four minor errors in grammar, syntax, spelling, etc.	Major errors in grammar, syntax, spelling, etc.	
TOTAL SCORE						

Grading Checklist for Collection of Specimens and/or Photographs that Illustrate Biodiversity (3.4)

- _____ 1. Collection of specimen and/or picture to represent each of the five kingdoms
- _____ 2. Picture of two or more organisms sharing a resource
- _____ 3. Photos of five different vertebrate animals
- _____ 4. Photos of five different invertebrate animals
- _____ 5. Photos of five different plants
- _____ 6. Photo depicting ecological diversity
- _____ 7. Photo depicting genetic diversity
- _____ 8. Photo depicting species diversity

Rubric for Pest Pamphlet (3.5)

Criteria	Superior	Exceptional	Adequate	Marginal	Minimal	Score
	5 Points	4 Points	3 points	2 points	1 Point	
Pamphlet contains information on an environmental pest	Pamphlet includes specific details on the environmental pest.	Pamphlet includes general details on the environmental pest.	Pamphlet includes details on the environmental pest.	Pamphlet includes minimal details on the environmental pest.	Pamphlet includes few details on the environmental pest.	
Content includes in pamphlet	Includes all the required information	Includes at least four of the required components	Includes at least three of the required components	Includes at least two of the required components	Includes at least one of the required components	
Quality of pamphlet layout	Pamphlet is in color and includes at least five graphics, artwork, or pictures. Layout is easy to follow and organized.	Pamphlet is in color and includes at least three graphics, artwork, or pictures. Layout is easy to follow and organized.	Pamphlet is in color and includes at least one graphic, artwork, or picture. Layout is organized.	Pamphlet is not in color but includes at least three graphics, artwork, or pictures. Layout is somewhat organized.	Pamphlet is not in color and does not include any graphics/artwork or pictures. Layout is difficult to follow.	
Quality of brochure presentation	No errors in grammar, syntax, spelling, etc.	One to two minor errors in grammar, syntax, spelling, etc.	Two to four minor errors in grammar, syntax, spelling, etc.	More than four minor errors in grammar, syntax, spelling, etc.	Major errors in grammar, syntax, spelling, etc.	
TOTAL SCORE						

Grading Checklist for the Wiki on Ecology (3.6)

An effective wiki shows the following:

- ___ 1. **A collaborative effort** (as seen in the history)
Several students in the assigned group contributed to the Wiki.
- ___ 2. **Visual appeal**
Graphics are effectively used.
- ___ 3. **Organization**
A table of contents, headings, and/or other visual organizers are used.
- ___ 4. **Hyperlinks to sources**
Wiki contains several hyperlinks to sources of information. These hyperlinks have been checked to make sure they work.
- ___ 5. **Original, intelligent wording**
Words used in the Wiki are original, not cut and pasted into the Wiki. Any text present is original, not copied.
Optional wiki traits
- ___ 6. **Multisensory tools are used.**
Multimedia information is presented in the Wiki. This strengthens the influence of the Wiki.
- ___ 7. **RSS Feeds and Cutting edge tools are used.**
Web 2.0 technology is also used, such as podcasts.

Grading Rubric for the Owl Pellet Dissection (3.7)

	Possible Points	Points Awarded
Safety <ul style="list-style-type: none"> • Personal safety (glasses, gloves, clothing, etc.) • Safe use of tools • Safely performs the task 	25	
Performance of the Task <ul style="list-style-type: none"> • Follows the instructions on dissecting owl pellets • Successfully dissects the pellet • Records data and information accurately • Identifies specimen classification 	50	
Lab Maintenance <ul style="list-style-type: none"> • Properly handled the tools • Proper disposal of waste • Area cleanup (clean and tidy) • Area organization (before, during, and after the task) 	25	
Total	100	

Comments for deductions:

Grading Rubric for Stream Monitoring (3.8)

	Possible Points	Points Awarded
Safety <ul style="list-style-type: none"> • Personal safety (glasses, clothing, etc.) • Safe use of tools • Safely performs the task • Safely works in outdoor stream environment 	25	
Performance of the Task <ul style="list-style-type: none"> • Follows the task instructions • Performs the task efficiently • Performs the task satisfactorily • Records data and information accurately 	50	
Outdoor Safety <ul style="list-style-type: none"> • Area cleanup (clean and tidy) • Maintained operation of tools and monitoring equipment • Equipment organization (before, during, and after the task) 	25	
Total	100	

Comments for deductions:

Land Measurement Checklist (4.2)

- _____ 1. Student demonstrated measuring horizontal distance.
- _____ 2. Student demonstrated land chaining.
- _____ 3. Student demonstrated direction measurements using a compass.
- _____ 4. Student demonstrated making elevation measurements using a level.
- _____ 5. Student accurately measured horizontal distance using the appropriate tools.
- _____ 6. Student accurately measured a horizontal distance using the chaining method.
- _____ 7. Student accurately measured direction using a compass.
- _____ 8. Student accurately measured slope using a level.

Part 2

Provide a boundary survey of a given tract of land.

- _____ 1. Student was able to identify markers using a GPS.
- _____ 2. Student was able to identify markers using compass and land description.
- _____ 3. Student was able to visually identify boundary lines.
- _____ 4. Student was able to identify boundary lines using GPS technology and compasses.
- _____ 5. Student demonstrated ability to pace distance along a boundary.

Reflective Writing Rubric (4.3)

CATEGORY	4	3	2	1
Writing Structure	Sentences and paragraphs are complete, well-constructed, and of varied structure.	All sentences are complete and well-constructed (no fragments, no run-ons). Paragraphing is generally done well.	Most sentences are complete and well-constructed. Paragraphing needs some work.	Many sentence fragments or run-on sentences OR paragraphing needs lots of work.
Content	The writing contains a description of all steps taken during the “feel” test of the soil.	The writing contains a description of three steps taken during the “feel” test of the soil.	The writing contains a description of two steps taken during the “feel” test of the soil.	The writing contains a description of one step taken during the “feel” test of the soil.
Content Accuracy	The writing contains at least three accurate descriptions of the soil texture.	The writing contains at least two accurate examples of the soil texture.	The writing contains at least one accurate example of the soil texture.	The writing contains no examples of the soil texture.
Content Understanding	Ideas were expressed in a clear and organized fashion. It was easy to tell that the students grasped the “feel” test concept of texture.	Ideas were expressed in a pretty clear manner, but the organization could have been better.	Ideas were somewhat organized but were not very clear. It took more than one reading to figure out what the student was describing.	The writing seemed to be a collection of unrelated sentences. It was very obvious the student could not communicate about the experience.

Mechanical Analysis of Soil Rubric (4.4)

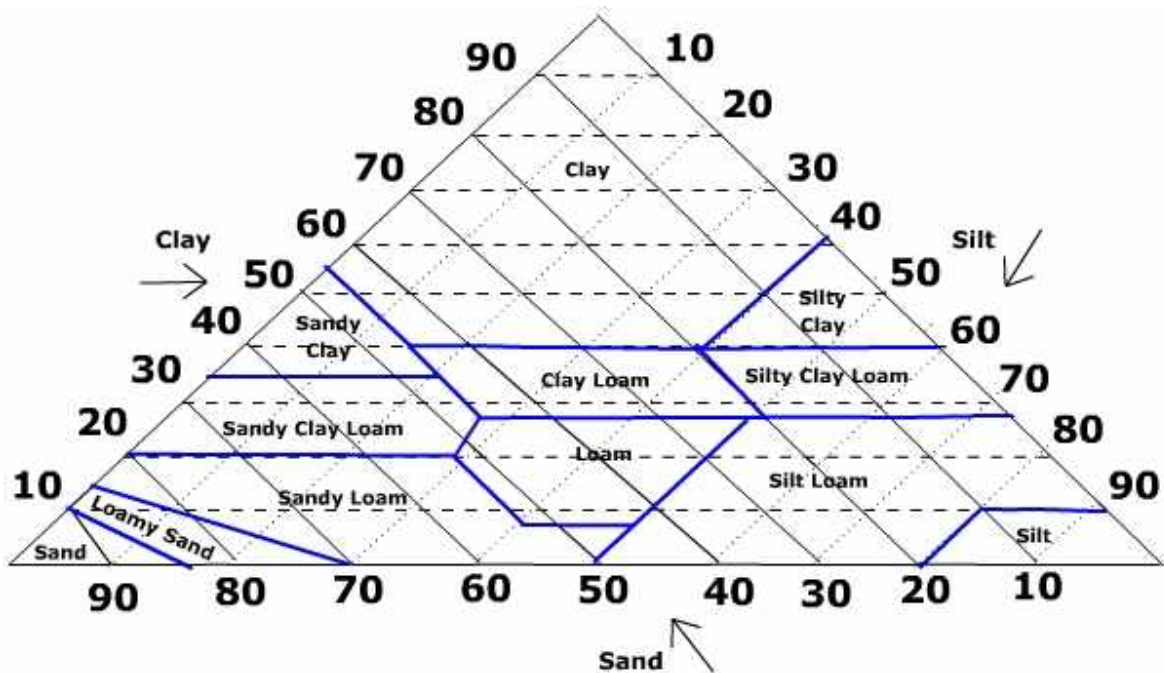
	Possible Points	Points Awarded
Safety <ul style="list-style-type: none"> • Personal safety (glasses, clothing, etc.) • Safe use of tools and materials • Safely performs the task 	25	
Performance of the Task <ul style="list-style-type: none"> • Follows the task instructions • Performs the task efficiently • Performs the task satisfactorily • Records data and information accurately 	50	
Lab Maintenance and Reporting <ul style="list-style-type: none"> • Kept accurate records of all steps taken • Completed the laboratory report • Area cleanup (clean and tidy) • Area organization (before, during, and after the task) 	25	
Total	100	

Comments for deductions:

Soil Texture Classification Assignment (4.5)

Use the chart below to determine the texture of soils with the following sand, silt, and clay content.

1. _____ 50% sand, 40% silt, 10% clay _____
2. _____ 34% Sand, 35% silt, 31% clay _____
3. _____ 0% sand, 50% silt, 50% clay _____
4. _____ 20% sand, 65% silt, 15% clay _____
5. _____ 10% sand, 10% silt, 80% clay _____
6. _____ 85 % sand, 15% clay _____
7. _____ 67% sand, 10% silt, 23% clay _____
8. _____ 0% sand, 20% silt, 80% clay _____
9. _____ 90% silt, 10% clay _____
10. _____ 45% sand, 45% silt, 10% clay _____



Rubric for Evaluating Oral Report on Soil Conservation and Degradation (4.6)

Criteria	Superior 5 Points	Exceptional 4 Points	Adequate 3 points	Marginal 2 points	Minimal 1 Point	Score
Written report addressed the topic on soil erosion and degradation	Provided specific details on erosion and degradation	Provided general details on erosion and degradation	Provided details on erosion and degradation	Provided minimal details on erosion and degradation	Provided limited information on erosion and degradation	
Presentation addressed the topic	Provided specific details on the topic	Provided general details on the topic	Provided details on the topic	Provided some details on the topic	Provided limited information on the topic	
Quality of the visual aid	Shows relevance to the topic by creatively displaying specific details related to the topic	Shows relevance to the topic by creatively displaying general details related to the topic	Shows relevance to the topic by displaying details related to the topic	Shows some relevance to the topic by displaying limited details related to the topic	Shows very little relevance to the topic	
Quality of written report	No errors in grammar, syntax, spelling, etc.	One to two minor errors in grammar, syntax, spelling, etc.	Two to four minor errors in grammar, syntax, spelling, etc.	More than four minor errors in grammar, syntax, spelling, etc.	Major errors in grammar, syntax, spelling, etc.	
TOTAL SCORE:						

Fish Research Group Project Rubric (5.1)

CATEGORY	4-Exceptional	3-Admirable	2-Acceptable	1-Amateur	SCORE
Group Participation	All students participated in the activity.	3/4 of the students participated in the activity.	1/2 of the students participated in the activity.	Only one or two students actively participated.	
Shared Responsibility	Responsibility for task is shared evenly by all members of the group.	Responsibility is shared by most group members.	Responsibility is shared by 1/2 the group members.	One or two members bore the majority of the responsibility for accomplishing the task.	
Quality of Interaction	All members exhibited excellent listening and leadership skills.	Most students exhibited excellent listening skills.	The group demonstrated some ability to listen, interact, and discuss.	There was very little interaction or discussion. Some students were disinterested or distracted.	
Roles Within Group	Each student was assigned a clearly defined role; group members perform roles effectively.	Each student was assigned a role, but roles were not clearly defined or consistently adhered to.	Students were assigned roles, but roles were not consistently adhered to.	No effort was made to assign roles to group members.	
Completing the Assignment	The group effectively responded to the assignment and presented information on three fish species and gave thorough descriptions.	The group responded to the assignment and presented information on three fish species and gave weak descriptions.	The group somewhat responded to the assignment and presented information on less than three fish species and gave poor descriptions.	The group did not respond to the assignment and presented information on less than three fish species and gave no descriptions.	
Content	Information provided was very detailed and technically accurate. Illustrations were provided.	Information provided was very detailed and technically accurate.	Information was general in nature but technically accurate.	Limited information was provided, or there were major inaccuracies in the report.	
Total Score:					

Identify five ways in which you could conserve water.

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

Reflective Writing Rubric on the Differences between Ground Water and Surface Water (5.3)

CATEGORY	4	3	2	1
Writing Structure	Sentences and paragraphs are complete, well-constructed, and of varied structure.	All sentences are complete and well-constructed (no fragments, no run-ons). Paragraphing is generally done well.	Most sentences are complete and well-constructed. Paragraphing needs some work.	Many sentence fragments or run-on sentences OR paragraphing needs lots of work.
Content	The writing contains a detailed description of both surface and ground water.	The writing contains a general description of the characteristics of ground water and surface water.	The writing contains a limited description of the characteristics of ground water and surface water.	The writing contains a very weak description or inaccurate description of the characteristics of ground water and surface water.
Content Accuracy	The writing contains at least three accurate descriptions of ground water and surface water.	The writing contains at least two accurate descriptions of ground water and surface water.	The writing contains at least one accurate example descriptions of ground water and surface water.	The writing contains no examples of descriptions of ground water and surface water.
Content Understanding	Ideas were expressed in a clear and organized fashion. It was easy to figure out that the student understands the difference between surface and ground water.	Ideas were expressed in a clear manner, but the organization could have been better.	Ideas were somewhat organized but were not very clear. It took more than one reading to figure out whether the student understood the difference between surface and ground water.	The writing seemed to be a collection of unrelated sentences. The student did not grasp the concept of the difference between surface and ground water.

Name: _____

Date: _____

Period: _____

Stream Monitoring Activity Performance Rubric (5.4)

	Possible Points	Points Awarded
Safety <ul style="list-style-type: none">• Personal safety (glasses, gloves, clothing, etc.)• Safe use of tools and equipment• Safely performs the task	25	
Performance of the Task <ul style="list-style-type: none">• Follows the instructions on conducting stream monitoring practices• Successfully collects information for assessment• Records data and information accurately• Summarizes data correctly	50	
Lab Maintenance <ul style="list-style-type: none">• Properly handled the Ecology Kit tools and equipment• Understood the mechanics of water quality measuring devices• Area cleanup (clean and tidy)• Area organization (before, during, and after the task)	25	
Total	100	

Comments for deductions:

Name: _____

Date: _____

Period: _____

Water Quality Testing Laboratory Rubric (5.5)

Scoring Criteria				
<i>The student/team does the following:</i>	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Explains the skill				
Explains the skill as performed				
Summarizes conclusions				
Participates as a team				
Presents effective explanation				
Subtotal of explanation				
Performs the skill				
Prepares (sets up supplies and equipment for demonstration)				
Performs the water quality test				
Cleans the demonstration area (removes supplies and equipment and cleans the area)				
Demonstrates satisfactory participation by all team members				
<i>Subtotal for skill performance</i>				
Demonstrates overall effectiveness				
Completes laboratory report				
Observes all safety practices				
Maintains appropriate dress				
Maintains personal grooming				
<i>Subtotal for overall effectiveness</i>				
Summative Total				

Field Trip to Wastewater Treatment Plant Participation Checklist (5.6)

- ___ 1. The student arrived at the designated meeting place on time with all materials and supplies required for the field trip.
- ___ 2. The student observed all safety rules and policies while traveling to and participating in the field trip.
- ___ 3. The student demonstrated interest in the content of the field trip by paying attention to the exhibits and speakers, asking pertinent questions, and taking notes.
- ___ 4. The student exhibited a positive attitude toward the events and activities of the field trip.
- ___ 5. The student remained on task throughout the field trip.
- ___ 6. The student exhibited cooperative workplace skills with other students throughout the field trip.

Checklist for Evaluating the Diagram of the Atmosphere (6.1)

- _____ 1. The diagram included the five layers of the atmosphere and a description of their characteristics and functions.
- _____ 2. The diagram was properly labeled with detail.
- _____ 3. The diagram was in color.
- _____ 4. The diagram was easy to understand.
- _____ 5. The diagram was drawn on an 8 ½-in. x 11-in. sheet of paper.

Grade _____ %

Locating Latitude and Longitude on Maps (6.2)

Identify the latitude and longitude of each of the following cities, and classify them as being in either the temperate or tropical zone.

CITY	LATITUDE	LONGITUDE	ZONE
San Diego, California			
Albany, New York			
London, England			
Sydney, Australia			
New Delhi, India			
Rome, Italy			
Denver, Colorado			

San Francisco, California, lies at a latitude of 37° 48' N. Paris, France, lies at a latitude of 49° 50' N. Which city would you expect to have a colder climate based on its latitude?

Puerto San Julian, Argentina, lies at a latitude of 49° 17'S. St Louis, Missouri, lies at a latitude of 38° 35' N. Which city would you expect to have a warmer climate based on latitude?

Denver, Colorado, lies at a latitude of 39° 46'N and an altitude of 5,240 ft. Baltimore, Maryland, lies at a latitude of 39° 16'N and an altitude of 30 ft. Based on the latitude and altitude, how would you compare the climate of the two cities? (Warmer, cooler, or the same)

Air Pollution Presentation Rubric (6.3)

	Possible Points	Points Earned
1. Information was accurate and complete.	30	
2. Presentation included appropriate information on the topic of air pollution.	30	
3. Correct grammar, spelling, and punctuation were used.	20	
4. Proper design elements were used.	10	
5. Student worked well with team members.	5	
6. Student contributed to the finished product.	5	
TOTAL SCORE	100	

Detecting Air Pollution Activity Performance Rubric (6.4)

	Possible Points	Points Awarded
Safety <ul style="list-style-type: none"> • Personal safety (glasses, clothing, etc.) • Safe use of tools, equipment, and supplies • Safely performs the task 	25	
Performance of the Task <ul style="list-style-type: none"> • Follows the task instructions • Performs the task efficiently • Performs the task satisfactorily • Records data and information accurately 	50	
Lab Maintenance <ul style="list-style-type: none"> • Area cleanup (clean and tidy) • Area organization (before, during, and after the task) 	25	
Total	100	

Comments for deductions:

Environmental Science Weather Test (6.5)


Select from the following terms to answer the remaining questions.


dew point	precipitation	temperature	humidity
atmospheric pressure	wind	clouds	warm front
cirrus	cumulus	stratus	cold front
weather front	high	low	

1. Clouds that appear in large layers or sheets are called _____.
2. Any form of moisture that falls to the earth is _____.
3. The measure of the amount of heat in something is _____.
4. Moving air is called _____.
5. The amount of water vapor in the air is described as relative or absolute _____.
6. The temperature of the air when dew begins to form is called _____.
7. The pressure exerted by the air is called _____.
8. Large, dense, billowy clouds that have flat bases and a towering, dome-like appearance are called _____.
9. When a warm air mass and a cold air mass meet, it is called a _____.
10. Clouds that are high, white, and thin are _____.

11. Small droplets or ice crystals in the atmosphere that form together are called

_____.

12. This symbol () on a weather map indicates a _____.

13. This symbol () on a weather map indicates a _____.

14. Colder air is often indicated by an area of _____ pressure.

15. Warmer air is often indicated by an area of _____ pressure.

Multiple Choice

- How often does the earth revolve around the sun?
 - Every 12 hr
 - Every 24 hr
 - Every 7 days
 - Every 365 days
- How often does the earth rotate?
 - Every 12 hr
 - Every 24 hr
 - Every 7 days
 - Every 365 days
- The time when the earth's axis tilts at the greatest angle toward or away from the sun is called the:
 - orbit.
 - equinox.
 - revolution.
 - solstice.
- The time when the sun is directly over the equator is called the:
 - orbit.
 - equinox.
 - revolution.
 - solstice.
- In which direction does the earth's axis point?
 - North/South
 - East/West

- c. Northeast/Southeast
- d. Northwest/Southwest

6. The air that surrounds the earth is called the:
- a. atmosphere.
 - b. hemisphere.
 - c. climate.
 - d. weather.
7. The weather that generally prevails is called the:
- a. atmosphere .
 - b. hemisphere.
 - c. climate.
 - d. weather.
8. The current condition of the atmosphere is called:
- a. atmosphere.
 - b. hemisphere.
 - c. climate.
 - d. weather.
9. The part of the atmosphere closest to the earth is the:
- a. mesosphere.
 - b. stratosphere.
 - c. thermosphere.
 - d. troposphere.
10. The uppermost layer of the atmosphere that is very HOT is called the:
- a. mesosphere.
 - b. stratosphere.
 - c. thermosphere.
 - d. troposphere.
11. The area that extends about 30 miles above the earth and is used by airplanes is the:
- a. mesosphere.
 - b. stratosphere.
 - c. thermosphere.
 - d. troposphere.
12. The area that extends about 50 miles above the earth and is very COLD is the:
- a. mesosphere.
 - b. stratosphere.

- c. thermosphere.
 - d. troposphere.
13. The distance between any location on the earth and the Prime Meridian is called the:
- a. atmosphere.
 - b. altitude.
 - c. longitude.
 - d. latitude.
14. The distance North and South of the equator measured in degrees is the:
- a. atmosphere.
 - b. altitude.
 - c. longitude.
 - d. latitude.
15. The distance a point is above sea level is called the:
- a. atmosphere.
 - b. altitude.
 - c. longitude.
 - d. latitude.

Short Answer. Answer the following in complete sentences or by showing your math calculations.

1. What are four characteristics of a tornado?

2. What is the rating scale for tornadoes called? What is the worst rating?

3. What is time based upon?

4. What four factors are used to determine the weather?

5. What direction do weather fronts tend to move in North America?

Use the following formula to solve questions 6 and 7. Show the mathematical equations that you used to arrive at the answer.

$$C = \frac{5}{9}(F - 32)$$

$$F = \frac{9}{5}(C + 32)$$

6. Convert 36 degrees Fahrenheit to Celsius.

7. Convert 105 degrees Celsius to Fahrenheit.

Name: _____

Date: _____

Period: _____

Picture Assessment Rubric (7.1)

	Exemplary 4 points	Accomplished 3 points	Developing 2 points	Beginning 1 point	Score
Required Content	The picture includes all required content elements as well as additional information.	All required content elements are included on the picture.	All but one of the required content elements are included on the picture.	Several required content elements were missing.	
Labels	All items of importance on the picture are clearly labeled with labels that are easy to read.	Almost all items of importance on the picture are clearly labeled with labels that are easy to read.	Many items of importance on the picture are clearly labeled with labels that are easy to read.	Labels are too small to read, or no important items were labeled.	
Attractiveness	The picture is exceptionally attractive in terms of design, layout, and neatness.	The picture is attractive in terms of design, layout, and neatness.	The picture is acceptably attractive though it may be a bit messy.	The picture is distractingly messy or very poorly designed.	
Grammar	There are no grammatical or mechanical mistakes on the picture.	There are one to two grammatical or mechanical mistakes on the picture.	There are three to four grammatical or mechanical mistakes on the picture.	There are more than four grammatical or mechanical mistakes on the picture.	
					Total Score

Comments:

Name: _____

Date: _____

Period: _____

Tree Characteristics Chart (7.2)

Students will create a chart identifying major commercial forest trees (oaks, hickories, pines, ash, etc.) that will include common names, types (hardwood or softwood), physical characteristics, and uses. Students may use the Internet, classroom books, or encyclopedias as resource information to complete this project.

Common Name	Type (Hardwood or Softwood)	Physical Characteristics	Uses

Name: _____

Date: _____

Period: _____

Volume Estimation Sheet for Sawlogs (7.3)

Tree Number	D.B.H.	No. 16 ft Logs	Board Feet	Score
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

TOTAL BOARD FEET IN ONE ACRE _____

Scoring:

4 points for each correct DBH and number of logs

20 points for correct Total Board Feet

2 points to be deducted for each 5% plus or minus from the correct measured volume

Maximum score (10 logs) = 100 points

Name: _____

Date: _____

Period: _____

Doyle Log Rule (Form Class 80) (7.4)

Volume (Board Feet) by Number of 16 Foot Logs

D.B.H.	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5
10	16	20	23	24	26	29	32	35	38
11	24	30	35	38	42	45	48	51	55
12	31	39	47	52	57	60	62	65	59
13	42	53	64	72	80	84	88	91	95
14	52	67	82	93	104	109	114	117	121
15	64	84	104	118	132	141	150	157	165
16	77	101	125	143	161	174	186	196	207
17	92	122	152	175	198	214	230	244	258
18	108	144	179	206	234	254	273	290	308
19	126	168	210	244	278	301	324	345	367
20	144	193	242	282	321	348	374	396	417
21	164	221	278	324	370	403	436	462	489
22	185	250	315	368	420	458	497	529	561
23	208	282	356	417	478	521	564	604	643
24	231	314	397	466	536	583	630	678	725
25	256	350	443	522	600	655	710	764	818
26	282	386	489	576	663	727	791	852	912
27	310	425	540	638	735	806	877	946	1015
28	339	466	592	700	807	885	963	1040	1118
29	370	509	648	766	884	970	1056	1144	1232
30	400	552	703	832	961	1055	1149	1248	1346

Name:	
Date:	
Period:	

Volume Estimation Sheet for Pulpwood (7.5)

Tree Number	D.B.H.	Height	Cords	Score
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

TOTAL CORDAGE IN ONE ACRE

Scoring:

4 points for each correct DBH and height

20 points for correct Total Cordage

2 points to be deducted for each 5% plus or minus from the correct measured volume

Maximum score (10 logs) = 100 points

Name: _____

Date: _____

Period: _____

Volume Estimation Sheet for Pulpwood (7.6)

DBH (Inches)	Height (Feet)								
	8	16	24	32	40	48	54	64	72
	Cords								
6	0.01	0.02							
8	0.02	0.03	0.04	0.05					
10		0.07	0.10	0.12	0.15	0.18	0.21	0.24	
12			0.14	0.18	0.22	0.26	0.30	0.35	
14			0.19	0.24	0.29	0.35	0.41	0.47	
16			0.25	0.31	0.38	0.46	0.54	0.62	0.69
18			0.31	0.40	0.49	0.58	0.69	0.78	0.88
20			0.35	0.43	0.53	0.63	0.75	0.85	0.95
22				0.59	0.73	0.87	1.02	1.16	1.31
24				0.70	0.87	1.03	1.22	1.38	1.56
26				0.83	1.02	1.21	1.43	1.62	1.83

Name: _____

Date: _____

Period: _____

Tree Planting Checklist (7.7)

Place a check by each step or practice that the student performed correctly.

- _____ 1. The student protected the seedlings to be planted from drying out from sun or wind damage.
- _____ 2. The student followed all safety practices in working in the field.
- _____ 3. The student selected the proper spacing for planting the seedling.
- _____ 4. The student used the dibble or shovel to make a planting hole of the correct size and depth.
- _____ 5. The student planted the seedling to the correct depth and checked to make sure that the tap root was pointing straight down (not J-rooted or L-rooted).
- _____ 6. The student used the dibble to close both the bottom and top of the planting hole eliminating any air pockets around the root.
- _____ 7. The student finished closing the hole with his or her shoe heel to create a small indentation at the seedling to collect and hold water.
- _____ 8. The student correctly stored all tools and remaining seedlings after completing the planting task.

Comments:

Name: _____

Date: _____

Period: _____

Fire Prevention Poster Rubric (7.8)

	Exemplary 4 points	Accomplished 3 points	Developing 2 points	Beginning 1 point	Score
Required Content	The poster includes all required content elements as well as additional information.	All required content elements are included on the poster.	All but one of the required content elements are included on the poster.	Several required content elements were missing.	
Labels	All items of importance on the poster are clearly labeled with labels that are easy to read.	Almost all items of importance on the poster are clearly labeled with labels that are easy to read.	Many items of importance on the poster are clearly labeled with labels that are easy to read.	Labels are too small to read, or no important items were labeled.	
Attractiveness	The poster is exceptionally attractive in terms of design, layout, and neatness.	The poster is attractive in terms of design, layout, and neatness.	The poster is acceptably attractive though it may be a bit messy.	The poster is distractingly messy or very poorly designed.	
Grammar	There are no grammatical or mechanical mistakes on the poster.	There are one to two grammatical or mechanical mistakes on the poster.	There are three to four grammatical or mechanical mistakes on the poster.	There are more than four grammatical or mechanical mistakes on the poster.	
Total Score:					

Comments:

Name: _____

Date: _____

Period: _____

Written Report Rubric (8.1)

	Exemplary 4 Points	Accomplished 3 Points	Developing 2 Points	Beginning 1 Point	Score
Content	Clear thesis and focus that remain apparent	Thesis and focus that remain apparent	Addresses subject matter with minimal support	Does not focus on topic	
Grammar	Correct and effective use of grammar and mechanics	Occasional errors in use of grammar and mechanics	Problems in use of grammar and mechanics	Repeated errors in use of grammar and mechanics	
Content	Clear thesis and focus that remain apparent	Thesis and focus that remain apparent	Addresses subject matter with minimal support	Does not focus on topic	
Organization	Ideas flow smoothly and logically with clarity and coherence	Logical order and appropriate sequencing of ideas with adequate transition	Some evidence of an organizational plan or strategy	Lacks organization	
TOTAL					

Name: _____

Date: _____

Period: _____

Poster Assessment Rubric (8.2)

	Exemplary 4 Points	Accomplished 3 Points	Developing 2 Points	Beginning 1 Point	Score
Required Content	The poster includes all required content elements as well as additional information.	All required content elements are included on the poster.	All but one of the required content elements are included on the poster.	Several required content elements were missing.	
Labels	All items of importance on the poster are clearly labeled with labels that are easy to read.	Almost all items of importance on the poster are clearly labeled with labels that are easy to read.	Many items of importance on the poster are clearly labeled with labels that are easy to read.	Labels are too small to read, or no important items were labeled.	
Attractiveness	The poster is exceptionally attractive in terms of design, layout, and neatness.	The poster is attractive in terms of design, layout, and neatness.	The poster is acceptably attractive though it may be a bit messy.	The poster is distractingly messy or very poorly designed.	
Grammar	There are no grammatical or mechanical mistakes on the poster.	There are one to two grammatical or mechanical mistakes on the poster.	There are three to four grammatical or mechanical mistakes on the poster.	There are more than four grammatical or mechanical mistakes on the poster.	
TOTAL					

Comments:

Name: _____

Date: _____

Period: _____

Oral Report Rubric (8.3)

Scoring Criteria				
<i>The student does the following:</i>	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Communicates the main idea or theme				
Organizes the content				
Uses appropriate emphasis to express main points				
Expresses ideas clearly				
Maintains eye contact with the audience				
Maintains poise and body posture				
Displays self-confidence				
Maintains ease before the audience				
Conveys thought and meaning				
Uses appropriate visual aids (if applicable) that are meaningful				
Accomplishes purpose and/or objectives				
Responds to questions with carefully planned answers				

Notes:

Name: _____

Date: _____

Period: _____

Group Work Assessment Rubric (8.4)

	Highly Successful 3 points	Meeting Success 2 points	Experiencing Difficulty 1 point	Score
Sharing	Shared ideas with others	Occasionally shared ideas with others	Seldom shared ideas with others	
Listening	Always listened to peers	Occasionally listened to peers	Ignored ideas of peers	
Respecting	Interacted with, encouraged, and supported ideas of others	Occasionally encouraged and supported others	Seldom encouraged and supported others	
Participating	Shared task equally with group members	Did most of the task	Did very little of the task	
TOTAL				

Comments:

Name: _____

Date: _____

Period: _____

Written Report Rubric (9.1)

	Exemplary 4 Points	Accomplished 3 Points	Developing 2 Points	Beginning 1 Point	Score
Content	Clear thesis and focus that remain apparent	Thesis and focus that remain apparent	Addresses subject matter with minimal support	Does not focus on topic	
Grammar	Correct and effective use of grammar and mechanics	Occasional errors in use of grammar and mechanics	Problems in use of grammar and mechanics	Repeated errors in use of grammar and mechanics	
Content	Clear thesis and focus that remain apparent	Thesis and focus that remain apparent	Addresses subject matter with minimal support	Does not focus on topic	
Organization	Ideas flow smoothly and logically with clarity and coherence	Logical order and appropriate sequencing of ideas with adequate transition	Some evidence of an organizational plan or strategy	Lacks organization	
TOTAL					

Name: _____

Date: _____

Period: _____

Oral Report Rubric (9.2)

Scoring Criteria				
<i>The student does the following:</i>	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Communicates the main idea or theme				
Organizes the content				
Uses appropriate emphasis to express main points				
Expresses ideas clearly				
Maintains eye contact with the audience				
Maintains poise and body posture				
Displays self-confidence				
Maintains ease before the audience				
Conveys thought and meaning				
Uses appropriate visual aids (if applicable) that are meaningful				
Accomplishes purpose and/or objectives				
Responds to questions with carefully planned answers				

Notes:

Name: _____

Date: _____

Period: _____

Environmental and Natural Resources Agencies (9.3)

Name of agency/organization	Major purpose or role
U.S Environmental Protection Agency	
U.S. Occupational Safety and Health Administration	
U.S. Forest Service	
U.S. Natural Resources and Conservation Service	
Mississippi Department of Environmental Quality	
Mississippi Department of Wildlife, Fisheries, and Parks	
Mississippi Forestry Commission	
Nature Conservatory	
Sierra Club	
Mississippi Department of Agriculture and Commerce	
National Wildlife Federation	

Name: _____

Date: _____

Period: _____

Advantages and Disadvantages of Waste Disposal Methods (9.5)

The three most common means of solid waste disposal are listed below. For each method, list the major advantage and the major disadvantage. Also, how can the disadvantage be overcome?

1. LANDFILLS

Advantage:

Disadvantage:

Ways to Overcome:

2. INCINERATION

Advantage:

Disadvantage:

Ways to Overcome:

3. RECYCLING

Advantage:

Disadvantage:

Ways to Overcome:

Name: _____

Date: _____

Period: _____

Recycling Program Rubric (9.6)

Rate the effectiveness of the students' recycling program plan using the following indicators.

Scale:

5 – Very Effective

4 – Effective

3 – Adequate

2 – Minimal

1 – Needs improvement

- _____ 1. The students organized themselves into a team with defined roles and responsibilities for all members.
- _____ 2. The students conducted a recycling audit to determine the types and volume of solid waste being generated at the school.
- _____ 3. The students identified markets for recycled products, taking transportation costs into effect.
- _____ 4. Based on the information found in steps 2 and 3, the students determined which waste products should be collected for recycling.
- _____ 5. The students established a system for collecting, sorting, and storing different types of waste products.
- _____ 6. The students implemented an education program for staff and other students to inform them of the program.
- _____ 7. The students established a reward system to encourage participation in the recycling program.

Comments:

Name: _____

Date: _____

Period: _____

School Composting Plan Rubric (9.7)

Rate the effectiveness of the students' recycling program plan using the following indicators.

Scale:

5 – Very Effective

4 – Effective

3 – Adequate

2 – Minimal

1 – Needs improvement

- _____ 1. The students organized themselves into a team with defined roles and responsibilities for all members.
- _____ 2. The students conducted a composting audit to determine the sources, kinds, and amounts of material to be composted and determined where composted materials could be used.
- _____ 3. The students designed and constructed a composting facility.
- _____ 4. The student established a schedule for collecting materials.
- _____ 5. The students informed staff and other students of the composting program.
- _____ 6. The students established a schedule for turning the compost.
- _____ 7. The students established a reward program for participation in the project.

Comments:

Name: _____

Date: _____

Period: _____

Hazardous Materials Discovery Assignment (9.8)

Your instructor will assign you a common material found in agricultural enterprises that can pose a hazard to your health or the environment. Using the Internet, search for information to answer the following questions.

1. What is the common name of this material?
2. How hazardous is this material to your health?
3. If you accidentally drank or ate some of this material, what should you do?
4. If you accidentally spilled some of this material, what should you do?
5. How should you store this material?
6. If you no longer need this material, how should you dispose of it?

Name: _____

Date: _____

Period: _____

Rubric for Student Electronic Notebook (9.9)

Scoring Criteria				
<i>The student did the following:</i>	Excellent 4	Good 3	Needs Improvement 2	Unacceptable 1
Captured the main ideas from the presentation or lecture in handwritten form				
Accurately transcribed the main ideas into the proper electronic format				
Checked spelling and grammar				
Demonstrated comprehension of the writing process				
Summarized the important points and added personal reflections				

Name: _____

Date: _____

Period: _____

Rubric for PowerPoint Presentation on Landscape Degradation and Defacement (10.1)

CATEGORY	4-Exceptional	3-Admirable	2-Acceptable	1-Amateur	SCORE
Technical Content	Clearly illustrated a local issue related to landscape degradation/defacement and provided specific details related to its causes and possible solutions	Clearly illustrated the local issue and provided general information related to cause and solution	Vaguely illustrated a local issue and provided limited information on cause and solution	Vaguely illustrated a local issue and provided very little or no information on cause or solution	
Organization	Extremely well organized in a logical format that is easy to follow and flows smoothly from one idea to another enhancing the effectiveness of the project	Presented in a thoughtful, organized manner, and most transitions were easy to follow. Only a few ideas were unclear.	Somewhat organized, ideas were not presented coherently, and transitions were not always smooth.	Choppy and confusing; difficult to follow; transitions were abrupt and seriously distracted from theme and purpose.	
Content Accuracy	All content was completely accurate; all facts were precise and explicit.	Content was mostly accurate with only a few inconsistencies or errors in information.	Content was somewhat accurate, but there were more than a few inconsistencies or errors in information.	Content was grossly inaccurate to the point that the facts in this project were misleading to the audience.	
Research	Research on the project went above and beyond expectations. The student solicited material in addition to what was provided and brought in personal ideas and information to enhance project.	The student did a very good job of researching, using materials provided to his or her full potential, and at least one source came from information outside of the school.	The student used at least three references provided by the school in an acceptable manner but did not consult any additional resources.	The student did not use provided resources effectively and did little or no fact gathering on the topic.	
Creativity	The report demonstrated exceptional creativity and originality on the part of the student.	The report was cleverly presented in a thoughtful and interesting manner.	The student did add a few creative touches to enhance the report but mostly reported the information as provided.	The report showed little creativity or originality.	

Name: _____

Date: _____

Period: _____

Rubric for Tropical Rain Forest Paper (10.2)

	Exemplary (4 points)	Accomplished (3 points)	Developing (2 points)	Beginning (1 point)	Score
Content	Thesis and focus provide specific details on the causes and remedies for rainforest destruction.	Thesis and focus provide general details on the causes and remedies for rainforest destruction.	Thesis and focus provide limited details on the causes and remedies for rainforest destruction.	Does not focus on topic	
Grammar	Correct and effective use of grammar and mechanics	Occasional errors in use of grammar and mechanics	Problems in use of grammar and mechanics	Repeated errors in use of grammar and mechanics	
Organization	Ideas flow smoothly and logically with clarity and coherence.	Logical order and appropriate sequencing of ideas with adequate transition	Some evidence of an organizational plan or strategy	Lacks organization	
Total Score:					

Name: _____

Date: _____

Period: _____

Group Participation Rubric (10.3)

	Beginning	Developing	Accomplished	Exemplary	Score
	1 point	2 points	3 points	4 points	
Group Discussions	Rarely contributed to discussions of the group	Contributed good effort to discussions of the group	Contributed great effort to discussions of the group	Contributed exceptional effort to discussions of the group	
On-task Behavior	Exhibited on-task behavior inconsistently	Exhibited on-task behavior some of the time	Exhibited on-task behavior most of the time	Exhibited on-task behavior consistently	
Helping Others	Did not assist other group members	Seldom assisted other group members	Occasionally assisted other group members	Assisted other group members	
Listening	Ignored ideas of group members	Seldom listened to ideas of group members	Occasionally listened to ideas of group members	Always listened to ideas of group members	
					Total Score:

Name: _____

Date: _____

Period: _____

Environmental Plan Rubric (10.4)

	Exemplary 4 Points	Accomplished 3 Points	Developing 2 Points	Beginning 1 Point	Score
Current Conditions	The plan provides specific and detailed data related to local conditions.	The plan provides a general description of local conditions.	The plan provides a limited description of local conditions.	A description is provided but contains errors.	
Problem Statement	The problem statement is stated concisely and accurately reflects the problem.	The problem statement is stated concisely and generally reflects the problem.	The problem statement is wordy and marginally reflects the problem.	The problem statement is poorly written and marginally reflects the problem.	
Goals and Objectives	Stated goals and objectives are specific and measurable.	Stated goals and objectives are general but measurable.	Stated goals are general and vague.	Stated goals and objectives are poorly written and cannot be measured.	
Evaluation	The evaluation statement provides specific details on how the success of the program will be measured.	The evaluation statement provides general details on how the success of the program will be measured.	The evaluation statement provides very limited details on how the success of the program will be measured.	The evaluation statement provides few if any details on how the success of the program will be measured.	
TOTAL					

Appendix B: 21st Century Skills Standards¹

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

CSS1-21st Century Themes

CS1 Global Awareness

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

CS2 Financial, Economic, Business and Entrepreneurial Literacy

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

CS3 Civic Literacy

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

CS4 Health Literacy

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

CS5 Environmental Literacy

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

CSS2-Learning and Innovation Skills

CS6 Creativity and Innovation

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

CS7 Critical Thinking and Problem Solving

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

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

CS8 Communication and Collaboration

1. Communicate Clearly
2. Collaborate with Others

CSS3-Information, Media and Technology Skills

CS9 Information Literacy

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

CS10 Media Literacy

1. Analyze Media
2. Create Media Products

CS11 ICT Literacy

1. Apply Technology Effectively

CSS4-Life and Career Skills

CS12 Flexibility and Adaptability

1. Adapt to change
2. Be Flexible

CS13 Initiative and Self-Direction

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

CS14 Social and Cross-Cultural Skills

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

CS15 Productivity and Accountability

1. Manage Projects
2. Produce Results

CS16 Leadership and Responsibility

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

Appendix C: MS Academic Standards

MISSISSIPPI SCIENCE FRAMEWORK 2010

Marine and Aquatic Science

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

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
 - a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
 - b. Formulate questions that can be answered through research and experimental design. (DOK 3)
 - c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
 - d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
 - e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
 - g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
2. **Develop an understanding of physical and chemical properties of water and aquatic environments.**
 - a. Analyze the physical and chemical properties of water, and justify why it is essential to living organisms. (DOK 1)
 - b. Explain the causes and characteristics of tides. (DOK 1)
 - c. Research, create diagrams, and summarize principles related to waves and current characteristics and formation. (DOK 2)
 - d. Compare and contrast the physical and chemical parameters of dissolved O₂, pH, temperature, salinity, and results obtained through analysis of different water column depths/zones. (DOK 2)
 - e. Investigate the causes and effects of erosion and discuss conclusions. (DOK 2)
 - f. Describe and differentiate among the major geologic features of specific aquatic environments. (DOK 1)
 - Plate tectonics
 - Rise, slope, elevation, and depth
 - Formation of dunes, reefs, barrier/volcanic islands, and coastal/flood plains
 - Watershed formation as it relates to bodies of freshwater
 - g. Compare and contrast the unique abiotic and biotic characteristics of selected aquatic ecosystems. (DOK 2)
 - Barrier island, coral reef, tidal pool, and ocean
 - River, stream, lake, pond, and swamp
 - Bay, sound, estuary, and marsh
3. **Apply an understanding of the diverse organisms found in aquatic environments.**
 - a. Analyze and explain the diversity and interactions among aquatic life. (DOK 3)
 - Adaptations of representative organisms for their aquatic environments

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

Biology I

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

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

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

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

Biology II

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

BIOII 5 Develop an understanding of organism classification.

- 1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
 - a. Use current technologies such as CD-ROM, DVD, Internet, and on-line data search to explore current research related to a specific topic. (DOK 3)
 - b. Clarify research questions and design laboratory investigations. (DOK 3)
 - c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
 - d. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
 - e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
 - f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
 - g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBL's, etc.). (DOK 3)
- 2. Describe and contrast the structures, functions, and chemical processes of the cell.**
 - a. Relate the structure and function of a selectively permeable membrane to its role in diffusion and osmosis. (DOK 2)
 - b. Summarize how cell regulation controls and coordinates cell growth and division. (DOK 2)
 - c. Analyze and describe the function of enzymes in biochemical reactions. (DOK 2)
 - The impact of enzymatic reactions on biochemical processes
 - Factors that affect enzyme function (e.g., pH, concentration, temperature, etc.)
 - d. Differentiate between photosynthesis and cellular respiration. (DOK 2)
 - Cellular sites and major pathways of anaerobic and aerobic respiration (with reactants, products, and ATP per monosaccharide)
 - Cellular respiration with respect to the sites at which they take place, the reactions involved, and the energy input and output in each stage (e.g., glycolysis, Krebs cycle, electron transport chain)
 - Pigments, absorption, reflection of light, and light-dependent and light-independent reactions of photosynthesis
 - Oxidation and reduction reactions
- 3. Investigate and discuss the molecular basis of heredity.**
 - a. Explain how the process of meiosis clarifies the mechanism underlying Mendel's conclusions about segregation and independent assortment on a molecular level. (DOK 1)
 - b. Research and explain how major discoveries led to the determination of DNA structure. (DOK 2)
 - c. Relate gene expression (e.g., replication, transcription, translation) to protein structure and function. (DOK 2)
 - Translation of a messenger RNA strand into a protein
 - Processing by organelles so that the protein is appropriately packaged, labeled, and eventually exported by the cell
 - Messenger RNA codon charts to determine the effects of different types of mutations on amino acid sequence and protein structure (e.g., sickle cell anemia resulting from base substitution mutation)
 - Gene expression regulated in organisms so that specific proteins are synthesized only when they are needed by the cell (e.g., allowing cell specialization)
 - d. Assess the potential implications of DNA technology with respect to its impact on society. (DOK 3)
 - Modern DNA technologies (e.g., polymerase chain reaction (PCR), gene splicing, gel electrophoresis, transformation, recombinant DNA) in agriculture, medicine, and forensics
 - e. Develop a logical argument defending or refuting bioethical issues arising from applications of genetic technology (e.g., the human genome project, cloning, gene therapy, stem cell research). (DOK 3)

- 4. Demonstrate an understanding of the factors that contribute to evolutionary theory and natural selection.**
- 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
 - Provide support for the argument based upon evidence from anatomy, embryology, biochemistry, and paleontology that organisms descended with modification from common ancestry. (DOK 2)
 - Identify and provide supporting evidence for the evolutionary relationships among various organisms using phylogenetic trees and cladograms. (DOK 2)
 - 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)
 - Compare and contrast the basic types of selection (e.g., disruptive, stabilizing, directional, etc.). (DOK 2)
 - Cite examples to justify behaviors that have evolved through natural selection (e.g., migration, parental care, use of tools, etc.). (DOK 1)
 - 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)
 - Develop a logical argument describing ways in which the influences of 20th century science have impacted the development of ideas about evolution (e.g., synthetic theory of evolution, molecular biology). (DOK 3)
 - 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.**
- Classify organisms according to traditional Linnaean classification characteristics (e.g., cell structure, biochemistry, anatomy, fossil record, methods of reproduction) and the cladistic approach. (DOK 2)
 - Categorize organisms according to the characteristics that distinguish them as Bacteria, Archaea, or Eucarya. (DOK 1)
 - Bacteria, fungi, and protists
 - Characteristics of invertebrates (e.g., habitat, reproduction, body plan, locomotion) as related to phyla (e.g., Porifera, Cnidarians, Nematoda, Annelida, Platyhelminthes, and Arthropoda) and classes (e.g., Insecta, Crustacea, Arachnida, Mollusca, Echinodermata)
 - Characteristics of vertebrates (e.g., habitat, reproduction, body plan, locomotion) as related to classes (e.g., Agnatha, Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, Mammalia)
 - Nomenclature of various types of plants (e.g., Bryophyta, Tracheophyta, Gymnospermae, Angiospermae, Monocotyledonae, Dicotyledonae, vascular plants, nonvascular plants)

Botany

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

- 1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
- Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
 - Formulate questions that can be answered through research and experimental design. (DOK 3)

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

- d. Describe the chemical compounds extracted from plants, their economical importance, and the impact on humans. (DOK 3)
- Plant extracts, their function, and origin
 - Impact of the timber industry on local and national economy

Chemistry I

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

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

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

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

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

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

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

Organic Chemistry

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

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
 - a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
 - Safety rules and symbols
 - Proper use and care of the compound light microscope, slides, chemicals, etc.
 - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
 - b. Formulate questions that can be answered through research and experimental design. (DOK 3)
 - c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
 - d. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
 - e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
 - f. Recognize and analyze alternative explanations for experimental results, and make predictions based on observations and prior knowledge. (DOK 3)
 - g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
2. **Demonstrate an understanding of the properties, structure, and function of organic compounds.**
 - a. Apply International Union of Pure and Applied Chemistry (IUPAC) nomenclature, and differentiate the structure of aliphatic, aromatic, and cyclic hydrocarbon compounds. (DOK 1)
 - Structures of hydrocarbon compounds
 - Isomerism in hydrocarbon compounds
 - b. Relate structure to physical and chemical properties of hydrocarbon. (DOK 1)
 - c. Apply principles of geometry and hybridization to organic molecules. (DOK 2)
 - Lewis structures for organic molecules
 - Bond angles
 - Hybridization (as it applies to organic molecules)
 - d. Write, complete, and classify common reactions for aliphatic, aromatic, and cyclic hydrocarbons. (DOK 1)
 - e. Construct, solve, and explain equations representing combustion reactions, substitution reactions, dehydrogenation reactions, and addition reactions. (DOK 2)
 - f. Classify functional groups (e.g., alcohols, ethers, aldehydes, ketones, carboxylic acids, esters, amines, amides, and nitriles) by their structure and properties. (DOK 2)
 - Structural formulas from functional group names and vice versa
 - Chemical and physical properties of compounds containing functional groups

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

Earth and Space Science

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

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

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

2. **Develop an understanding of the history and evolution of the universe and earth.**

- a. Summarize the origin and evolution of the universe. (DOK 2)
 - Big bang theory
 - Microwave background radiation
 - The Hubble constant
 - Evidence of the existence of dark matter and dark energy in the universe and the history of the universe
- b. Differentiate methods used to measure space distances, including astronomical unit, light-year, stellar parallax, Cepheid variables, and the red shift. (DOK 1)

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

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

Environmental Science

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

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

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

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

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

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

Genetics

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

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

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

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

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

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

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

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

Geology

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

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

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

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

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

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

Physical Science

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

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

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

2. Describe and explain how forces affect motion.

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

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

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

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

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

Physics I

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

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

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

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

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

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

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

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

Spatial Information Science

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

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

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

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

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

Zoology

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

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

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

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

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

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

Appendix D: ACT College Readiness Standards

English

E1 Topic Development in Terms of Purpose and Focus

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

E2 Organization, Unity, and Coherence

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

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

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

E4 Sentence Structure and Formation

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

E5 Conventions of Usage

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

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

E6 Conventions of Punctuation

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

Math

M1 Basic Operations and Applications

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

M2 Probability, Statistics, and Data Analysis

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

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

M3 Numbers: Concepts and Properties

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

M4 Expressions, Equations, and Inequalities

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

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

M5 Graphical Representations

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

M6 Properties of Plane Figures

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

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

M7 Measurement

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

M8 Functions

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

Notes

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

Reading

R1 Main Ideas and Author’s Approach

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

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

R2 Supporting Details

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

R3 Sequential, Comparative, and Cause–Effect Relationships

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

R4 Meaning of Words

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

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

R5 Generalizations and Conclusions

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

Science

S1 Interpretation of Data

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

S2 Scientific Investigation

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

S3 Evaluation of Models, Inferences, and Experimental Results

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

Writing

W1 Expressing Judgments

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

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

W2 Focusing on the Topic

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

W3 Developing a Position

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

W4 Organizing Ideas

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

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

W5 Using Language

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

Appendix E: Pathway Content Standards

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

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

AGRIBUSINESS SYSTEMS

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

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

ANIMAL SYSTEMS

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

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

AS.01.01. Evaluate the development and implications of animal origin, domestication, and distribution.

AS.02. Classify, evaluate, select, and manage animals based on anatomical and physiological characteristics.

AS.02.01. Classify animals according to hierarchical taxonomy and agricultural use.

AS.02.02. Apply principles of comparative anatomy and physiology to uses within various animal systems.

AS.02.03. Select animals for specific purposes and maximum performance based on anatomy and physiology.

AS.03. Provide for the proper health care of animals.

AS.03.01. Prescribe and implement a prevention and treatment program for animal diseases, parasites, and other disorders.

AS.03.02. Provide for the biosecurity of agricultural animals and production facilities.

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

AS.04.01. Formulate feed rations to provide for the nutritional needs of animals.

AS.04.02. Prescribe and administer animal feed additives and growth promotants in animal production.

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

AS.05.01. Evaluate the male and female reproductive systems in selecting animals.

AS.05.02. Evaluate animals for breeding readiness and soundness.

AS.05.03. Apply scientific principles in the selection and breeding of animals.

AS.06. Prepare and implement animal handling procedures for the safety of animals, producers and consumers of animal products.

AS.06.01. Demonstrate safe animal handling and management techniques.

AS.06.02. Implement procedures to ensure that animal products are safe.

AS.07. Select animal facilities and equipment that provide for the safe and efficient production, housing, and handling of animals.

AS.07.01. Design animal housing, equipment, and handling facilities for the major systems of animal production.

AS.07.02. Comply with government regulations and safety standards for facilities used in animal production.

AS.08. Analyze environmental factors associated with animal production.

AS.08.01. Reduce the effects of animal production on the environment.

AS.08.02. Evaluate the effects of environmental conditions on animals.

BIOTECHNOLOGY

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

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

ENVIRONMENTAL SERVICE SYSTEMS

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

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

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

FOOD PRODUCTS AND PROCESSING SYSTEMS

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

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

NATURAL RESOURCE SYSTEMS

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

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

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

PLANT SYSTEMS

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

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

POWER, STRUCTURAL AND TECHNICAL SYSTEMS

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

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

Appendix F:

National Educational Technology Standards for Students

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

T1 Creativity and Innovation

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

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

T2 Communication and Collaboration

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

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

T3 Research and Information Fluency

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

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

T4 Critical Thinking, Problem Solving, and Decision Making

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

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

T5 Digital Citizenship

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

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

- c. Demonstrate personal responsibility for lifelong learning.
- d. Exhibit leadership for digital citizenship.

T6 Technology Operations and Concepts

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

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