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Horticulture

Horticulture

Program CIP: 01.0601 – Applied Horticulture/Horticultural Operations, General

Direct inquiries to

Scott Kolle
Instructional Design Specialist
P.O. Drawer DX
Mississippi State, MS 39762
(662) 325-2510
E-mail: scott.kolle@rcu.msstate.edu

Lee James
Program Coordinator for Agriculture
Office of Career Education and Technical Education
Mississippi Department of Education
P.O. Box 771
Jackson, MS 39205
662.285.7306
E-mail:leejjames@yahoo.com

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Career and Technical Education
Mississippi State University
Mississippi State, MS 39762

Betsey Smith, Curriculum Manager
Scott Kolle, Instructional Design Specialist for Agriculture
Jolanda Harris, Instructional Technology Specialist
Kim Harris, Multimedia Specialist
Ashleigh Barbee Murdock, Editor

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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Ms. Rosetta Richards
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Finally, standards in the *Horticulture Curriculum Framework and Supporting Materials* are based on the following:

International Technology Education Association (ITEA) Standards
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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).

Horticulture Executive Summary

Program Description

The secondary pathway in Horticulture prepares individuals for entry-level employment or continuing education in a wide variety of fields in the horticulture industry. Students enrolled in the program participate in a variety of instructional activities including lectures, discussions, laboratory experiences at the school, and work-based learning activities in the field such as field trips and shadowing experiences. Students also receive supplementary instruction and reinforcement of learning through activities in youth organizations. Topics covered in the 2-year program include plant structure and growth; plant propagation; pest management; floristry; greenhouse crops and management; olericulture; plantscaping; landscape design, installation, and management; and turfgrass management. Student competencies and suggested objectives in the curriculum framework have been correlated to the knowledge and skill statements listed in Career Cluster Resources for Agriculture, Food, and Natural Resources, as published by the National Association of State Directors of Career and Technical Education.

Industry Certification

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

Articulation

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

High School Program	Community College Programs	Community College Course
Horticulture (Program CIP: 01.0601 – Applied Horticulture/Horticultural Operations, General)	Horticulture Technology (Program CIP: 01.0601 – Horticulture Service Operations and Management) (Program CIP: 01.0605 – Landscaping) (Program CIP: 01.0607 – Turf Management)	HLT 1411 - Leadership MGT HLT 1213 - Applied Principles of Plan Propagation

Assessment

Students will be assessed using the Horticulture MS-CPAS2 test. If there are questions regarding assessment of this program, please contact the agriculture instructional design specialist at the Research and Curriculum Unit at 662.325.2510.

Student Prerequisites

In order for students to experience success in the Horticulture program, the following prerequisites are recommended:

1. C or Higher in Pre-Algebra

   or
2. TABE Math Computation and TABE Math Applied Score (eighth grade or higher)

   or
3. Instructor Approval

Applied Academic Credit

Content of the Horticulture course has been aligned to the 2010 Mississippi Science Curriculum Framework. Students who complete Horticulture will receive two electives and two science credits or four elective credits that will count toward high school science graduation requirements.

Licensure Requirements

The 991 licensure endorsement is needed to teach the Horticulture program. The requirements for the 991 licensure endorsement are listed below:

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

Note: If the applicant meets all requirements listed above, that applicant will be issued a 991 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 https://cia.rcu.msstate.edu/pl/. 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

Program CIP Code: 01.0601

This curriculum framework is divided into four one-Carnegie-unit courses as outlined below. The first two courses are comprised of units from Horticulture Year 1. The last two courses are comprised of units from Horticulture Year 2.

Option 1 – Four One-Carnegie-Unit Courses

Course Description: Introduction to Horticulture teaches students about horticulture orientation and leadership development. Students are also introduced to basic plant and soil science (Plant Structure and Growth). This course also focuses on horticulture structures.

Course Description: Horticulture Plant Processes focuses on plant propagation, principles of pest management greenhouse crops, and olericulture production.

Course Description: Horticulture Nursery is a comprehensive course that reviews leadership, careers, and safety. It also introduces students to nursery and landscape plant identification horticulture marketing and business procedures container and field crop production.

Course Description: Horticulture Landscape and Turfgrass covers the concepts of landscape design, installation, construction, and maintenance. Students will also learn skills and knowledge associated with turfgrass installation and maintenance, pomology production, basic principles of floristry.

Introduction to Horticulture (Course Code: 991402)

Unit		Title	Hours
1		Horticulture Orientation and Leadership Development	17.5
2		Basic Plant and Soil Science (Plant Structure and Growth)	67.5
3		Horticulture Structures	20.0
			105

Horticulture Plant Processes (Course Code: 991403)

Unit		Title	Hours
4		Plant Propagation	33.0
5		Principles of Pest Management	28.0
6		Greenhouse Crops and Olericulture Production	44.0
			105

Horticulture Nursery (Course Code: 991404)

Unit		Title	Hours
7		Leadership, Careers, and Safety	25.0
8		Nursery and Landscape Plant Identification	25.0
9		Horticulture Marketing and Business Procedures	27.5
10		Container and Field Crop Production	27.5
			105

Horticulture Landscape and Turfgrass (Course Code: 991405)

Unit		Title	Hours
11		Landscape Design, Installation, Construction, and Maintenance	67.5
12		Turfgrass Installation and Maintenance	15.0
13		Pomology Production	10.0
14		Basic Principles of Floristry	22.5
			115

Program CIP Code: 01.0601

This curriculum framework is divided into four one-Carnegie-unit courses as outlined below. The first two courses are comprised of units from Horticulture Year 1. The last two courses are comprised of units from Horticulture Year 2.

Horticulture I (Two Carnegie Unit) - Course Code: 991400

Unit		Title	Hours
1		Horticulture Orientation and Leadership Development	17.5
2		Basic Plant and Soil Science (Plant Structure and Growth)	67.5
3		Horticulture Structures	20.0
4		Plant Propagation	33.0
5		Principles of Pest Management	28.0
6		Greenhouse Crops and Olericulture Production	44.0
			210

Horticulture II (Two Carnegie Unit) - Course Code: 991401

Unit		Title	Hours
7		Leadership, Careers, and Safety	25.0
8		Nursery and Landscape Plant Identification	25.0
9		Horticulture Marketing and Business Procedures	27.5
10		Container and Field Crop Production	27.5
11		Landscape Design, Installation, Construction, and Maintenance	67.5
12		Turfgrass Installation and Maintenance	15.0
13		Pomology Production	10.0
14		Basic Principles of Floristry	22.5
			220

Research Synopsis

Articles, books, Web sites, and other materials listed at the end of each course were considered during the revision process. The American Horticulture Society was especially useful in providing insight into trends and issues in the field. These references are suggested for use by instructors and students during the study of the topics outlined.

Industry advisory team members from colleges throughout the state were asked to give input related to changes to be made to the curriculum framework. Instructors from colleges throughout the state were also asked to give input on changes to be made to the curriculum framework. Specific comments related to this program included statements from Advisory Committee members including this is a good program that covers the needs of industry. Changes suggested for the curriculum included provide math skills necessary to complete the work and stress employability skills.

Needs of the Future Workforce

Horticulture occupations are projected to grow much faster than average in Mississippi, 30% and faster than average in The United States, 20 % (EMSI, 2011). Job opportunities are expected to be good. Opportunities vary based on the season and local conditions. Non-seasonal employment opportunities will be most abundant in regions with temperate climates where horticultural services are in demand year-round. Job opportunities will emerge and the industry grows and workers leave the industry (US Bureau of Labor Statistics, 2010).

Region	2010 Jobs	2020 Jobs	Change	% Change	Openings	2010 Median Hourly Earnings
Regional Total	11,112	14,421	3,309	30%	4,623	$9.37
National Total	1,332,032	1,604,464	272,432	20%	434,196	$10.76

Source: EMSI Complete Employment - 1st Quarter 2011

Curriculum

The following national standards were referenced in each course of the curriculum:

- CTB/McGraw-Hill LLC *Tests of Adult Basic Education, forms 9 and 10* Academic Standards
- *21st Century Skills*

Industry and instructor comments, along with current research, were considered by the curriculum revision team during the revision process; changes were made as needed and appropriate. Many of the skills and topics noted in the research were already included in the curriculum framework. Specific changes made to the curriculum at the August 24–25, 2010, curriculum revision meeting included:

- Competencies and objectives were reviewed to ensure accuracy and appropriateness.
- The Recommended Tools and Equipment list was reviewed.

Assessment

Students will be assessed using the secondary *Horticulture MS-CPAS2 Test*.

Professional Learning

It is suggested that instructors participate in professional learning related to the following concepts:

- Computer skills for college credit – To learn more about computer skills instruction such as keyboarding, word processing, PowerPoint, and so forth, please go to http://msvcc.blackboard.com/webapps/portal/frameset.jsp.
- Computer skills for CEU credit – To learn more about computer skills instruction such as keyboarding, word processing, PowerPoint, and so forth, please go to https://cia.rcu.msstate.edu/OnlinePD/.
- Keyboarding skills – To learn to keyboard, please go to http://www.learn2type.com/ for a free typing tutor.
- Blackboard training – To learn more about Blackboard training, please go to https://cia.rcu.msstate.edu/OnlinePD/.
- For the latest in online and yearly *Connect* training provided by the RCU, please go to http://info.rcu.msstate.edu/.

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

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

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

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

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

Horticulture

Unit 1: Horticulture Orientation and Leadership Development

Competency 1: Identify school and program policies and procedures related to the horticulture program. (DOK 1)

Suggested Enduring Understandings

1. Safety is an integral part of daily life.
2. Rules and regulations are essential to a safe work environment.

Suggested Essential Questions

1. What would happen if there were no rules and regulations?
2. How would people function without rules and regulations?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe local program and vocational–career technical center policies and procedures including dress code, attendance, academic requirements, discipline, and the school technology acceptable use policy and horticulture regulations. (DOK 1)	a. Divide students into two groups. Assign one of the following scenarios to each group. Have groups present a role-play for their assigned scenarios. • Imagine a school or business without rules. What would a normal day be like? What would a normal class be like? How productive would your day be? • Imagine a school or business that has created a rule and a procedure for everything. What would a normal day be like? What would a normal class be like? How productive would your day be? CLS5 T1 T2 T3T5 T6 E1 E2 E6 M1 M M6 M7 M8 R12 S3 W5 Review all of the local program policies, including dress code, attendance, academic requirements, discipline, and the technology acceptable use policy using the presentation station. Post all of these documents on the classroom bulletin board.	a. After the role-play, students will ask questions and discuss the answers. Evaluate the role-play using the Role-Play or Skit Rubric for Shop/Lab Safety Activity (1.1).
b. Describe basic employee responsibilities and how to communicate effectively in on-the-job situations. Identify and apply the practices that affect employer and employee decision making as it relates to identifying and applying appropriate algebraic formulas to	b. Have students use the Internet and other classroom resources to research employment opportunities, educational opportunities, and working conditions in the horticulture industry. Have students role-play a given situation. Have students choose to be a technician, manager, customer, or parts specialist. Have students interact with each other in a variety of situations related to the workplace (i.e., practices that affect employer and employee decision making as it relates to identifying and applying appropriate algebraic formulas to personal finance situations, linear programming to business decisions, and	b. Evaluate the skit using the Role-Play or Skit Rubric for Employment Skills (1.2).

personal finance situations, linear programming to business decisions, and algebraic formulas to personal and business investments. (DOK 2)	algebraic formulas to personal and business investments). After each skit, the class will discuss the situations, the pros and cons of each, and how each will relate to a successful business. CLS1 T3 T4 E4 E5 E6 R5 S1 W2 W5	

Competency 2: Demonstrate basic and fundamental safety practices related to horticulture enterprises. (DOK 1)

Suggested Enduring Understandings

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

Suggested Essential Questions

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

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify hazards that may be found in horticulture operations, laboratory, and activities such as poisons and other chemicals, sunburn, ladders and scaffolds, electrical shock, fire, poisonous insects and snakes, equipment and tool hazards, spills and slipping. (DOK 1) BOI BIOII BIOI	a. Take students on a tour of the horticulture laboratory, and point out hazards and hazardous materials present. Discuss the use of colors and signal words for recognizing hazards. Stress that awareness of hazards is a key element in the prevention of accidents and injuries. After a classroom discussion, have students record facts in their electronic journals. CLS4 CLS5 T1 T2 E3 M1 M2 R1 R2 R5 W3 W5	a. Teacher observation of student participation in discussions and activities. Evaluate the electronic journal activity using the Journal Rubric (1.3).
b. Identify and demonstrate the use of personal protection devices including eye	b. Identify and demonstrate/discuss the use of personal protection equipment and when the use of such equipment is necessary. Students will use each device in a role-play. CLS1 E1 E5 E6 M4 R1 R2 S1 S2 S3 W1	b. Evaluate the role-play activity using the Role-Play or Skit Rubric for Shop/Lab

protection, hearing protection, foot protection, respiratory protection, clothing, and body protection, general safety equipment in horticulture operations including fire extinguishers, eyewash and shower stations, and first-aid kits. (DOK 1) BOI BIOII BIOI		Safety Activity. (1.1). Required written tests will follow each section of guidelines for safety rules and procedures. When applicable, use the assessment tools found in the Blackboard Learning System. Monitor student participation, and grade the safety exam. The student must achieve 100% accuracy. Print and place in the student's file.

Competency 3: Develop life and career skills for success in the 21st century. (DOK 3)

Suggested Enduring Understandings

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

Suggested Essential Questions

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

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify, describe, and apply essential life and career skills. (DOK 3)	a. Provide students with the listing of *21st Century Life and Career Skills (1.4)* found in this unit. Lead students in a discussion of how these skills apply to their current careers as students and will apply to their career success after school. Provide students with a copy of the rubric that will be used to evaluate each student's demonstration of life and career skills. Have students self-evaluate their current scores on this rubric and explain that they will be periodically (at least once a grading period) be graded on their ability to demonstrate these skills. CLS1 T2 T3 T4 T5 E5 E6 M1 M2 M3 M4 W4 W5	a. Use 21st Century Life and Career Skills Rubric (1.4) for assessing student ability to demonstrate the essential life and career skills.
b. Apply the concepts of team-building and team member participation. (DOK 3)	b. Lead a classroom discussion on the basic concepts of team building and team member participation. Explain to the students that they will be working in pairs or on teams in many of the activities related to the horticulture program. Provide students with a copy of the rubric that will be used periodically to evaluate their team-	b. Use the Rubric for Assessing Team Building and Participation Skills (1.5) to periodically evaluate the team-building and

			building and participation skills. CLS1 T1 T2 T3 T4 T5 T6 E1 E2 E3 M1 M2 M3 M4 R2 R3 W2 W3		participation skills of all students.
c.	Demonstrate basic parliamentary procedures. (DOK 3)	c.	Ask students to identify situations in which they have seen parliamentary procedure used, and have them describe their experiences. Identify the purpose and form for a main motion, an amendment, and a privileged motion. Have students practice these steps in small groups and during FFA chapter and committee meetings. CLS1 CLS2 T1 T2 T3 E5 E6 M1 M2 M3 R1 R2 R3 R4 R5 W4 W5	c.	Use the Scorecard for Assessing Parliamentary Procedures Skills (1.6) to evaluate parliamentary procedure skills of students.

Competency 4: Explore the role of the FFA in promoting leadership, personal development, and human relations skills. (DOK 1)

Suggested Enduring Understandings

1. The FFA is an integral part of the horticulture program, promoting leadership, human relations, and technical skill attainment and providing recognition for accomplishments.
2. In addition to the technical skills required to obtain a job, people need essential life and career skills to succeed in a career including leadership, team-building, and human relations skills and work ethics and values.

Suggested Essential Questions

1. What is the role of the FFA in the horticulture program?
2. What are the necessary life and career skills for success in the modern world?

Suggested Performance Indicators		Suggested Teaching Strategies		Suggested Assessment Strategies	
a.	Explore the history and nature of the FFA in promoting and developing leadership, personal development, and human relations skills. (DOK 3)	a.	Using the history of the FFA, the FFA creed, the FFA opening and closing ceremony, and other FFA activities, identify and discuss with the students the role of the organization in developing leadership, personal development, and human relations skills. CLS1 CLS2 CLS3 CLS4 CLS5 T1 T2 T3 T4 T5 T6 E1 E2 E3 E4 E5 E6 M1 M2 M3 M4 M5 M6 M7 M8 R1 R2 R3 R4 R5 S1 S2 S3 W1 W2 W3 W4 W5	a.	Monitor discussion to ensure that all students are participating and attentive.
b.	Identify career-related values and ethics promoted through the FFA. (DOK 1)	b.	Have students read the FFA creed and complete an assignment to identify and describe in their own words the values and ethics represented in the creed. Have students share and critique their completed assignments. Hold a class discussion to identify key values and ethics promoted through the FFA. Have students record these values and ethics in their electronic journals. CLS1 T1 E5 M5	b.	Evaluate the summaries in the electronic journals for completeness and accuracy.
c.	Identify benefits of FFA membership. (DOK 1)	c.	Have an officer of the local FFA chapter speak to the class on the benefits of membership. Have the students take notes on the presentation. Following the presentation, lead a class discussion to identify and summarize the benefits. Have students transcribe the findings into their electronic notebooks or journals. CLS1 T1 E6 M1 M6 S2 S3 W4 W5	c.	Evaluate the students' electronic notebooks or journals for completeness and accuracy.
d.	Select FFA activities	d.	Have students search the FFA Web site	d.	Have students peer

that promote personal development and leadership skills. (DOK 3)	(http://www.ffa.org) and identify and describe an activity or program in which they would like to participate. Have students continue their research to learn what skills and knowledge they must master to participate. Have students complete an assignment on selecting personal development and leadership activities. CLS1 CLS5 T1 T2 T3 T4 T5 T6 E1 M2 M3 R4 W4 W5	review and comment on the completed attachment, Select a Personal/ Leadership Activity Assignment (1.7*).*

Competency 5: Examine the concept of leadership. (DOK 3)

Suggested Enduring Understandings

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

Suggested Essential Questions

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

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Explain the role of effective leadership. (DOK 3)	a. Have students name people in their lives that they perceive as leaders and describe ways in which these people exhibit leadership. From this discussion, draw out a definition of leadership and the characteristics of leaders. Have students write a summary of findings in their own words and transcribe into their electronic journals or notebooks. CLS1 T1 E2 E6 M1 R1 S3 W5	a. Evaluate electronic journals or notebooks for completeness and accuracy.
b. Have students self-evaluate their personal leadership traits and develop a plan for improvement. (DOK 2)	b. Provide the students with a survey instrument that lists major traits and characteristics of successful leaders. (See the *Leadership Characteristics Survey [1.8]*.) Define and discuss these traits and characteristics. Have students rate their ability to exhibit these characteristics and identify three that they will work on improving over the course of the school year. CLS2 T1 T2 E1 M2 M8 R1 R2 R3 R4 W1	b. Have students peer review other students' surveys and offer comments and recommendations on improvement practices. (See the Leadership Characteristics Survey 1.8.)

Competency 6: Describe the role of work ethics and values in establishing and building a successful career. (DOK 3)

Suggested Enduring Understandings

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

Suggested Essential Questions

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

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Define and describe universally accepted	a. Invite a human resources person from a local industry or business to speak to the class regarding	a. Evaluate electronic notebooks/

	work ethics and values as applied to horticulture careers. (DOK 1)		the importance of universally accepted work ethics such as attendance, promptness, responsibility, trustworthiness, loyalty, and so forth. Have students summarize the key points from the presentation and transcribe into their electronic notebooks or journals. CLS2 T1 T2 E1 M2 M8 R1 R2 R3 R4 W1		journals for accuracy and completeness.
b.	Practice work ethics and values in the horticulture classroom and lab. (DOK 2)	b.	Students will be evaluated on their practice of work ethics and values periodically through the activities and assignments made in the remainder of the course. CLS2 T1 T2 E1 M2 M8 R1 R2 R3 R4 W1	b.	Use the Sample Rubric for Evaluating Work Ethics and Values (1.9) to evaluate student work ethics and values periodically, or add indicators of work ethics and values to other rubrics used in the course.

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PS.04. Employ elements of design to enhance an environment.

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Unit 2: Basic Plant and Soil Science (Plant Structure and Growth)

Competency 1: Explore plant structure and their functions. (DOK2) PS.01 PS.02 PS.03 PS.04

Suggested Enduring Understandings

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

Suggested Essential Questions

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

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Draw a diagram of a flowering plant, and label and describe the major parts (roots, stems, leaves, and flowers) and functions as related to plant growth (cell division, cell elongation, and cell differentiation). (DOK 1) BOI BIOII BIOI	a. Have the students prepare a chart showing the major parts of a flowering plant and describe each part's structure and function. Have students scan their charts and enter into their electronic journals. CLS2 T1 T2 E1 M1 M2	a. Use the Rubric for Evaluating Student Chart of Plant Parts and Functions (2.1) to evaluate the students' charts.
b. Describe the process of respiration, photosynthesis, and transpiration. (DOK 1) BOI BIOII BIOI	b. Have students prepare a chart showing the steps in the photosynthesis, respiration, and transpiration processes including the relationship and differences of each process to the others. (See Chart for Comparing Photosynthesis, Respiration, and Transpiration [2.2].) CLS2 T1 T2 E1 M1 M2	b. Evaluate charts for accuracy and completeness. (See Chart for Comparing Photosynthesis, Respiration, and Transpiration [2.2].)
c. Describe the relationship of environmental and cultural factors to plant growth (water, light, temperature, soil, climatic zones). (DOK 2) BOI BIOII BIOI	c. Have students write a short essay on the relationship of environmental and cultural factors to plant growth. CLS2 T1 T2 E1 M1 M2	c. Evaluate the students' essays for accuracy and completeness.

Competency 2: Apply systems of plant classification. (DOK 2) PS.01 PS.02 PS.03 PS.04

Suggested Enduring Understandings

1. The scientific classification system was developed to allow scientists to have a universally recognized name for a plant and to classify plants according to their characteristics.
2. Types of plants are grouped together according to their characteristics.
3. Through biotechnology, plant breeders develop new varieties that offer genetic characteristics of disease and insect resistance, drought tolerance, higher yields, and different color flowers to farmers and consumers.
4. Annuals, biennials, and perennials are three common life cycles of plants.
5. There are some types of plants that thrive better when produced in a controlled environment. This type of growing environment is beneficial to growers producing these plants in a mass production system.
6. Some of these types of plants that do better in a controlled environment are bedding and seasonal potted plants. Bedding plants are typically installed with other plants for visual appeal in a landscaping design.

Suggested Essential Questions

1. Why do we classify plants?
2. What plant characteristics are commonly used to identifying plants?
3. Why is variety selection important?
4. What are the differences in the three common life cycles of plants?
5. What are the reasons plants should be produced in a controlled environment?
6. What are some common types of bedding and seasonal potted plants?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Interpret the scientific classification of plants. (DOK 1) BOI BIOII BIOI	a. Show students a picture of a common plant that is grown across the world (i.e., corn). Ask students to name the plant (using a common name). Point out that this plant may have an entirely different common name in China or England. To allow people across the world to identify and describe using a universal name, the scientific classification system has been developed and accepted. Review the nomenclature of the scientific classification system beginning with kingdom and going through species. Tour campus and/or greenhouse on a weekly basis, and introduce students to the classification of a new plant each week. The students will be responsible for verbally identifying the scientific name of each plant during that week. Give each student an index card, and ask him or her to write down the name of his or her favorite plant and write down or draw sketches of 2–5 characteristics of the plant. To help students choose, the teacher could provide resources such as textbooks, seed catalogs, seed company Web sites, and/or the USDA plant database Web site. Using information from the USDA NRCS plant database Web site (http://plants.usda.gov/), have students create a poster that includes scientific	a. Use the Classification Poster Rubric (2.3) to evaluate student mastery.

			classification of their favorite plant. Make the poster assignment a competition with rewards for winners. CLS4 T1 T3 E1 E2 M1 M5 R5 S1 W1 W5		
b.	Discuss variety and variety selection of various plants. (DOK 2) BOI BIOII BIOI	b.	Divide students into pairs, and assign each student an agronomic or horticultural crop. Have students search the Mississippi State University Extension Service Web site for variety recommendations and compile a list of different factors that must be considered in selecting a variety (yield, color, insect, disease, and drought resistance, response to day length, etc.). Bring the students back into a large group, and use PowerPoint or the White Board to compile a list of common characteristics used in selecting a specific variety. Have students include the listing in their electronic notebooks. CLS4 T1 T3 E1 E2 M1 M5 R5 S1 W1 W5	b.	Use the Daily Participation Rubric (2.4) to evaluate student participation in the discussion.
c.	Classify plants according to life cycle. (DOK 1) BOI BIOII BIOI	c.	Review the three different life cycles of plants. Provide students Annual, Biennial, or Perennial (2.5) assignment, and have students conduct a search on the Internet to determine the life cycle of each plant. CLS4 T1 T3 E1 E2 M1 M5 R5 S1 W1 W5	c.	Evaluate Annual, Biennial, or Perennial (2.5) assignment for accuracy and completeness.

Competency 3: Describe and apply principles of plant growth media. (DOK 2) PS.01 PS.02 PS.03 PS.04

Suggested Enduring Understandings

1. Essential nutritional elements are needed for plant growth.
2. If a plant does not receive the proper nutrition, it will not grow or produce satisfactorily.
3. Soil pH plays a large role in the availability of plant nutrients.
4. When soil pH is above or below the plants preferred range, nutrients become unavailable, and plants do not grow or produce satisfactory.

Suggested Essential Questions

1. What is the difference between macronutrients and micronutrients?
2. What are some of the common symptoms of nutrient deficiencies in plants?
3. What happens when too much fertilizer is applied?
4. Why is soil sampling technique important?
5. What range of soil pH are nutrients most available?
6. How do growers adjust pH of soil?

Suggested Performance Indicators		Suggested Teaching Strategies		Suggested Assessment Strategies	
a.	Identify and compare the components of natural soil and soil-less mix. List and explain the characteristics each one imparts to the root medium. (DOK 2) ORGC I BOI BIOII BIOI	a.	Divide students into groups, and have them research the advantages and disadvantages of soil/soil-less mixes. Have groups debate different mixes. CLS4 T1 T3 E1 E2 M1 M5 R5 S1 W1 W5	a.	Evaluate the debate using the Debate Rubric (2.6).
b.	Prepare a growing media to	b.	Have students discuss what they already know about soil/soil-less mixes. Have students work as a class to	b.	Have students evaluate other's KWL (2.7)

	specifications, or identify the components and proportions in a commercially prepared root medium, and discuss/explain the advantages of a commercial root medium over media containing natural soil. (DOK 2) ORGC I BOI BIOII BIOI	complete a KWL Chart. (See also the KWL Chart: Teacher Instructions at the end of this unit.) In the "K" column, have students list information they currently know about soil/soil-less mixes. In the "W" column, have students brainstorm a list of things they want to learn about soil/soil-less mixes. Have students work in groups or as individuals to interview industry members to find answers to their "W" list. Have students return to the KWL chart and list everything they learned from the interviews in the "L" column. CLS1 T1 E1 M8 R3 R4 R5 W3 W5	projects and presentations for content. Monitor student activity, and evaluate the KWL project for content, clarity, and length. Revisit the KWL Chart after practice in the lab to see what areas still need to be addressed in instruction.
c.	Identify macronutrients and micronutrients and their effects on plant growth. (DOK 2) CHI BOI BIOII BIOI	c. Project the periodic chart (http://www.chemicool.com/) on the board, and ask students if they remember what certain elements stood for. Show students a bag of fertilizer, and discuss label information. Write elemental symbols on board, and let students make up an analogy to help them remember the content. Allow students to choose a plant nutrient to conduct Internet search on and develop a PowerPoint presentation that covers nutrient functions in the plant, excess and deficiencies symptoms, and pH influence. CLS1 T1 E1 M8 R3 R4 R5 W3 W5	c. Use the Plant Nutrition PowerPoint Presentation Rubric (2.8) to evaluate student mastery.
d.	Describe the effect of excesses and deficiencies. (DOK 2) BOI BIOII BIOI	d. Discuss effects of soluble salt buildup, remedies; show an example of soluble salt buildup at the bottom of a potted plant. Working in groups, design and conduct a nutrient experiment in which results will show deficiency and excesses symptoms. Have students record procedure, data, and conclusion. CLS1 T1 E1 M8 R3 R4 R5 W3 W5	d. Use the Nutrient Deficiencies and Excesses Experiment Rubric (2.9) to evaluate student mastery.
e.	Demonstrate the proper procedure for taking a soil sample. (DOK 1) BOI BIOII BIOI	e. Have students review *Soil Testing for the Farmer* (http://msucares.com/pubs/infosheets/is0346.pdf) from the Mississippi Cooperative Extension Service and lead a discussion on the "do's and don'ts" of soil sampling. Using soil probe and bucket, demonstrate soil sampling techniques on school campus. CLS1 T1 E1 M8 R3 R4 R5 W3 W5	*e.* Use the Daily Participation Checklist (2.10) to evaluate student mastery.
f.	Predict the effect various pH levels will have on plant nutrition and growth. (DOK 2) BOI BIOII BIOI	f. Discuss pH effect on nutrient availability. Using the soil sample taken from campus, demonstrate procedures for pH analysis using proper lab safety procedures. Discuss the effect, if any, pH would have on nutrient availability. Have students add pH effects to their plant nutrient PowerPoint presentation. CLS2 E3 E4 M2 M3 M6 R1 S2 S3 W5	f. Use the Plant Nutrition PowerPoint Presentation Rubric (2.8) to evaluate student mastery.
g.	Analyze a soil sample for nutrient deficiencies by using the scientific method. (DOK 2) BOI BIOII BIOI	g. Place students in three groups. Have at least one student in each group provide soil samples of sand, silt, and clay and discuss properties of each soil type. Have each group analyze a soil sample for pH and nutrient deficiencies and complete the *Soil Report*	g. Evaluate Soil Report Summary (2.11) for accuracy and completeness.

			Summary (2.11). CLS2 E3 E4 M2 M3 M6 R1 S2 S3 W5		
h.	Calculate fertilizer application rates to meet nutritional requirements for a specific crop. (DOK 2) BOI BIOII BIOI	h.	Discuss and demonstrate the procedure for calculating fertilizer application rates based on soil test recommendations and fertilizer analysis. Provide students with the *Fertilizer Calculation Worksheet (2.12)*, and have them complete it in class. CLS2 E3 E4 M2 M3 M6 R1 S2 S3 W5	h.	Evaluate Fertilizer Calculation worksheet (2.12) for accuracy and completeness.
i.	Select fertilizer application methods for different plant enterprises. (DOK 1) BOI BIOII BIOI	i.	Using the University of California – Davis PowerPoint presentation *Fertilizer Applications*, discuss the different methods and timings in applying fertilizers to different crops. Have students research fertilizer application methods for different plant. Have students exchange findings and critique and compare content. Have students present findings to the class. CLS2 E3 E4 M2 M3 M6 R1 S2 S3 W5	i.	Evaluate presentation using the Presentation Assessment Rubric (2.13). The presentation should be loaded into the student's Blackboard E-Portfolio for future reference of skill attainment.

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Unit 3: Horticulture Structures

Competency 1: Describe the characteristics and features of different types of greenhouses. (DOK 3) PS.01 PS.02 PS.03 PS.04

Suggested Enduring Understandings

1. Greenhouses and other structures are used by horticulturists to extend the growing season and to grow plants that would not normally be grown in the prevailing climate. There are several different types of commercial greenhouses in use today, and selection of a greenhouse type is based on crops to be grown and construction and maintenance costs.
2. Shade cloths are used to protect plants from strong sunlight and wind exposure.
3. While glass was used in the past, most greenhouses today are covered with polycarbonate, polyethylene, or fiberglass materials because of the economical cost of the material and the ease of installation.
4. For optimum plant growth, the greenhouse environment must be controlled to provide the proper temperature, light, humidity, and water level for the plants.
5. Light is essential for plant growth and must be monitored and controlled for intensity, color, and duration. Blue wavelengths affect photosynthesis, and red wavelengths affect flowering and reproduction.

Suggested Essential Questions

1. What is the purpose of a greenhouse?
2. What are the advantages and disadvantages of the different types of greenhouses?
3. Why is shade necessary for some plants?
4. How do you select a covering for a greenhouse?
5. What controls and equipment are used to control the environment within a greenhouse?
6. What factors must be considered in providing light for a greenhouse?
7. What factors must be considered in controlling temperature within a greenhouse?
8. How is plant watering managed in greenhouses?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify and compare the greenhouse structures and coverings and auxiliary (shade house, hot beds, and cold frame) types: Quonset, ridge and furrow, even span, and shade houses. (DOK 2) BOI BIOII BIOI	a. Organize a tour activity using Horticulture greenhouse. Identify the different components, controls, and systems that will be covered in this unit. Assign some students to develop a PowerPoint presentation on the different types of greenhouses, their characteristics, and advantages/disadvantages. Assign other students a topic related to the different types of structures and environmental controls used in these structures, and have them develop and present a PowerPoint presentation. See the Structure and Control Systems Presentation and Rubric (3.1) for more instructions for PowerPoint development and presentation criteria. Topics can be assigned to individual	a. Use the Structure and Control Systems Presentation and Rubric (3.1) to evaluate student mastery.

			students or groups, depending on class size. Have students assigned the topics related to different types of greenhouses and make their presentations to the class. Following each presentation, hold a class discussion to make sure that all key points related to the topic have been covered. Have students summarize the key points from the presentation and place in their electronic journals or notebooks. CLS1 T12E1 M1 R1 W1		
b.	Describe the environmental controls including humidistat, thermostat, cooling, watering, and heating. (DOK 2) BOI BIOII BIOI	b.	For this indicator, have students who developed PowerPoint presentations on different systems for heating, cooling, and controlling humidity and watering make their presentations to the class. Following the presentation, hold a class discussion to make sure that all key points have been covered. Have all students summarize the key points in the presentation and record in their electronic journals or notebooks. CLS1 T12E1 M1 R1 W1	b.	Use the Structure and Control Systems Presentation and Rubric (3.1) to evaluate student performance.
c.	Describe the importance of light in plant growth. (DOK 1) BOI BIOII BIOI	c.	Give each student a copy of NASA Predicts Non-Green Plants on Other Planets, and refer to Appendix 6C. Have them review the article and highlight what they consider the top three important points of the article. Throw a ball around to call on students to list their three important points. Keep a tally of how many students listed the same points. Review article contents with the class to make sure that all key points are covered. Have students read out loud about the effects of light colors, duration, and intensity needed for plant growth. CLS1 CLS2 CLS3 T1 T5 T6 E1 E6 M1 R1 R2 R3 R4 W1	c.	Use the Daily Participation Rubric (2.4) to evaluate student participation and understanding.
d.	Discuss water, fertigation, and chemigation management in growing plants. (DOK 2) BOI BIOII BIOI	d.	Have students read out loud about the water needs of plants. Discuss water, fertigation, chemigation management of plants to be maintained including greenhouse, nursery, campus landscape, and interior school plants. In groups of two, have students maintain water, fertigation, chemigation regime for plants and record data using the Plant Water/Fertigation/Chemigation Management Data Sheet (3.3). Challenge Activity: This assignment can be rotated among classmates with students training each other about water/fertigation/chemigation	d.	Evaluate the Plant Water/Fertigation/Chemigation Management Data Sheet (3.2) to determine student understanding.

			requirements. CLS1 CLS5 E1 E2 E3 E4 M2 W5		
e.	Identify and describe factors to consider in establishing a floor plan for a greenhouse including sanitation, benching, flooring, potting facilities, chemical and dry storage, and traffic patterns. (DOK 2) BOI BIOII BIOI	e.	Review the text, Internet, manuals, and handouts regarding establishing a floor plan for a greenhouse including sanitation, benching, flooring, potting facilities, chemical and dry storage, and traffic patterns. Divide the students into groups, and have them develop a multimedia presentation regarding the information and present their findings to the class. Allow students to discuss their findings. Have students record findings in their electronic journals using a Blog or a word processing program. Have students use the writing process to summarize their information. CLS1 CLS5 E1 E2 E3 E4 M2 W5	e.	Evaluate the journal activity using the Journal Rubric (1.3).

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Unit 4: Plant Propagation

Competency 1: Distinguish between sexual and asexual reproduction. (DOK 2) PS.01 PS.02 PS.03 PS.04

Suggested Enduring Understandings

1. Plants reproduce sexually by producing seed that contains a plant embryo and plant food surrounded by a seed wall.
2. The rate of germination is dependent on a number of factors including type of seed, quality of seed, seed treatment, temperature and light conditions, and moisture.
3. Asexual reproduction involves the reproduction of plants through the use of plant parts (roots, cuttings, explants, etc.). Asexual reproduction produces a plant that is genetically identical to the parent plant.
4. Traditional methods of plant propagation include cuttings, grafting, layering, separation, and division.
5. A newer, highly technical method of plant propagation is tissue culture.

Suggested Essential Questions

1. What advantage does sexual reproduction provide to a plant?
2. What conditions are needed for good seed germination?
3. What is seed viability, and how is it determined?
4. What are the advantages of asexual plant reproduction?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe sexual reproduction in plants. (DOK 1) BOI BIOII BIOI	a. Use the following metaphor to recall by association: sexual reproduction and seed; the two S's. Have students read out about sexual plant reproduction. Discuss and make a connection between parts of the flower that develop into the fruit we eat (i.e., ovary develop into fruit and ovules develop into seed). Demonstrate by cutting open a fruit (i.e., watermelon), and discuss fruit parts. CLS1 CLS5 E1 E2 E3 E4 M2 W5	a. Use a written test to evaluate student understanding. Questions can be used from Unit Test Questions (4.1) to create the test.
b. Describe the conditions needed for good seed germination. (DOK 1) BOI BIOII BIOI	b. Lead a discussion about the relationship between good seed germination conditions and what students already know about spring plantings. Use a metaphor to recall information by association that stratification connects with stratus and cold; scarification connects with scaring of seed coat by animal stomach acid. CLS1 CLS2 T1 T2 E1 E6 S1 S2 S3 W1	b. Use a written test to evaluate student understanding. Questions can be used from Unit Test Questions (4.1) to create the test.
c. Plan and conduct a seed germination test. (DOK 2) BOI BIOII BIOI	c. Show an example of a certified seed label, and describe/discuss the elements that it contains (purity, viability, inert matter, noxious weeds, etc.).	c. Evaluate the Germination Test Experiment (4.2) for accuracy and completeness.

			Set up an experiment using equal numbers of acorns, corn, and beans. Place some of each seed in moist peat moss in a refrigerator and others in moist peat moss in the greenhouse, culture incubator, and classroom. Make observations, and record data over time using the Germination Test Experiment (4.2). Determine germination as a percentage. Seed test could involve lighting treatment including greenhouse light, artificial light, and no light. Keep records of seeding date and number of seed that germinate each day. Mist daily and water peat moss when necessary. CLS1 CLS2 T1 T2 E1 E6 S1 S2 S3 W1		
d.	Interpret information found on a seed tag. (DOK 1)	d.	Provide the students with a seed tag or seed package (or copy of), and explain the various components of the tag/package. Explain the legal requirements of a seed tag, and identify the USDA as the governmental agency that requires the tag. Have students make a germination chamber from a sandwich bag and paper towel and journal the progress of seed germination. CLS1 CLS2 T1 T2 E1 E6 S1 S2 S3 W1	d.	Evaluate using the Journal Rubric (1.3).
e.	Describe, discuss, or demonstrate how to propagate plants from scarified or stratified seeds. (DOK 2)	e.	Using presentation media and/or live specimens, identify the parts of a plant involved in grafting and budding. Demonstrate at least one method to the students. Have the students perform the assigned tasks. CLS1 CLS2 T1 T2 E1 E6 S1 S2 S3 W1	e.	Evaluate using the Activity Rubric (4.3).
f.	Identify and describe asexual reproduction methods. (DOK 2) BOI BIOII BIOI	f.	Have plant material and tools on hand to demonstrate asexual reproduction by cuttings. CLS1 CLS2 CLS3 CLS4 CLS5 T1 T2 T3 T4 T5 T6 E1 E2 E3 E4 E5 E6 M1 M2 M3 M4 M5 M6 M7 M8 R1 R2 R3 R4 R5 S1 S2 S3 W1 W2 W3 W4 W5 Obtain rooting hormone, and discuss with students the ingredients. Have students conduct an experiment that compares use of rooting hormone to no rooting hormone (control) while preparing vegetative cuttings. CLS1 CLS2 T1 T2 E1 E6 S1 S2 S3 W1	f.	Evaluate the Rooting Hormone Experiment Data Collection Sheet (4.4) for accuracy and completeness.
g.	Explore asexual plant reproduction techniques using grafting, budding, cuttings (root, stem and leaf), layering, separation and division, and tissue culture methods. (DOK 2) BOI BIOII BIOI	g.	Invite a local horticulturist to demonstrate grafting. Repot plants in greenhouse to demonstrate separation and division methods of asexual plant reproduction. Use the laminar flow hood to practice the aseptic techniques required for tissue culture. Challenge Activity: Use Venus Fly Trap tissue culture kits from Carolina Biological to practice tissue culture lab techniques. CLS1 CLS2 T1 T2 E1 E6 S1 S2 S3 W1	g.	Use the Daily Participation Rubric (2.4) to evaluate student understanding.

h. Identify common tools and chemicals used in asexual reproduction, and demonstrate their safe use and care. (DOK 1) BOI BIOII BIOI	h. Demonstrate the safe use of knives, hand pruning shears, and scalpels and their cleaning, disinfection, and maintenance; and have students use them according to direction. Demonstrate and discuss the variety, advantages, and safe use of rooting hormones. CLS1 CLS2 T1 T2 E1 E6 S1 S2 S3 W1	h. Evaluate using the Activity Rubric (4.3).

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W3 Developing a Position
W4 Organizing Ideas
W5 Using Language

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PHYI Physics I
PSI Physical Science
GEI Geology
GI Genetics
ESI Environmental Science
EI Earth and Space Science

ORGC I Organic Chemistry
CHI Chemistry I
BOI Botany I
BIOII Biology II
BIOI Biology I
AQ Marine and Aquatic Science

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Unit 5: Principles of Pest Management

Competency 1: Assess the effects of pests on plant production. (DOK 2) PS.01 PS.02 PS.03 PS.04

Suggested Enduring Understandings

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

Suggested Essential Questions

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

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify types of plant pests (insects, wildlife, diseases, and weeds), and describe how each type of pest affects production, the control, and management practices for plant pests and concepts related to integrated pest management. (DOK 3) BOI BIOII BIOI	a. Have students collect weed samples from school campus and/or greenhouse and bring them back to the classroom. Use the Web site *Weeds of Lawns, Yards and Flowerbeds in Mississippi* to project images of different weeds and identify the weeds collected. Identify types of weeds collected. Have students identify insect and disease problems in the greenhouse; collect and observe under a microscope. While observing, the instructor could include comments about host plants and susceptibility, resistance to pesticides, and biological control methods. The instructor should tailor further instruction according to crops grown in the area. The types of plant pests instruction should cover the following: **Insects** o Siphoning o Chewing o Sucking o Piercing **Diseases** o Fungus o Viruses o Bacteria **Weeds** o Annuals o Perennials o Biennials	a. Evaluate the Pest Identification Chart (5.1) for accuracy and completeness. The plant pest brochure should be graded by a presentation rubric.

	Wildlife o Raccoon o Deer o Rabbit o Armadillo Have students collect at least 10 pests and enter the appropriate information on the Pest Identification Chart (5.1). The students will create a brochure describing the types of plant pests with their characteristics. CLS1 CLS2 CLS4 CLS5 T1 T2 T3 T4 E1 E2 E3 E4 E5 E6 M1 R1 R2 R3 R4 R5 S1 S2 S3 W1 W2 W3 W4 W5	
b. Design an integrated pest management plan for a designated horticulture crop. (DOK 2) BOI BIOII BIOI	b. Divide the class into groups of two to three students, and assign each student a specific crop to design an integrated pest management plan. Using the Internet and other resources, the plan should include the name of the crop, typical pests encountered, and a description of cultural, mechanical, biological, and chemical methods what will be integrated for control of all pests. CLS1 CLS2 CLS4 CLS5 T1 T2 T3 T4 E1 E2 E3 E4 E5 E6 M1 R1 R2 R3 R4 R5 S1 S2 S3 W1 W2 W3 W4	b. Use the Integrated Pest Management Plan Rubric (5.2) to evaluate the IPM.

Competency 2: Identify, describe, and apply pesticide safety procedures. (DOK1) ESS.02 ESS.04 S.04 PS.01 PS.02 PS.03 PS.04

Suggested Enduring Understandings

1. Pest control may be achieved by means of biological, chemical, cultural, and mechanical methods.
2. Many insects are actually beneficial to plants since they prey on other insects that damage plants.
3. Biological, chemical, cultural, and mechanical methods are important in pest control by disrupting insect, weed, and disease cycles.

Suggested Essential Questions

1. How are biological and cultural pest control methods related?
2. What are examples of biological, chemical, and mechanical plant pest controls?
3. What factors is important in pest control?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Interpret safety and first-aid precautions and formulations on pesticide labels (insecticide, herbicides, rodenticide, fungicide, miticide, molluscicide and nematocides). (DOK 1) BOI BIOII BIOI	a. Use the Environmental Protection Agency *Read the Label First* Web site to allow students to read about the information that is required to be printed on a pesticide label. Assign a specific chemical pesticide to each student, and have him or her search for label information on the Web and complete the Pesticide Label Interpretation Assignment (5.3) to interpret that information. CLS1 CLS2 CLS4 CLS5 T1 T2 T3 T4 E1 E2 E3 E4 E5 E6 M1 R1 R2 R3 R4 R5 S1 S2 S3 W1 W2 W3 W4	a. Evaluate the Pesticide Label Interpretation Assignment (5.3) for completion and accuracy.
b. Identify beneficial insects, and discuss how they benefit	b. Have students investigate one of the beneficial insects listed below and prepare a Beneficial Insects Ag News Report (5.4) that includes a	b. Use the Beneficial Insects Ag News Report (5.4) to

	plants. (DOK 1) BOI BIOII BIOI	picture of the insect, plants that are associated with the insect, and pests that they aid in controlling. Students should share their findings with the class. CS1, CS2, CS4, CS5, T1, T2, T3, T4, T6, R1, R2, R3, R$, R5, W1, W2, W4, W5 **Beneficial Insects** o Ladybugs o Parasitic wasps o Praying mantis o Bees	evaluate student mastery.
c.	Discuss the relationship between biological, chemical, cultural, and mechanical control methods. (DOK 2) BOI BIOII BIOI	c. Use the *Insect Populations Critical Thinking Activity* in the text (Biondo & Lee, 2003) to help students understand how pest populations multiply. Have students review text material covered in the sections related to integrated pest management, insect and nematode management, plant disease management, and weed management from the text (Biondo & Lee, 2003). Have students develop a table biological, chemical, cultural, and mechanical control methods and compare similarities. Instruction can be reinforced using greenhouse activities. CLS1 CLS2 CLS4 CLS5 T1 T2 T3 T4 E1 E2 E3 E4 E5 E6 M1 R1 R2 R3 R4 R5 S1 S2 S3 W1 W2 W3 W4	c. Evaluate the biological, chemical, cultural, and mechanical control comparison table for accuracy and completeness.
d.	Discuss and apply general precautions for working with pesticides in relation to the requirements for pesticide applicator's certification/licensure. (DOK 1)	d. Provide students with an example of a pesticide label and the pesticide applicators guide, and identify the 11 standard points that are required by law, including signal words. Divide students into groups. Each group will receive a pesticide label and the pesticide applicators guide. Have students research the assigned item and answer the questions on the Interpret Pesticide Label Rubric. CLS1 CLS2 CLS4 CLS5 T1 E1 E2 E3 E4 E5 R2 R3 R4 S3 W1	d. Evaluate for clarity and accuracy using the Interpret Pesticide Label Rubric (5.5).

Standards

National Standards

ENVIRONMENTAL SERVICE SYSTEMS

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.
ESS.05. Examine the relationships between energy sources and environmental service systems.
ESS.06. Use tools, equipment, machinery, and technology to accomplish tasks in environmental service systems.

PLANT SYSTEMS

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Unit 6: Greenhouse Crops and Olericulture Production

Competency 1: Describe and apply principles of greenhouse crop production. (DOK 1) PS.01 PS.02 PS.03 PS.04

Suggested Enduring Understandings

1. To choose the right plant for specific use, knowledge of the different types of greenhouse crops is necessary.
2. There is a wide variety of tools and equipment in the horticulture industry. Each has a purpose and must be used properly.

Suggested Essential Questions

1. What environmental and cultural requirements are necessary for proper plant growth?
2. What happens when you choose the improper tool for the job or use a tool in an incorrect manner?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify different types of greenhouse crops (bedding plants, vegetables, flowering plants, foliage plants, etc.) and common species of each type, to include cultural considerations for greenhouse crops including fertilizer, water, growing medium, pest control, temperature, natural and chemical growth control and stimulation, and light control for common crops. (DOK 1) BOI BIOII BIOI	a. Have students complete the greenhouse crops keyword worksheet. CLS1 CLS2 T1 T2 T3 T4 T5 E1 E2 E3 E4 E5 E6 M1 R1 S1 S2 S3 W1 W2 W5	a. Evaluate using the Greenhouse Crops Keyword Worksheet (6.1).
b. Produce a greenhouse crop following accepted commercial practices (ongoing throughout the year). (DOK 3) BOI BIOII BIOI	b. Identify and discuss with the students cultural considerations for a specific bedding plant, flowering plant, and foliage plants. Divide students into groups, and assign specific tasks to each group in regards to growing out a commercial greenhouse crop. Rotate the groups over the growing period so that each group completes all tasks in regards to the growing of the crop. CLS1 CLS2 T1 T2 T3 T4 T5 E1 E2 E3 E4 E5 E6 M1 R1 S1 S2 S3 W1 W2 W5	b. Evaluate using the Growing Crops Data Sheet (6.2).

Competency 2: Describe and apply principles of Olericulture production. (DOK 2) PS.01 PS.02 PS.03 PS.04

Suggested Enduring Understandings

1. Know the types of vegetables that can be grown in Mississippi.
2. Understand site preparation and planting techniques for different types of vegetable plants that can be grown in Mississippi.
3. Know how to market finished product and what government agencies set standards for quality control.

Suggested Essential Questions

1. What is the difference between running and standing vegetables in relation to support structures do they require for production?
2. What is the recommended pesticide usage for vegetables grown commercially?
3. What time of year is the best time of year to start spring and fall vegetables?
4. What state agency in Mississippi is responsible for regulating vegetable production?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe characteristics of common vegetables grown for commercial production including cultural requirements, direct seeding versus transplanting, plant growth style, and growing season; and distinguish between warm season and cool season crops. (DOK 1) BOI BIOII BIOI	a. Have students identify/name vegetables they commonly eat or see in the grocery store. From the list, select those which are grown in Mississippi. Ask them to distinguish between those which are true vegetables (roots, stems, and leaves) and those which are fruits or flowers (arise from the reproductive phase of plant growth). Explain, compare, and distinguish the nominal methods of production and culture among the vegetables listed. CLS1 CLS2 T1 T2 T3 T4 T5 E1 E2 E3 E4 E5 E6 M1 R1 S1 S2 S3 W1 W2 W5	a. Evaluate the discussion for content, clarity, and understanding.
b. Identify and demonstrate the use of common tools and equipment used in gardening including tillers, spreaders, sprayers, watering devices, rakes, hoes, and shovels. (DOK 1)	b. Have students performs tasks using each one of the tools and/or equipment. CLS1 CLS2 T1	b. Evaluate using the Job Sheet/Performance Rubric (6.3).
c. Identify and describe factors to consider in preparing a seedbed including soil class and texture, use of soil amendments, and characteristics of a properly prepared seedbed. (DOK 2) BOI BIOII BIOI	c. Have students list or name common tools used in horticulture operations and describe their uses in olericulture—explaining the crossover uses of tools common in the industry. Record information in journal. CLS1 CLS2 CLS3 CLS4 CLS5 T1 T2 T3 T4 E1 M1 W1 W2 W3 W4 W5	c. Evaluate the journal activity for clarity, content, and accurateness.
d. Develop a plan for an	d. After students have completed their readings,	d. Evaluate using the

	intensive culture garden including crop and variety selection, location and spacing of different crops, scheduling of crops, crop rotation, and harvesting and marketing of crops. (DOK 3) BOI BIOII BIOI		have them discuss the factors in gardening with regards to the latest trends and practices. CLS1 CLS2 CLS3 CLS4 CLS5 T1 T2 T3 T4 E1 E5 E6 M1 4 W5		Horticulture News Rubric (6.4).
e.	Identify common garden pests including insects, diseases, and weeds, and methods of control. (DOK 1) BOI BIOII BIOI	e.	Use presentation media and specimens to identify common garden pests and describe different control methods. CLS1 CLS2 CLS3 CLS4 E2 E3 E4 E5 E6 M1 W5	e.	Evaluate using the Presentation Assessment Rubric (2.13).
f.	Discuss new and emerging technologies, trends, and issues concerning the production and marketing of vegetables in Mississippi. Identify and discuss the roles of agencies and organizations that regulate the production and marketing of vegetables. (DOK 1)	f.	Use lecture and discussion to explore the significance of new technologies and equipment such as GPS, mechanical versus hand harvesting, new organic standards, and bio-pesticides. Here is a good place to put the role of the EPA in recent banning of some chemical pest controls and the other federal agencies which regulate the levels of pesticides allowable in processed foods and so forth. Have students do research and prepare a report on an agency or new technology affecting vegetable production or marketing, such as standards for organic produce; the role of genetically modified organisms (GMOs) in olericulture and their dangers and benefits; and the impact of NAFTA or the WTO in the import/export of vegetable crops. CLS1 CLS2 CLS3 CLS4 E2 E3 E4 E5 E6 M1 W5	f.	Evaluate using the Written Report Rubric (6.5).

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Unit 7: Leadership, Careers, and Safety (Review and Reinforcement-Ongoing)

Competency 1: Review program policies, procedures, and safety rules. (DOK 1)

Suggested Enduring Understandings

1. Safety is an integral part of daily life.
2. Rules and regulations are essential to a safe work environment.

Suggested Essential Questions

1. What would happen if there were no rules and regulations?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Review program operation policies and procedures, including general safety procedures. (DOK 1)	a. Provide students with written copies of policies and procedures for the horticulture department and for the school. Have students read these policies; then, discuss them with students, asking questions to make sure that all students understand the policies, procedures, and rules. CLS1 CLS2 CLS3 CLS4 CLS5 T1 T2 T3 T4 T5 T6 E1 E2 E3 E4 E5 E6 M1 R1 R2 R3 R4 R5 W1 W2 W3 W4 W5	**a.** Students sign a statement certifying that they have received, discussed, and understand policies and procedures. Evaluate using a teacher-constructed test on policies and procedures.

Competency 2: Practice leadership skills. (DOK 2)

Suggested Enduring Understandings

1. Leadership and team-building skills are needed to be successful in a career.
2. Student involvement in FFA develops and enhances the skills employers are looking for.
3. First impressions are key when seeking employment.

Suggested Essential Questions

1. What leadership and team-building skills are necessary for success in any career?
2. What are some strategies you could use to make yourself more employable?
3. What attributes and/or documents contribute to an employer's first impression of you?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify and discuss fundamental parliamentary procedures for participating in a public meeting and public speaking. (DOK 1)	a. Identify and discuss with the students the basic rules of parliamentary procedure (making, seconding, and disposing of a main motion and announcing the results). Have students practice these procedures in a mock meeting, taking turns serving as chair and members of the house. CLS1 CLS2 CLS3 CLS4 CLS5 T1 T2 T3 T4 T5 T6 E1 E2 E3 E4 E5 E6 M1 R1 R2 R3 R4 R5 W1 W2 W3 W4 W5	a. Use the Scorecard for Assessing Parliamentary Procedures/Public Speaking Skills (1.6) to evaluate parliamentary procedure skills of students.
b. Select FFA activities that promote personal development and leadership skills. (DOK 1)	b. Have students search the FFA Web site (http://www.ffa.org) and identify and describe an activity or program in which they would like to participate. Have students continue their research to learn what skills and knowledge they must master to participate. Have students complete an assignment on selecting personal development and leadership activities. CS1, CS2,	b. Have students peer review and comment on the completed attachment, Select a Personal/ Leadership Activity Assignment (1.7).

CS3, CS4, CS5, T3, T4, T6

Competency 3: Complete school-to-careers activities related to horticulture. (DOK 1)

Suggested Enduring Understandings

1. Society depends on horticulturalists. Employers are looking for specific skills in employees.

Suggested Essential Questions

1. What would the nation and world be like without horticulturalists?
2. What skills do employers look for in horticulturalists?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify employment and career opportunities in the horticulture industry. (DOK 1)	a. Have students research career and employment opportunities at the local, state, and regional levels using the Internet, industry periodicals, and other sources. This research should include educational requirements, working conditions and salaries, advancement opportunities, skills required for entry, and so forth. Have students present their findings to the class. CLS1 CLS2 CLS3 CLS4 CLS5 T1 T2 T3 T4 T5 T6 E1 E2 E3 E4 E5 E6 M1 R1 R2 R3 R4 R5 W1 W2 W3 W4 W5	a. Evaluate the presentation using the Presentation Assessment Rubric (2.13).
b. Investigate educational opportunities related to horticulture at the postsecondary level. (DOK 2)	b. Invite representatives of community college and 4-year college horticulture departments to speak to the class concerning postsecondary programs in horticulture. CLS1 CLS2 CLS3 CLS4 CLS5 T1 T2 T3 T4 T5 T6 E1 E2 E3 E4 E5 E6 M1 R1 R2 R3 R4 R W1 W2 W3 W4 W5	b. Evaluate electronic notebooks/ journals for accuracy and completeness.
c. Describe national standards and certification/licensing procedures, trade organizations, associations, and unions as related to horticulture. (DOK 1)	c. Invite a representative of the horticulture industry or certifying agency or trade organization to speak to the class concerning certification and licensure procedures in the industry. CLS1 CLS2 CLS3 CLS4 CLS5 E1 E2 E3 E4 E5 E6 M1 R1 R2 R3 R4 R5 W1 W2 W3 W4 W5	c. Use the Guest Speaker Evaluation Form (7.1) to evaluate student mastery.

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PS.04. Employ elements of design to enhance an environment.

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M8 Functions
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R4 Meaning of Words
R5 Generalizations and Conclusions
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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

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CLS1	Flexibility and Adaptability
CLS2	Initiative and Self-Direction
CLS3	Social and Cross-Cultural Skills
CLS4	Productivity and Accountability
CLS5	Leadership and Responsibility

National Educational Technology Standards for Students

T1	Creativity and Innovation
T2	Communication and Collaboration
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T5	Digital Citizenship
T6	Technology Operations and Concepts

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Unit 8: Nursery and Landscape Plant Identification

Competency 1: Identify and describe the use of major plants associated with nursery and landscape operations. (DOK 1) PS.01 PS.02 PS.03 PS.04

Suggested Enduring Understandings

1. A horticulturalist should be able to identify the major plants used in landscapes, floral arrangements, and interiorscapes.
2. A horticulturalist should be able to describe the where and how to use of the major plants used in landscapes, floral arrangements, and interiorscapes.

Suggested Essential Questions

1. Is it important to be able to identify the major plants used in the horticulture industry?
2. Why should a horticulturalist know where and how to use the major horticulture plants?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify and describe the use of major nursery plants including trees, shrubs, ground covers, vines, and ornamental grasses. Include the use of major foliage plants used in nursery and landscape operations and flowering plants including annuals, biennials, and perennials. (DOK 1) BOI BIOII BIOI	a. Using specimens, pictures, walking tours or field trips, and presentation media, identify nursery and landscaping plants by common and scientific name. Have students compile a leaf collection of these plants showing common and scientific name and record information into an electronic journal. CLS1 CLS2 CLS3 CLS4 CLS5 T1 T2 T3 T4 T5 TE1 E2 E3 E4 E5 E6 M1 R1 R2 R3 R4 R5 W1 W2 W3 W4 W5	a. Evaluate the field trip using the Field Trip Participation Checklist (8.1). Evaluate the journal entries using the Journal Rubric (1.3).

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Unit 9: Horticulture Marketing and Business Procedures

Competency 1: Describe and apply marketing and business practices associated with horticulture operations. (DOK 1) PS.01 PS.02 PS.03 PS.04

Suggested Enduring Understandings

1. Proper planning and timing are essential when growing any horticulture crop.
2. Accurate inventories and financial records are necessary for business practices.
3. Knowledge of sales etiquette and customer service is important for employees.

Suggested Essential Questions

1. Why should a growing calendar be used to schedule crops?
2. Why is keeping accurate records important for managing a horticulture business?
3. Why are developing good customer service skills important to a successful business?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Maintain an inventory of plants and supplies for the horticulture program (ongoing throughout the year). (DOK 3)	a. Discuss and demonstrate procedures for maintaining an inventory. Provide students with the ending inventory from the previous year, and have students maintain this inventory throughout the current school year. Students will create a PowerPoint presentation displaying inventory of plants and supplies. CLS1 CLS2 CLS3 CLS4 CLS5 E1 E2 E3 E4 E5 E6 M1 M2 R1 R2 R3 R4 R5 W1 W2 W3 W4 W5	a. Evaluate using the Powerpoint Presentation Rubric (9.1).
b. Develop an annual calendar of activities/enterprises for a horticulture business to include ordering materials/supplies for an enterprise. (DOK 2)	b. Describe and discuss procedures for scheduling horticulture crops including ordering supplies and materials. Have students create a calendar to show which activities will be taking place for given enterprises throughout the year. CLS1 CLS2 CLS3 CLS4 CLS5 E1 E2 E3 E4 E5 E6 M1 M2 R1 R2 R3 R4 R5 W1 W2 W3 W4 W5	b. Evaluate student activity on creating an annual calendar of activities for a horticulture business.
c. Describe factors to consider in pricing products of an enterprise, and complete a sales transaction including providing customer service. (DOK 1)	c. Describe and discuss factors to consider in pricing horticultural products including supplies, competition, bench space, labor, overhead, and so forth. Provide students with examples of these factors, and have students compute a price for a given product. Have students role-play sales procedures. CLS1 CLS2 CLS3 CLS4 CLS5 E1 E2 E3 E4 E5 E6 M1 M2 R1 R2 R3 R4 R5 W1 W2 W3 W4 W5	c. Evaluate the role-play using the Role-play Rubric (9.2).
d. Describe factors to consider in marketing and advertising products. (DOK1	d. Lead a discussion on the pros and cons of marketing and advertising horticulture products including advertising methods, relative effectiveness and costs, and marketing plans. Have students develop a marketing and advertising plan for a given enterprise and record in a student electronic notebook. CLS1 CLS2 CLS3 CLS4 CLS5 E1 E2 E3 E4 E5 E6 M1 M2 R1 R2 R3 R4 R5 W1 W2 W3 W4 W5	d. Evaluate the marketing and advertising plan using the Student Electronic Notebook Rubric (9.3).

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Unit 10: Container and Field Crop Production

Competency 1: Describe and apply principles of container and field crop production. (DOK 2) PS.01 PS.02 PS.03 PS.04

Suggested Enduring Understandings

1. Know the types and sizes of containers available for growing landscape plants for commercial sale.
2. Understand the production, marketing and shipping advantages for container grown plants.
3. Know the importance of controlling labor costs by incorporating equipment technology where possible.
4. Understand all of the cultural elements involved in container crop and field production.

Suggested Essential Questions

1. What is the difference between container plants and field grown plants?
2. What types and sizes of containers are most popular with landscapers and designers?
3. Why is automation where possible important in crop production?
4. What factors do you consider when picking a location for a field crop nursery?
5. What cultural factors do you need to consider in planning a container crop?
6. What human functions does a container potting machine perform?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe advantages and disadvantages of container crop production and filed crop production. (DOK 2)	a. Divide students into small groups. Have groups of students research container and field crop production to include cultural requirements, fertilizer, water, pest control, and harvesting procedures and different types and sizes of containers, and compare their advantages and disadvantages. Site criteria for container and field crop production, and present their findings to the class for discussion. CLS1 CLS2 CLS5 E1 E2 M1 R1 W1 W2 W3 W4 W5	a. Evaluate using the Group Participation Rubric (10.1).
b. Identify and demonstrate the safe use of tools and equipment for container and field crop production. (DOK 1)	b. Have students research the tools and equipment. The students will lead a discussion on the use and safety practices associated with each tool or equipment. Students will demonstrate use of the tools and equipment. CLS1 CLS2 CLS5 E1 E2 M1 R1 W1 W2 W3 W4 W5	b. Evaluate using the Daily Participation Rubric (2.4).
c. Produce container and field grown plants. (DOK 3) BOI BIOII BIOI	c. Have students search Web sites and prepare a newspaper article on container and field grown plants to present to the class. (The instructor should suggest keywords to help students improve search strategies.) CLS1 CLS2 CLS5 E1 E2 M1 R1 W1 W2 W3 W4 W5	c. Use the Horticulture News Rubric (6.4) to evaluate the newspaper article.
d. Describe automation and plug production in the nursery industry. (DOK 1)	d. Have a local grower speak to the class on automation and plug production in the nursery industry. CLS1 CLS2 CLS5 E1 E2 M1 R1 W1 W2 W3 W4 W5	d. Evaluate using the Guest Speaker Rubric (7.1).

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National Educational Technology Standards for Students

T1 Creativity and Innovation
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T6 Technology Operations and Concepts

References

American Nursery and Landscape Association. (2004). *American standards for nursery stock*. Washington, DC: Author. Retrieved October 18, 2011, from http://www.anla.org

Ingels, J. E. (2009). *Ornamental horticulture: Science, operations, and management* (4th ed.). Clifton Park, NY: Delmar.

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Reiley, H. E., & Shry, C. L. (2010). *Introductory horticulture* (8th ed.). Clifton Park, NY: Delmar.

Unit 11: Landscape Design, Installation, Construction, and Maintenance

Competency 1: Describe and apply principles of landscape design. (DOK 1) PS.01, PS.02, PS.03, PS.04

Suggested Enduring Understandings

1. Landscape design requires the use of design principles.
2. There is a wide variety of tools and equipment utilized in landscape design.
3. A site analysis/needs assessment plays a vital role in the design process.
4. The final product in the design process is the creation of a landscape plan to scale.

Suggested Essential Questions

1. What are the basic design principles used in the landscape design process?
2. How are specialized tools used to create a landscape design?
3. Why is it important to do a site analysis/needs assessment at the beginning of the design process?
4. Why is a landscape plan drawn to scale?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe careers in the landscape design field. (DOK 1)	a. Provide a list of career areas in the plant industry. Have each student select an area of personal interest and prepare a PowerPoint presentation on the area. The presentation should include information on major skill areas, educational requirements, salary, specific skills, and occupational outlook. CS2, CS4, T2, T3, T4, T6, R1, R2,	a. Evaluate student PowerPoint for accuracy and completeness.
b. Identify and demonstrate the use of tools and equipment for landscape design including computer-assisted landscape design hardware and software. (DOK 1)	b. Use a display of tools, software, and equipment for landscape design; demonstrate their use to the students. Have students complete exercises associated with the use of tools, equipment, and software for landscape design. CLS1 CLS5	b. Evaluate the student exercises associated with lettering and landscape symbols for clarity, accuracy, and neatness.
c. Identify and demonstrate the methods of lettering and symbols used in landscape design plans. (DOK 2)	c. Use presentation media and discussion to acquaint students with the methods of lettering and symbols used in a landscape design plan. Provide students with exercises/assignments to demonstrate lettering methods used in landscape design. CS2, CS4, T2, T3, T4, T6, R1, R2	c. Evaluate exercises/assignments for clarity, correctness, and neatness.
d. Describe principles of design associated with landscaping including simplicity, balance, and proportion. (DOK 2)	d. Use photographs, landscape drawings and plans, and field trips to discuss and illustrate basic principles of landscape design. E2, E3	d. Evaluate using classroom discussions.
e. Prepare site analysis/needs assessment for a given site. (DOK 3) BOI BIOII BIOI	e. Provide students with an example of a site analysis, and discuss the elements and practices involved in preparing this document. Provide students with a scenario, and have them prepare a site analysis and display on a	e. Evaluate using the Poster Assessment Rubric (11.1).

			poster. CLS1 CLS2 CLS3 CLS4 CLS5 E2 E3 E4 E5		
f.	Prepare a simple landscape plan to scale for a given site to include plant selection and location. (DOK 2) BOI BIOII BIOI	f.	Using the poster content in the step above, have students prepare a simple landscape plan to scale including plant key and symbols. CLS1 CLS2 CLS3 CLS4 CLS5 E2 E3 E4 E5	f.	Evaluate the students' plan for accuracy and completeness.

Competency 2: Describe and apply basic principles of landscape installation and construction. (DOK 1) PS.01, PS.02, PS.03, PS.04

Suggested Enduring Understandings

1. Landscape professionals must be familiar with the elements of an installation contract.
2. There are certain licensure requirements for installing a landscape.
3. There are certain steps that must be taken in order to prepare the planting site, install plant material, and perform post-transplant maintenance.

Suggested Essential Questions

1. Why is it important to have an installation contract in place?
2. What is the significance of having a particular landscape license?
3. What will occur if the proper steps are not followed in the landscape installation process?

Suggested Performance Indicators		Suggested Teaching Strategies		Suggested Assessment Strategies	
a.	Discuss the essential elements of a landscape installation contract (to include warranty and an estimate). (DOK 2)	a.	Have students review examples of landscape installation contracts and estimates, and identify/discuss the essential elements of each, and discuss in class. CLS1 CLS2 E2 E3 E4 E5 E6 M1 R1 R2 R3 R4 R5 W1 W5	a.	Evaluate using the class discussion and peer comments.
b.	Develop a contract and pricing estimate for the landscape plan. (DOK 2)	b.	Have students develop a contract and estimate for installing the landscape plan designed in the previous unit and present to class. CLS1 CLS2 CLS5 E2 E3 E4 E5 E6 M1 R1 R2 R3 R4 R5 W1 W2 W3 W4 W5	b.	Evaluate the presentation using the Presentation Assessment Rubric (2.13).
c.	Describe and discuss procedures for preparing a planting site, installing plants, and providing post-transplant care according to a landscape plan. (DOK 2)	c.	Using photographs and other presentation media, describe and discuss procedures for site preparation, installation, and post-transplant care of a landscape project. Where possible, have students work as a group to prepare a planting site, install plants, and provide post-transplant care. CLS1 CLS5 T1 T2 T5 T6 E1 E2 E3 E4 E5 E6 M1 R1 W1 W2 W3 W4 W5	c.	Evaluate using a teacher-constructed test on principles associated with contracts, estimates, installation, and irrigation.
d.	Describe licensing requirements for landscape installation. (DOK 1)	d.	Invite a landscape contractor or representative of the landscape industry to speak to the class on licensing requirements. CLS1 CLS2 CLS3 M1 W1 W2 W3 W4 W5	d.	Evaluate using the Guest Speaker Rubric (7.1).
e.	Discuss installation and maintenance of a landscape irrigation system. (DOK 1) BOI BIOII BIOI	e.	Using presentation media, identify the components of an irrigation system, and discuss their installation and operation. Take a field trip to observe installation of an irrigation system if possible. CLS1 CLS5 T1 T5 T6 E1 E2 E3 E4 E5 E6 M1 R1 W1 W4 W5	e.	Evaluate using the Field Trip Checklist (8.1).

Competency 3: Describe and apply principles of landscape maintenance. (DOK 1) PS.01, PS.02, PS.03, PS.04

Suggested Enduring Understandings

1. There is a wide variety of landscape maintenance equipment on the market today.
2. A cost estimate for landscape maintenance is essential for every job.
3. Certain skills are required to properly prune trees and shrubs.
4. Trees, shrubs, and other plant materials have particular fertilizer and pest control needs.

Suggested Essential Questions

1. Why is it important to know how to properly operate and maintain landscape equipment?
2. What does development of a cost estimate require?
3. Why is it necessary to know how to properly prune trees and shrubs?
4. What will happen if fertilizer is not applied and pests are not controlled?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify and demonstrate the safe use of equipment and hand tools for landscape maintenance. (DOK 1)	a. Demonstrate the safe and proper use of landscape maintenance tools to the students. Have students complete a series of activities demonstrating the safe and proper use of these tools. CLS1 CLS2 CLS3 CLS4 CLS5 M1 W1	a. Evaluate using the activity using peer reviews.
b. Identify and discuss the proper procedures for pruning trees and shrubs. (DOK 1)	b. Discuss and demonstrate procedures for pruning trees and shrubs with the students. Have students work in small groups, when possible, to prune trees and shrubs. CLS1 CLS2 CLS3 CLS4 CLS5 M1 W1	b. Evaluate using the Job Sheet/Performance Rubric (6.3 or the Activity Rubric 4.3).
c. Determine and discuss a cost estimate for fertilizer needs, pest control, and maintenance needs of trees, shrubs, and beds. (DOK 2) BOI BIOII BIOI	c. Provide students with an example of a cost estimate for landscape maintenance, and have them identify key elements and practices. Have students complete an assignment to develop a cost estimate and. Have students record findings in their electronic journals using a Blog or a word processing program. Have students use the writing process to summarize their information. CLS1 CLS4 CLS5 T1 T2 T3 T4 E2 E3 E4 E5 E6 M1 W1 W2 W3 W4 W5	c. Evaluate using the Journal Rubric (1.3).

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Unit 12: Turfgrass Installation and Maintenance

Competency 1: Describe and apply principles of turfgrass installation. (DOK 1) PS.01, PS.02, PS.03, PS.04

Suggested Enduring Understandings

1. A horticulturalist should know the factors to consider when selecting a species of turfgrass.
2. To grow a lush lawn, a horticulturalist must be able to identify and describe the major varieties of turfgrass grown in Mississippi.
3. To produce a healthy lawn, a landscaper must know how to prepare a site, install a turfgrass, and estimate the cost of installation.
4. A turfgrass maintenance employee should be able to safely use turfgrass tools and equipment.
5. The identification of pest is required in the turfgrass field.
6. A turfgrass maintenance employee must be able to calibrate fertilizer and spray equipment.
7. Installation of irrigation equipment is required of turfgrass employees.
8. A lawn maintenance employee should know how to repair and renovate a lawn.

Suggested Essential Questions

1. Why is it important to know the different requirements for growing the various turfgrass species?
2. What is required to properly prepare a site for installing turfgrass?
3. Why is it important to be able to safely use turfgrass tools and equipment?
4. How do you determine how much fertilizer to apply to a turf?
5. What is required to set up an irrigation system in a turf?
6. What can you do to repair a landscape turf?
7. How do you determine how much does it cost to maintain a landscape?
8. What pest attack turfgrass?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Describe factors to consider in selecting a turfgrass for a specific area. (Identify varieties of turfgrass, and describe their characteristics.) (DOK 2) BOI BIOII BIOI	a. Take students on a tour of the campus and local area. Identify common varieties of turfgrass and their characteristics. Hold a class discussion on varieties of turfgrass and their characteristics, uses, and limitations. Have students analyze the tour and classroom discussion and explain why the factors for selecting turfgrass is important in their electronic journals. CLS1 CLS2 5 T1 T2 T3 E1 E2 E3 E4 E5 E6 M1 W1 W2 W3 W4 W5	a. Evaluate the students' journal activities for accuracy and completeness.
b. Describe installation practices for different turfgrasses including site preparation and initial care. (DOK 1)	b. Provide students with a copy of *Establish and Manage Your Home Lawn* from Mississippi State University Extension Service. Discuss installation for different turfgrasses commonly grown in Mississippi. M1 R1 R2 R3 R4 R5 W1 W2 W3 W4 W5	b. Evaluate the students using the Home Lawn worksheet. (12.1)
Competency 2: Describe and apply principles of turfgrass maintenance. (DOK 1) PS.01, PS.02, PS.03, PS.04		
a. Identify and demonstrate the safe use and maintenance of equipment and tools used for turfgrass maintenance including mowers, dethatchers,	a. Have a teacher demonstration of operation of power equipment, stressing the safe use of the equipment and precautions to be followed. Take students on a field trip if necessary to view equipment in operation. Allow students to operate equipment under close supervision if possible. Have students summarize the important	a. Use a written test on piece of equipment for safety. Students must score 90% or higher before being allowed to use the equipment.

	aerators, and other equipment. (DOK 1)		points about each piece of equipment and transcribe them into their electronic journals or notebooks. CLS1 CLS2 CLS3 M1		
b.	Use mower, sprayers, or spreaders for a specific grass. (DOK 3)	b.	Mini-lecture on proper mowing height and techniques for different grasses. Demonstrate the procedure for calibrating a sprayer and spreader. Provide students with a given scenario, and have them recalibrate to specifications and mow turf to specific criterion. CLS1 CLS2 CLS3 M1	b.	Evaluate the tasks using the Equipment Operation Record Rubric (12.2). Have students record operations in their journals. Peer review the journal activities.
c.	Identify and describe common pests of turfgrass including insects, diseases, and weeds and common irrigation methods for turfgrass. (DOK 1) BOI BIOII BIOI	c.	Have the students create a PowerPoint presentation identifying the most common insect, weed, and disease pests of turf; their symptoms; and their control. CLS1 CLS2 T1 T2 T3 T4 T5 T6 M1 R1 R2 W1	c.	Evaluate the Power Point presentation for accuracy and content.
d.	Perform repair/renovation practices including aeration and dethatching. (DOK 2)	d.	Demonstrate turf repair and renovation procedures and equipment to students. Allow students to operate the equipment under close supervision if possible. If equipment is not available, take students on a field trip to let them see the equipment in operation. CLS1 CLS2 CLS3 M1	d.	Observe students in performing the repair/renovation activities. Make corrections as needed.
e.	Develop a plan/cost estimate for a turfgrass management program. (DOK 2)	e.	Provide students with a sample plan and a scenario where they have to develop a simple plan for turf management. CLS1 CLS2 CLS3 M1	e.	Students will present the plan for peer evaluation.

Standards

PLANT SYSTEMS

PS.01. Apply knowledge of plant classification, plant anatomy, and plant physiology to the production and management of plants.

PS.02. Prepare and implement a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.

PS.03. Propagate, culture, and harvest plants.

PS.04. Employ elements of design to enhance an environment.

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E1 Topic Development in Terms of Purpose and Focus
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E3 Word Choice in Terms of Style, Tone, Clarity, and Economy
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E5 Conventions of Usage
E6 Conventions of Punctuation
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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
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ZOI Zoology
SPI Spatial Information Science
PHYI Physics I
PSI Physical Science
GEI Geology
GI Genetics
ESI Environmental Science
EI Earth and Space Science

ORGC I Organic Chemistry
CHI Chemistry I
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BIOII Biology II
BIOI Biology I
AQ Marine and Aquatic Science

21st Century Skills Standards

CLS1 Flexibility and Adaptability
CLS2 Initiative and Self-Direction
CLS3 Social and Cross-Cultural Skills
CLS4 Productivity and Accountability
CLS5 Leadership and Responsibility

National Educational Technology Standards for Students

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

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Unit 13: Pomology Production

Competency 1: Describe and apply principles of fruit and berry production. (DOK 1) PS.01, PS.02, PS.03, PS.04

Suggested Enduring Understandings

1. Know the types of fruit and berries that can be grown in Mississippi.
2. Understand site preparation and planting techniques for different types of fruit and berry plants.
3. Know how to market finished product and what government agencies set standards for quality control.

Suggested Essential Questions

1. What is the difference between a vine fruit and a bramble fruit, and what support structures do they require for production?
2. What is the recommended spacing requirement for most fruit trees grown commercially?
3. What time of year is best for pruning fruit and berry plants?
4. What state agency in Mississippi is responsible for regulating fruit and berry production?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Identify, discuss, and prepare a planting and marketing plan of common fruits and berries produced in Mississippi. (DOK 1)	a. Identify common fruits and berries produced in Mississippi, and discuss general cultural practices. Prepare a site, or describe/explain how to prepare a site and install fruit or berry plants common to Mississippi. Have students compile a report on one fruit or berry crop that discusses site preparation, variety selection, installation, cultural practices, and harvesting and marketing. Have students present a summary of their findings to the class. CLS1 CLS2 CLS3 CLS4 CLS5 T1 T2 T3 T4 T5 T6 E1 E2 E3 E4 E5 E6 M1 M2 M3 M4 M5 M6 M7 M8 R1 R2 R3 R4 R5 S1 S2 S3 W1 W2 W3 W4 W5	a. Evaluate the written report using the Written Report Rubric (6.5). Evaluate the presentation using peer reviewed comments and discussion.
b. Provide or explain/describe how to provide cultural care for fruit or berry plants commonly grown in Mississippi, to include pruning, fertilizing, pest control, and harvesting. (DOK 2) BOI BIOII BIOI	b. Assign students a specific fruit or vegetable. Students will research the cultural care characteristics of the specific plant. Have students' record information from the research. CLS1 CLS2 CLS3 CLS4 CLS5 T1 T2 T3 T4 T5 T6 E1 E2 E3 E4 E5 E6 M1 M2 M3 M4 M5 M6 M7 M8 R1 R2 R3 R4 R5 S1 S2 S3 W1 W2 W3 W4 W5	b. Evaluate assignments for accuracy and completeness.
c. Identify, discuss, and describe marketing of fruits and vegetables as it relates to local, state, national, and international	c. Have a classroom discussion on the roles of local, state, national, and international organizations that regulate or impact the production and marketing of fruit and berry crops in Mississippi, such as Mississippi Department of Plant Industry, USDA, OSHA,	c. Evaluate electronic journals for accuracy and completeness.

organizations that impact fruit and berry production. (DOK 2)	NAFTA, and the WTO. Have students design a marketing plan for fruits and vegetables. Scan their drawings, and enter into their electronic journals. CLS1 CLS2 CLS3 CLS4 CLS5 T1 T2 T3 T4 T5 T6 E1 E2 E3 E4 E5 E6 M1 M2 M3 M4 M5 M6 M7 M8 R1 R2 R3 R4 R5 S1 S2 S3 W1 W2 W3 W4 W5	

Standards

PLANT SYSTEMS

PS.01. Apply knowledge of plant classification, plant anatomy, and plant physiology to the production and management of plants.

PS.02. Prepare and implement a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.

PS.03. Propagate, culture, and harvest plants.

PS.04. Employ elements of design to enhance an environment.

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W1 Expressing Judgments
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PHYI Physics I
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ESI Environmental Science
EI Earth and Space Science

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CHI	Chemistry I
BOI	Botany I
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T1	Creativity and Innovation
T2	Communication and Collaboration
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T6	Technology Operations and Concepts

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Unit 14: Principles of Floristry

Competency 1: Describe and apply principles of floristry. (DOK 1) PS.03, PS.04

Suggested Enduring Understandings

1. A florist should be able to identify and safely use the common tools used in floral design.
2. It is important to identify the major plant materials used in the floral industry.
3. A florist should understand the basic design principles and be able to produce a basic and advanced floral arrangement.
4. A florist must be able to properly receive and prepare plant material.

Suggested Essential Questions

1. What tools are required in the floral industry?
2. What plant material is used in floral designs?
3. What are the basic design principles that are used to produce a floral arrangement?
4. How procedures are followed in receiving and storing plant material?

Suggested Performance Indicators	Suggested Teaching Strategies	Suggested Assessment Strategies
a. Demonstrate the procedures for receiving and storing (including rotation of inventory) of floral materials. (DOK 1)	a. Discuss with students procedures for receiving and storing floral materials. CLS1 CLS2 CLS3 CLS4 CLS5 T1 T2 T3 T4 T5 T6 E1 E2 E3 E4 E5 E6 M1 M2 M3 M4 M5 M6 M7 M8 R1 R2 R3 R4 R5 S1 S2 S3 W1 W2 W3 W4 W5	a. Evaluation of student performance in receiving and processing an order for a floral product
b. Apply basic design principles including balance, transition, rhythm, focal point, proportion, and scale. (DOK 2)	b. Describe basic design principles including balance, transition, rhythm, focal point, proportion, scale, and so forth, and create basic floral design products such as a packaged single corsage, wreath, bud vase, round centerpiece, or a dressed (wrapped) potted plant. CLS1 CLS2 CLS3 CLS4 CLS5 T1 T2 T3 T4 T5 T6 E1 E2 E3 E4 E5 E6 M1 M2 M3 M4 M5 M6 M7 M8 R1 R2 R3 R4 R5 S1 S2 S3 W1 W2 W3 W4 W5	b. Use a written test to evaluate student understanding of this indicator. Students will be further evaluated on their ability to apply these principles in a design for a given job during laboratory practice.
c. Receive and process orders for floral products. (DOK 1)	c. Discuss procedures for receiving and processing orders for floral design. Have students complete an order for a floral product. CLS1 CLS2 CLS3 CLS4 CLS5 T1 T2 T3 T4 T5 T6 E1 E2 E3 E4 E5 E6 M1 M2 M3 M4 M5 M6 M7 M8 R1 R2 R3 R4 R5 S1 S2 S3 W1 W2 W3 W4 W5	c. Evaluate using a teacher-constructed test on receiving and storing materials, receiving and processing orders, and basic principles of design.
d. Create an advanced floral design product such as a hogarth curve, fan, right or left triangle, diagonal. (DOK 3)	d. Divide students into groups, and assign a specific design to be completed by each group. CLS1 CLS2 CLS3 CLS4 CLS5 T1 T2 T3 T4 T5 T6 E1 E2 E3 E4 E5 E6 M1 M2 M3 M4 M5 M6 M7 M8 R1 R2 R3 R4 R5 S1 S2 S3 W1 W2 W3 W4 W5	d. Peer review the designs.
e. Identify and demonstrate the safe and proper use of tools and supplies	e. Use a display or media presentation to identify floral tools and supplies and describe their use. Show students the techniques used, and allow them to practice in lab activities. CLS1	e. Use a written test to evaluate student understanding of this indicator. Students will be

used in floristry including shears, tape, foam, and floral wire, to include plant materials used in floristry including potted, flower, and foliage materials. (DOK 1)	CLS2 CLS3 CLS4 CLS5 T1 T2 T3 T4 T5 T6 E1 E2 E3 E4 E5 E6 M1 M2 M3 M4 M5 M6 M7 M8 R1 R2 R3 R4 R5 S1 S2 S3 W1 W2 W3 W4 W5	further evaluated on their ability to apply these techniques in a design for a given job during laboratory practice.

Standards

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PS.01. Apply knowledge of plant classification, plant anatomy, and plant physiology to the production and management of plants.

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Student Competency Profile

Student's Name: _____

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

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

Unit 1: Horticulture Orientation and Leadership Development

_____ 1. Identify school and program policies and procedures related to the horticulture program. (DOK 1)

_____ 2. Demonstrate basic and fundamental safety practices related to horticulture enterprises. (DOK 1)

_____ 3. Develop life and career skills for success in the 21st century. (DOK 3)

_____ 4. Explore the role of the FFA in promoting leadership, personal development, and human relations skills. (DOK 1)

_____ 5. Examine the concept of leadership. (DOK 3)

_____ 6. Describe the role of work ethics and values in establishing and building a successful career. (DOK 3)

Unit 2: Basic Plant and Soil Science (Plant Structure and Growth)

_____ 1. Explore plant structure and their functions. (DOK2)

_____ 2. Apply systems of plant classification. (DOK 2)

_____ 3. Describe and apply principles of plant growth media. (DOK 2)

Unit 3: Horticulture Structures

_____ 1. Describe the characteristics and features of different types of greenhouses. (DOK 3)

Unit 4: Plant Propagation

_____ 1. Distinguish between sexual and asexual reproduction. (DOK 2)

Unit 5: Principles of Pest Management

_____ 1. Assess the effects of pests on plant production. (DOK 2)

2. Identify, describe, and apply pesticide safety procedures. (DOK1)

Unit 6: Greenhouse Crops and Olericulture Production

_____ 1. Describe and apply principles of greenhouse crop production. (DOK 1)

_____ 2. Describe and apply principles of Olericulture production. (DOK 2)

Unit 7: Leadership, Careers, and Safety (Review and Reinforcement Ongoing)

_____ 1. Review program policies, procedures, and safety rules. (DOK 1)

_____ 2. Practice leadership skills. (DOK 2)

_____ 3. Complete school-to-careers activities related to horticulture. (DOK 1)

Unit 8: Nursery and Landscape Plant Identification

Identify and describe the use of major plants associated with nursery and landscape operations.

_____ 1. (DOK 1)

Unit 9: Horticulture Marketing and Business Procedures

Describe and apply marketing and business practices associated with horticulture operations.

_____ 1. (DOK 1)

Unit 10: Containers and Field Crop Production

_____ 1. Describe and apply principles of container and field crop production. (DOK 2)

Unit 11: Landscape Design, Installation, Construction, and Maintenance

_____ 1. Describe and apply principles of landscape design. (DOK 1)

_____ 2. Describe and apply basic principles of landscape installation and construction. (DOK 1)

_____ 3. Describe and apply principles of landscape maintenance. (DOK 1)

Unit 12: Turfgrass Installation and Maintenance

_____ 1. Describe and apply principles of turfgrass installation. (DOK 1)

_____ 2. Describe and apply principles of turfgrass maintenance. (DOK 1)

Unit 13: Pomology Production

_____ 1. Describe and apply principles of fruit and berry production**.** (DOK 1)

Unit 14: Principles of Floristry

_____ 1. Describe and apply principles of floristry. (DOK 1)

Appendix A: Suggested Rubrics and Checklists

Name: _____

Date: _____

Period: _____

Role-Play or Skit Rubric for Shop/Lab Safety Activity (1.1)

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

Name: _____

Date: _____

Period: _____

Role-Play or Skit Rubric for Employment Skills (1.2)

	Exemplary **4 Points**	**Accomplished** **3 Points**	**Developing** **2 Points**	**Beginning** **1 Point**	**Score**
Accuracy	All service/business information was accurate.	Almost all service/business information was accurate.	Most service/business information was accurate.	Very little service/business information was accurate.	
Role	Excellent character development; student contributed in a significant manner	Good character development; student contributed in a cooperative manner	Fair character development; student might have contributed	Little or no character development; student did not contribute much at all	
Knowledge Gained	Can clearly explain several ways in which his or her character "saw" things differently than other characters and can explain why	Can clearly explain several ways in which his or her character "saw" things differently than other characters	Can clearly explain one way in which his or her character "saw" things differently than other characters	Cannot explain any way in which his or her character "saw" things differently than other characters	
Content	Service/business content used was appropriate to the workplace, and student can explain why.	Service/business content used was appropriate to the workplace.	Service/business content used was slightly appropriate to the workplace.	Service/business content used was not appropriate to the workplace.	
				Total Score	

Name _____

Date: _____

Period: _____

Journal Rubric (1.3)

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

Comments:

Name: _____

Date: _____

Period: _____

21st Century Life and Career Skills Rubric (1.4)

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

Superior (18–20 points): The student consistently demonstrates all aspects of this skill in classroom and laboratory activities.

Exceptional (15–17 points): The student consistently demonstrates most of the aspects of this skills in classroom and laboratory activities but lapses at times on one to two of the indicators.

Adequate (12–14 points): The 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	Total
Flexibility and Adaptability		
Initiative and Self-Direction		
Social and Cross-Cultural Skills		
Productivity and Accountability		
Leadership and Responsibility		
	TOTAL SCORE	

Name: _____

Date: _____

Period: _____

Rubric for Assessing Team-Building and Participation Skills (1.5)

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

Notes:

Name: _____

Date: _____

Period: _____

Scorecard for Assessing Parliamentary Procedure Skills (1.6)

Sample Scorecard for Parliamentary Procedure Demonstration

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

Adapted from FFA CDE Handbook

Name: _____

Date: _____

Period: _____

Select a Personal/Leadership Activity Assignment (1.7)

Which activity did you select?

Why did you select this activity?

When will this activity take place?

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

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

Name: _____

Date: _____

Period: _____

Leadership Characteristics Survey (1.8)

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

_____ 1. Honesty/Integrity – Personally holding a high moral standard and expressing the truth

_____ 2. Visionary/Forward looking – The ability see clearly into the future and communicate this vision to others

_____ 3. Competence – Knowledge of the organization, its goals, strengths, and limitations

_____ 4. Inspiring – The ability to get other people excited about your ideas and plans

_____ 5. Intelligence – The ability to locate knowledge and apply it to the current situation

_____ 6. Dedication/Commitment – The ability to concentrate and keep on, even if the situation is difficult

_____ 7. Openness – The ability to freely express your thoughts and to listen to the thoughts of others

_____ 8. Humility – A feeling that as a leader you are no more important than anyone else

_____ 9. Willingness to share – The ability to give credit for success to others

_____ 10. Fair and equitable – The ability to make decisions and treat other people fairly

What can you do to improve your three weakest indicators?

Name: _____

Date: _____

Period: _____

Sample Rubric for Evaluating Work Ethics and Values (1.9)

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

Name: _____

Date: _____

Period: _____

Rubric for Evaluating Student Chart on Plant Parts and Functions (2.1)

Rate each factor below using the following scale:

5 – Excellent (100%)

4 – Very Good (90–99%)

3 – Good (80–89%)

2 – Acceptable (70–79%)

1 – Needs Improvement (<70%)

_____ 1. Drew a diagram of a plant and labeled the four major parts (roots, stem, leaves, and flowers)

_____ 2. Described structure and function of roots

_____ 3. Described structure and function of stems

_____ 4. Described structure and function of leaves

_____ 5. Described structure and function of complete flowers

Name: _____

Date: _____

Period: _____

Chart for Comparing Photosynthesis, Respiration, and Transpiration (2.2)

For each process, identify or describe the following:

	Photosynthesis	Respiration	Transpiration
Inputs			
Outputs			
Lighting			
Contributing Factors			
Primary Difference			

Name: _____

Date: _____

Period: _____

Classification Poster Rubric (2.3)

I Got This √	Poster Content	What It Is Worth	Points Obtained
	Common name of plant	10	
	One statistic about your plant	20	
	Classification (Family, genus, specie, and variety)	20	
	Description of native status (Use more than one source if necessary.)	10	
	Image of plant	20	
	Distribution in US and/or internationally (Picture or text)	20	
	Quality Indicators		
	Quality of information • Poster provides accurate information and demonstrates complete understanding. (40) • Poster provides accurate information and demonstrates partial understanding. (20 • Poster contains inaccurate information and/or demonstrates limited understanding. (10)	40	
	Demonstration of understanding • Poster is very clear and easy to comprehend. (20) • Poster is cluttered but comprehensibile. (15) • Poster is not easy to read or understand. (10)	20	
	Production quality • Poster is creative and original. (20) • Poster shows some creativity. (15) • Poster shows little creativity and orginiality. (10)	20	
	Overall Appeal		

Name: _____

Date: _____

Period: _____

Daily Participation Rubric (2.4)

CATEGORY	90–100 points/day	80–89 points/day	70–79 points/day	60–69 points/day	0–59 points/day
Attitude	Consistently positive attitude	Mostly positive attitude	Somewhat positive attitude	Neutral attitude	Somewhat to totally negative attitude
Pride	Work reflected the best the student could offer.	Work reflected a strong effort.	Work reflected some effort.	Work reflected very little effort.	No effort and no work
Focus on the Task	Student consistently focused on task or topic.	Student focused on task or topic most of the time.	Student focused on the task or topic some of the time.	Student paid little attention to the task or topic.	Student did not focus on the assigned task or topic.
Participation	Student consistently participated in an appropriate manner.	Student participated most of the time.	Student participated some of the time.	Student participated occasionally.	Student refused to participate.

Name:	
Date:	
Period:	

Annual, Biennial, or Perennial (2.5)

Classify each of the following common plants as either an annual (A), a biennial (B), or a perennial (P).

_____	Parsley	_____	Corn	_____	Cotton
_____	Asparagus	_____	Roses	_____	Carrots
_____	Magnolia	_____	Daffodils	_____	Marigold
_____	Pansy	_____	Iris	_____	Soybean
_____	Lettuce	_____	Lima Bean	_____	Dandelion

Name: _____

Date: _____

Period: _____

Debate Rubric (2.6)

	Exemplary **4 Points**	**Accomplished** **3 Points**	**Developing** **2 Points**	**Beginning** **1 Point**	**Score**
Information	All information was accurate and clear.	Most information was accurate and clear.	Most information was accurate but not completely thorough or clear.	Information was inaccurate or needed clarification.	
Rebuttal	All counterarguments were accurate, relevant, and strong.	Most counter-arguments were accurate, relevant, and strong.	All counterarguments were accurate and relevant, but some were weak.	Counterarguments were not accurate or relevant.	
Organization	All arguments were logical and clearly followed a premise.	Most arguments were logical and clearly followed a premise.	Arguments were logical but did not always follow a premise.	Arguments were not logical and/or did not follow a premise.	
Understanding of the Topic	The individual/team clearly understood the topic fully and presented in a convincing manner.	The individual/team clearly understood the topic fully and presented with ease.	The individual/team understood the main points of the topic and presented those well.	The individual/team did not exhibit an adequate understanding of the topic.	
				Total Score	

Name: _____

Date: _____

Period: _____

KWL Chart: Teacher Instructions (2.7)

Purposes

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

Process

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

Name: _____

Date: _____

Period: _____

KWL Chart

KNOW	WHAT TO KNOW	WHAT I LEARNED

Name: _____

Date: _____

Period: _____

Plant Nutrient PowerPoint Presentation (2.8)

Worth 100 points

	Points Worth	Points Obtained
Slide Creation		
• Title slide	5	
• Introduction slide (Identify if macro/micro; elemental symbol)	5	
• Function in the Plant slide with pH reference	10	
• Deficiencies/Excess explanation with Illustration	10	
• Summary (no new information presented)	10	
• Reference Page	5	
Slide Format		
Bulleted list instead of paragraphs on slides	10	
Text Format/Capitalization Consistency (i.e., titles, bullets)	10	
Transition and Effect	5	
Presentation of Information		
• Voice Projection	10	
• Posture	5	
• Eye Contact with Audience	5	
• Familiar with Content	5	
• Answers to questions	5	
	Subtotal	
	Minus 2 points for each misspelled word	
	Minus 5 points for presentation over 5 minutes NOT including questions	
	Total	

- Each slide should have “Title Case.”
- Bulleted list should have consistency in formatting with no more than six bullets/slide.
- Summary never contains “new information.”
- Reference page should include where it came from (i.e., organization), not just the Web address.
- Presentation should be no longer than 5 minutes that does not include answers to questions.

Name: _____

Date: _____

Period: _____

Nutrient Deficiencies and Excesses Experiment (2.9)

Daily Observation Table

Treatment	Replication	Plant Height	Vigor Rating	Comments
Fertilizer Type	T-I			
	T-II			
Control Group	C-1			
	C-2			

- **Follow-Up Observations**
- Follow-up Observation and Summary

Treatment	Replication	Average Plant Height	Average Vigor Rating	Comments on color, deficiencies, excesses, etc.
Fertilizer Type	**T-I**			
	T-II			
Control Group	**C-1**			
	C-2			

- Major findings, summary, and recommendations: (Note to Instructor: Tables can be tailored to fit the experimental design. Students should record procedures and summarize results. Instructor can provide examples of findings, summary, and recommendations.)

Name: _____

Date: _____

Period: _____

Daily Participation Rubric (2.10)

CATEGORY	100 points/day	90 points/day	80 points/day	70 points/day	50 points/day
Attitude	I always have a positive attitude about the task(s).	I often have a positive attitude about the task(s).	I usually have a positive attitude about the task(s).	I often have a negative attitude about the task(s).	I refused to do the assigned task(s).
Pride	The work I did reflected my best effort.	The work I did reflected a strong effort.	My work reflected some effort.	My work reflected very little effort.	I refused to work on any assigned task.
Focus on the Task	I stayed focused on the task and what needed to be done.	I focused on the task and what needed to be done most of the time.	I focused on the task and what needed to be done some of the time.	I did not focus on the task and what needed to be done. I let others do the work.	I did not focus on any assigned task.
Cleanup	I helped make sure cleanup task were done to completion.	I helped do some of the cleanup task.	Cleanup tasks were done, but I did not participate.	The work space was left in a mess.	I refused to participate in cleanup.

Students will get up to 100 points/day for a possible total of 500 points for the week. A weekly average will be taken and posted on PARENT CONNECT for your viewing.

If a student is absent, he or she will be held responsible for making up any daily assignments and/or task missed.

I have read and understand the above terms in which grades will be issued based on my daily participation in Horticulture class.

_____

Student Name **Date**

_____

Parent/Guardian Name **Date**

Name: _____

Date: _____

Period: _____

Soil Test Report Summary (2.11)

Directions: Put your name on the top line, and fill in information under each column about the soil sample you brought in. Do the same for your group and each classmate.

Student Name	Soil Sample Site	Soil Type	Soil pH	Nutrient Content (if taken)			Recommendations
				N	P	K	

- The purpose of this table is to compile **all** soil sample information. Students should write down their results and their group test results and other classmate test results.

Name: _____

Date: _____

Period: _____

Fertilizer Calculation Worksheet (2.12)

For each of the following situations, calculate the total amount of fertilizer that should be applied. You may use a calculator, but show all calculations in the space below each situation. (Round you answer to the nearest whole pound.)

1. A soil test reports that you should apply 60 lb of active nitrogen per acre to a corn field. If you are planning on using ammonium nitrate which is 34% N, how many pounds of this material would you apply on one acre?

2. Ammonium phosphate is a fertilizer material with an analysis of 18-46-0. If a soil test calls for application of 50 lb of active phosphate per acre, how many pounds of this material would you apply to a 120-acre pasture?

3. A soil test for a lawn calls for the application of 1 ½ lb of active nitrogen per 1,000 sq ft. If calcium nitrate contains 15% active N, how many pounds will be needed for a lawn that is 7,000 sq ft?

4. A soil test shows that a lawn is deficient in nitrogen and phosphate. If the test recommends that at least 1 lb of nitrogen and 2.5 lb of phosphate be applied to every 1,000 sq ft of lawn and if ammonium phosphate is rated as an 18-46-0 fertilizer, how many pounds of ammonium phosphate would you apply to a 10,000 sq ft lawn to make sure you applied enough nitrogen? At this rate, how many pounds of phosphate would you also be applying?

- ANSWER SHEET FOR FERTILIZER CALCULATION WORKSHEET

1. 1 lb ammonium nitrate = 0.34 lb active nitrogen
   60 lb active nitrogen ÷ 0.34 lb active nitrogen/1 lb ammonium nitrate = 176 lb ammonium nitrate per acre

2. 1 lb ammonium phosphate = 0.46 lb active phosphate
   50 lb active phosphate ÷ 0.46 lb active phosphate/1 lb ammonium phosphate = 109 lb ammonium phosphate per acre
   109 lb per acre x 120 acres = 13,080 lb

3. 1 lb calcium nitrate = 0.15 lb active nitrogen
   1 ½ lb active nitrogen ÷ 0.15 lb active nitrogen/1 lb calcium nitrate = 10 lb calcium nitrate per 1,000 sq ft
   10 lb/1,000 sq ft x 7,000 sq ft = 70 lb of calcium nitrate

4. 1 lb ammonium phosphate = 0.18 lb active nitrogen and 0.46 lb active phosphate
   1 lb active nitrogen ÷ 0.18 lb active nitrogen/1 lb ammonium phosphate = 6 lb ammonium phosphate per 1,000 sq ft
   6 lb/1,000 sq ft x 10,000 sq ft = 60 lb
   6 lb ammonium phosphate x 0.46 lb active phosphate per 1 lb ammonium phosphate = 3 lb active phosphate

Name: _____

Date: _____

Period: _____

Presentation Assessment Rubric (2.13)

	Exemplary **4 Points**	**Accomplished** **3 Points**	**Developing** **2 Points**	**Beginning** **1 Point**	**Score**
Content	Clear, appropriate, and correct	Mostly clear, appropriate, and correct	Somewhat confusing, incorrect, or flawed	Confusing, incorrect, or flawed	
Clarity	Logical, interesting sequence	Logical sequence	Unclear sequence	No sequence	
Presentation	Clear voice and precise pronunciation	Clear voice and mostly correct pronunciation	Low voice and incorrect pronunciation	Mumbling and incorrect pronunciation	
Visual Aids	Attractive, accurate, grammatically correct	Adequate, mostly accurate, few grammatical errors	Poorly planned, somewhat accurate, some grammatical errors	Weak, inaccurate, many grammatical errors	
Length	Appropriate length	Slightly too long or short	Moderately too long or short	Extremely too long or short	
Eye Contact	Maintains eye contact, seldom looking at notes	Maintains eye contact most of time but frequently returns to notes	Occasionally uses eye contact but reads most of information	No eye contact because reading information	
				Total Score	

Name: _____

Date: _____

Period: _____

Structure and Control Systems Presentation and Rubric (3.1)

Assign a student or pair of students to research each of the following topics and prepare a PowerPoint presentation to be made to the entire class: even span greenhouses, Quonset greenhouses, ridge and furrow greenhouses, greenhouse coverings (fiberglass, polyethylene, polycarbonate, and shade cloths), heating systems and controls, cooling systems and controls, humidity indicators, and ventilation systems and controls. All students should make a presentation as it will count for a grade. Presentations will be evaluated using the rubric on the following page.

Have students present their PowerPoint presentations to the class as a whole. After the presentations, have students ask questions and hold a class discussion to make sure that all important points are covered. Have students summarize the major points of each presentation and enter into their electronic journals or notebooks. Questions on the major points covered will be included on the unit test.

PowerPoint Presentation Criteria and Rubric

100 points

Topic: _____

Name: **Date:**

	Points Worth	**Points Obtained**
Slide Creation (Three–six slides including reference page; all slides should contain pictures)		
• Title slide	5	
• Introduction slide with description and picture	5	
• Characteristics	10	
• Advantages/disadvantages/uses	10	
• Summary (no new information presented)	10	
• Reference page	5	
Slide format		
Bulleted list NOT PARAGRAPHS	10	
Text format/capitalization consistency(i.e., titles, bullets)	10	
Transition and effect	5	
Presentation of Information		
• Voice projection	10	
• Posture	5	
• Eye contact with audience	5	
• Familiar with content	5	
• Answers to questions	5	
	Subtotal	
Minus 2 points for each misspelled word and/or grammatical error		
Minus 5 points for presentation over 5 min NOT including questions		

Plant Water/Fertigation/Chemigation Management Data Sheet (3.2)

Did you use fertilizer?	If yes, with what?	At what rate?
Y N		
Did you use chemicals?	**If yes, with what?**	**At what rate?**
Y N		

Plant Name	Location	Pot Size	Soil Condition	Prunned?	Plant Health Observations	Other Comments

Name: _____

Date: _____

Period: _____

Unit Test Questions (4.1) Highlights are the correct answers.

Directions: Circle T if the statement is correct and F if the statement is false (5 pts ea).

	True	False	Question
1	T	F	rDNA uses DNA molecules from two unrelated organisms to create superior offspring.
2	T	F	DNA is located in chromatins.
3	T	F	Seeds require light for germination.
4	T	F	Leaves of a monocot have parallel venations.
5	T	F	Explants are small pieces of plants used in tissue culture.

Directions: Multiple Choice. Circle the best answer for each question. (5 pts each)

1. What is the molecular chain that stores genetic information in all living cells?
   a. Chromosomes
   b. Nucleus
   c. DNA
   d. Nuclear envelop
2. What profession involves genetic engineering of plants?
   a. Biotechnology
   b. Entomology
   c. Pathology
   d. Toxicology
3. Seeds develop from what part of the flower?
   a. Ovule
   b. Ovary
   c. Sperm
   d. Epicotyl
4. The process whereby a seed must go through a period of cold temperatures before it germinates is called:
   a. stratification.
   b. scarification.
   c. propagation.
   d. dissemination.
5. What form of plant reproduction involves the combining of genetic material from two parents?
   a. Sexual plant reproduction
   b. Asexual plant reproduction
   c. Tissue culture

d. Vegetative cuttings

6. What part of the flower develops into the fruit?
   a. Ovule
   b. Ovary
   c. Sperm
   d. Epicotyl
7. Seed leaves are called:
   a. embryo.
   b. cotyledon.
   c. epicotyl.
   d. hypocotyl.
8. What type of asexual plant reproduction allows for thousands of identical plants produced from small pieces of plants?
   a. Vegetative cuttings
   b. Layering
   c. Division
   d. Tissue culture

Name: _____

Date: _____

Period: _____

Germination Test Experiment (4.2)

Seed Germination Data Sheet

Date turned in: _____

Names in group: _____

Type of seed: Acorn

Treatments	Date planted	# planted	Seed coat Split date	Temp when planted	Date germinated	# Germinated	% Germinated	Comments
Refrigerated								
Greenhouse								
Incubator								
Classroom								

Type of seed: Bean

Treatments	Date planted	# planted	Seed coat Split date	Temp when planted	Date germinated	# Germinated	% Germinated	Comments
Refrigerated								
Greenhouse								
Incubator								
Classroom								

Type of seed: Corn

Treatments	Date planted	# planted	Seed coat Split date	Temp when planted	Date germinated	# Germinated	% Germinated	Comments
Refrigerated								
Greenhouse								
Incubator								
Classroom								

SUMMARY OF RESULTS: (30 pts) Discussion should include everything you did (procedures).

- Students could be placed in groups.
- Media should be the same. Moist peat moss usually recommended
- Have one data sheet per group.
- Each piece of data in the chart could be worth 5 and summary worth 20 points.

Adapted from Dirr, M & Heuser, C. JR. (1987). *The reference manual of woody plant propagation. From see to tissue culture.* Varsity Press, Inc. Athens, GA. ISBN 0-942375-00-9

Name: _____

Date: _____

Period: _____

Activity Rubric (4.3)

Task to Be Performed_____

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

Comments for Deductions:

Name: _____

Date: _____

Period: _____

Rooting Hormone Experiment Data Collection Sheet (4.4)

Rooting Hormone Experiment						
Plant Type:						
Media Type:						
Names in Group:						
Treatments	**ROOT RATINGS - After 1 Month**					
	0	**1**	**2**	**3**	**4**	**5**
RH-Plant1						
RH-P2						
RH-P3						
No rooting hormone						
No-RH-P1						
No-RH-P2						
No-RH-P3						

Root ratings are based on a scale with 0 = Dead and 5 = Most Roots.

SUMMARY OF RESULTS:

Name: _____

Date: _____

Period: _____

Pest Identification Chart (5.1)

PEST IDENTIFICATION CHART - 100 points Collect 10 samples, and fill in the chart. (2 pts each)				
Student Name:			**Date:**	
Pest Name	**Type of Pest (i.e., weed, insect, disease)**	**Location Collected**	**Type of Damage**	**Biological Control Recommendation**

Name: _____

Date: _____

Period: _____

Integrated Pest Management Plan Rubric (5.2)

Component	Possible Points	Score
Background: The plan clearly identified the plants to be protected under the plan and the most commonly associated pests including weeds, diseases, and insects. Life cycle and damage caused by each pest was described.	25	
Cultural and Mechanical Controls: The plan identified and described how cultural and mechanical pest control methods would be implemented and maintained during the growing season.	25	
Biological Controls: The plan identified any biological controls that would be implemented and maintained during the growing season.	25	
Chemical Controls: The plan identified chemical controls that would be used including the economic threshold that would cause chemicals to be applied and specific chemicals and formulations that would be used.	25	
	Total	

Name: _____

Date: _____

Period: _____

Pesticide Label Interpretation Assignment (5.3)

Your teacher will assign you a specific chemical pesticide. You are to search the Internet, locate a label for this chemical, and answer the following questions:

1. What is the active ingredient in this product and its percentage?

2. What personal protective equipment should be used when working with this pesticide?

3. What pests does this pesticide control?

4. How is this pesticide applied, and what plants are approved for its use?

5. What type(s) of formulation(s) are manufactured for this chemical?

6. If someone accidentally swallowed this material, what should you do?

Name: _____

Date: _____

Period: _____

Beneficial Insects Ag News Report Rubric (5.4)

Your instructor will assign you one of the beneficial insects listed below. Prepare a 1–2-min Ag News Report that includes the following information: (1) picture of the insect, (2) plants that are associated with the insect, and (3) pests that they aid in controlling.

Ladybugs
Praying mantis
Bees
Parasitic wasps

Name / Topic Presented	Introduction (name and source)	Relevant to Subject	Posture	Voice Projection	Eye Contact with Audience	Familiarity with Content	Visual Aid	Answers Questions	Total

Grading Instructions

Each News Report should be no less than 1 min and no more than 2. Teacher will hold up a sign at ½ min, 1 min, and 2 min. There will be a 5-point deduction for less than 1 and more than 2, unless permission and/or different instruction are given from teacher.

REMEMBER THERE WILL BE 10 POINTS DEDUCTED FOR EACH DAY LATE.

Name: _____

Date: _____

Period: _____

Interpret Pesticide Label Rubric (5.5)

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

1. What is the Web address of the Internet site that you found this information on?

2. If you accidentally drank some of this material, what is the first-aid procedure you would do first?

3. What special precautions should be taken in storing this material?

4. What is the flash point of this material?

5. If you spilled a small amount of this product, how would you clean it up?

6. What immediate effects would likely happen if you spilled some of this material on your skin?

Name: _____

Date: _____

Period: _____

Greenhouse Crops Keyword Worksheet (6.1)

1. Directions: Read the following paragraph, underline keywords already learned in lecture, and be prepared to discuss their meaning.

2. Hundreds of different annuals, perennials, herbs, and vegetable transplants can be grown and sold as bedding plants. A single commercial greenhouse business may produce as many as 500 different kinds of bedding plants in the spring. Some of the most popular bedding plants include impatiens, petunias, geraniums, pansies, begonias, and marigolds. Tomatoes, peppers, and cole crops are popular vegetable transplants.

Name: _____

Date: _____

Period: _____

Growing Crops Data Sheet (6.2)

1. Name of plant:
2. Length of time from seeding to market size:
3. Projected market date:
4. Planting date:
5. Type of container used:
6. Type of media used:
7. Number of seeds planted:
8. Number of seeds that germinated:
9. Use the following table to record events and growth records for your plants such as planting date, number of seeds that germinated, and fertilization, watering, and pest control practices:

DATE	ACTIVITIES	TIME SPENT	AVERAGE HEIGHT OF PLANTS

10. Enter the total cost of production below. (If you used school materials, have your teacher provide you with an estimated cost.)

Containers
Media
Fertilizer
Pest Control
Other Costs
TOTAL COSTS

11. How many plants did you produce?

12. What was the average cost per plant?

Name: _____

Date: _____

Job Sheet/Performance Rubric (6.3)

	Exemplary 4 Points	Accomplished 3 Points	Developing 2 Points	Beginning 1 Point	Score
Safety	Student follows all safety regulations without prompting.	Student follows all safety regulations but may require limited reminders or prompting.	Student follows all or nearly all safety regulations but requires significant reminders.	Student does not follow most safety regulations.	
Guidelines	Student properly diagnoses problem according to manufacturer guidelines and specifications within manufacturer-specified time limits.	Student properly diagnoses problem according to manufacturer guidelines and specifications but may take additional time.	Student properly diagnoses problem according to manufacturer guidelines and specifications with limited assistance.	Student's work is not performed to manufacturer guidelines and specifications.	
Diagnosis	Student quickly and accurately diagnoses problems and accurately determines causes of malfunction based on information obtained from resources.	Student accurately diagnoses problems and accurately determines causes of malfunction based on information obtained from resources.	Student diagnoses problem with limited assistance. With limited assistance, student determines causes of malfunction based on information obtained from resources.	Student is unable to diagnose problem.	
Written Information	Written report is accurate and complete and demonstrates thorough understanding of systems, how they operate, safety procedures, and importance of manufacturer recommendations.	Written report is accurate and complete and demonstrates solid understanding of systems, how they operate, safety procedures, and importance of manufacturer recommendations.	Written report is mostly accurate and complete and demonstrates understanding of types of systems, how they operate, safety procedures, and importance of manufacturer recommendations.	Written report is inaccurate and/or incomplete or indicates limited to no understanding of types of systems, how they operate, safety procedures, and importance of manufacturer recommendations.	
				Total Score	

Name: _____

Date: _____

Period: _____

Horticulture News Rubric (6.4)

Student Name	Content relevant to plant content (40 points)	Content current, accurate, and reliable (40 points)	Grammar, punctuation, and spelling (20 points)	Total (100 points possible)
			Total Score	

Name: _____

Date: _____

Period: _____

Written Report Rubric (6.5)

	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	
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	

Comments:

Name: _____

Date: _____

Period: _____

Guest Speaker Evaluation Form (7.1)

Name of Speaker: _____

1. List five main ideas expressed in the presentation.

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

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

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Name: _____

Date: _____

Period: _____

Field Trip Checklist (8.1)

_____ 1. The student arrived at the designated meeting place on time with all materials and supplies required for the field trip.

_____ 2 The student observed all safety rules and policies while traveling to and participating in the field trip.

_____ 3. The student demonstrated interest in the content of the field trip by paying attention to the exhibits and speakers, asking pertinent questions, and taking notes.

_____ 4. The student exhibited a positive attitude toward the events and activities of the field trip.

_____ 5. The student remained on task throughout the field trip.

_____ 6. The student exhibited cooperative workplace skills with other students throughout the field trip.

Name: _____

Date: _____

Period: _____

PowerPoint Presentation on Displaying Inventory of Plants and Supplies (9.1)

	Exemplary 4 points	Accomplished 3 points	Developing 2 points	Beginning 1 point	Score
Content	Provided detailed information on skills required, education and training, salaries and benefits, and occupational outlook	Provided general information on skills required, education and training, salaries and benefits, and occupational outlook	Provided limited information on skills required, education and training, salaries and benefits, and occupational outlook	Did not provide information on all required topics	
Accuracy and Reliability	All information was accurate and reliable.	All information was generally accurate and reliable.	All information was generally accurate and somewhat reliable.	Information was inaccurate and/or unreliable.	
References	Cited four or more references	Cited three references	Cited two references	Cited only one reference	
Grammar, Spelling, Punctuation, etc.	No mistakes	One to two minor mistakes	Three to four minor mistakes or one major error	More than four minor mistakes or two or more major errors	
Visual Aids	Attractive, accurate, and grammatically correct	Adequate, mostly accurate, and few grammatical errors	Poorly planned, somewhat accurate, and some grammatical errors	Weak, inaccurate, and many grammatical errors	
Length	Appropriate length	Slightly too long or short	Moderately too long or short	Extremely too long or short	
				TOTAL	

Comments:

Name: _____

Date: _____

Period: _____

Role-Play or Skit Rubric (9.2)

	Exemplary 4 Points	Accomplished 3 Points	Developing 2 Points	Beginning 1 Point	Score
Accuracy	All information was accurate.	Almost all information was accurate.	Most information was accurate.	Very little information was accurate.	
Role	Excellent character development; student contributed in a significant manner	Good character development; student contributed in a cooperative manner	Fair character development; student might have contributed	Little or no character development; student did not contribute much at all	
Knowledge Gained	Can clearly explain several ways in which his or her character "saw" things differently than other characters and can explain why	Can clearly explain several ways in which his or her character "saw" things differently than other characters	Can clearly explain one way in which his or her character "saw" things differently than other characters	Cannot explain any way in which his or her character "saw" things differently than other characters	
Props	Used several props and showed considerable creativity	Used one or two appropriate props that made the presentation better	Used one or two props that made the presentation better	Used no props to make the presentation better	
Required Elements	Included more information than required	Included all required information	Included most required information	Included less information than required	
				Total Score	

Name: _____

Date: _____

Period: _____

Student Electronic Notebook Rubric (9.3)

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

Name: _____

Date: _____

Period: _____

Group Participation Rubric (10.1)

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

Name: _____

Date: _____

Period: _____

Poster Assessment Rubric (11.1)

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

Name: _____

Date: _____

Period: _____

Home Lawns in Mississippi (12.1)

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

Turf grass	Cultural Needs	Mowing Requirements

Name: _____

Date: _____

Period: _____

Equipment Operation Record Rubric (12.2)

Equipment Operation: Properly operates equipment at the correct speed and the operation (cutting height, sprayer, or spreader) is properly adjusted or calibrated for the type of turf.	20
Safety: Safety procedures are followed.	40
Cleanup procedures are followed.	40
TOTAL SCORE	100

Name: _____

Date: _____

Period: _____

Written Report Rubric (13.1)

	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	
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	

Comments:

Appendix B: 21st Century Skills Standards[1]

CSS1-21st Century Themes

CS1 Global Awareness

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

CS2 Financial, Economic, Business, and Entrepreneurial Literacy

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

CS3 Civic Literacy

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

CS4 Health Literacy

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

CS5 Environmental Literacy

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

CSS2-Learning and Innovation Skills

CS6 Creativity and Innovation

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

CS7 Critical Thinking and Problem Solving

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

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[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: Mississippi Academic Standards

Marine and Aquatic Science

AQ Marine and Aquatic Science

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

a. Describe the impact of natural and human activity on aquatic ecosystems, and evaluate the effectiveness of various solutions to environmental problems. (DOK 3)
   - Sources of pollution in aquatic environments and methods to reduce the effects of the pollution
   - Effectiveness of a variety of methods of environmental management and stewardship
   - Effects of urbanization on aquatic ecosystems and the effects of continued expansion
b. Research and cite evidence of the effects of natural phenomena such as hurricanes, floods, or drought on aquatic habitats and organisms. (DOK 3)
c. Discuss the advantages and disadvantages involved in applications of modern technology in aquatic science. (DOK 2)
   - Careers related to aquatic science
   - Modern technology within aquatic science (e.g., mariculture and aquaculture)
   - Contributions of aquatic technology to industry and government

Biology I

BIOI Biology I

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

a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
   - Safety rules and symbols
   - Proper use and care of the compound light microscope, slides, chemicals, 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 2)
d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)

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

a. Explain and compare with the use of examples the types of bond formation (e.g., covalent, ionic, hydrogen, etc.) between or among atoms. (DOK 2)
   - Subatomic particles and arrangement in atoms
   - Importance of ions in biological processes
b. Develop a logical argument defending water as an essential component of living systems (e.g., unique bonding and properties including polarity, high specific heat, surface tension, hydrogen bonding, adhesion, cohesion, and expansion upon freezing). (DOK 2)
c. Classify solutions as acidic, basic, or neutral, and relate the significance of the pH scale to an organism's survival (e.g., consequences of having different concentrations of hydrogen and hydroxide ions). (DOK 2)

d. Compare and contrast the structure, properties, and principle functions of carbohydrates, lipids, proteins, and nucleic acids in living organisms. (DOK 2)
   - Basic chemical composition of each group
   - Building components of each group (e.g., amino acids, monosaccharides, nucleotides, etc.)

- Basic functions (e.g., energy, storage, cellular, 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. <u>Investigate and evaluate the interaction between living organisms and their environment.</u>

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. <u>Analyze and explain the structures and function of the levels of biological organization.</u>

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, microfiliaments, 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. <u>Demonstrate an understanding of the molecular basis of heredity.</u>

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

a. Draw conclusions about how organisms are classified into a hierarchy of groups and subgroups based on similarities that reflect their evolutionary relationships. (DOK 2)
   - Characteristics of the six kingdoms
   - Major levels in the hierarchy of taxa (e.g., kingdom, phylum/division, class, order, family, genus, and species)
   - Body plans (symmetry)
   - Methods of sexual reproduction (e.g., conjugation, fertilization, 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 Biology II

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

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

2. <u>Describe and contrast the structures, functions, and chemical processes of the cell.</u>

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. <u>Investigate and discuss the molecular basis of heredity.</u>

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

a. Explain the history of life on earth, and infer how geological changes provide opportunities and constraints for biological evolution. (DOK 2)
   - Main periods of the geologic timetable of earth's history
     - Roles of catastrophic and gradualistic processes in shaping planet Earth

b. Provide support for the argument based upon evidence from anatomy, embryology, biochemistry, and paleontology that organisms descended with modification from common ancestry. (DOK 2)

c. Identify and provide supporting evidence for the evolutionary relationships among various organisms using phylogenetic trees and cladograms. (DOK 2)

d. Formulate a scientific explanation based on fossil records of ancient life-forms, and describe how new species could originate as a result of geological isolation and reproductive isolation. (DOK 2)

e. Compare and contrast the basic types of selection (e.g., disruptive, stabilizing, directional, etc.). (DOK 2)

f. Cite examples to justify behaviors that have evolved through natural selection (e.g., migration, parental care, use of tools, etc.). (DOK 1)

g. Research and explain the contributions of 19th century scientists (e.g., Malthus, Wallace, Lyell, and Darwin) on the formulation of ideas about evolution. (DOK 2)

h. Develop a logical argument describing ways in which the influences of 20th century science have impacted the development of ideas about evolution (e.g., synthetic theory of evolution, molecular biology). (DOK 3)

i. Analyze changes in an ecosystem resulting from natural causes (succession), changes in climate, human activity (pollution and recycling), or introduction of nonnative species. (DOK 2)

5. **Develop an understanding of organism classification.**
   a. Classify organisms according to traditional Linnaean classification characteristics (e.g., cell structure, biochemistry, anatomy, fossil record, methods of reproduction) and the cladistic approach. (DOK 2)
   b. Categorize organisms according to the characteristics that distinguish them as Bacteria, Archaea, or Eucarya. (DOK 1)
      - Bacteria, fungi, and protists
      - Characteristics of invertebrates (e.g., habitat, reproduction, body plan, locomotion) as related to phyla (e.g., Porifera, Cnidarians, Nematoda, Annelida, Platyhelmenthes, 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

BOI Botany I

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
   a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
      - Safety rules and symbols
      - Proper use and care of the compound light microscope, slides, chemicals, etc.
      - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
   b. Formulate questions that can be answered through research and experimental design. (DOK 3)
   c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
   d. Construct and analyze graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs). (DOK 2)
   e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
   f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
   g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
2. **Distinguish among the characteristics of botanical organization, structure, and function.**
   a. Relate plant cell structures to their functions (e.g., major organelles, cell wall components, photosynthetic chemical reactions, plant pigments, plant tissues, roots, stems, leaves, flowers). (DOK 1)
   b. Differentiate the characteristics found in various plant divisions. (DOK 2)
      - Differences and similarities of nonvascular plants
      - Characteristics of seed-bearing and non-seed bearing vascular plants relative to taxonomy
      - Major vegetative structures and their modifications in angiosperms and gymnosperms
   c. Compare and contrast leaf modifications of gymnosperms and angiosperms (e.g., needles, overlapping scales, simple leaves, compound leaves, evergreen trees, and deciduous trees). (DOK 2)
   d. Apply the modern classification scheme utilized in naming plants to identify plant specimens. (DOK 2)
      - Classification scheme used in botany
      - Classification of native Mississippi plants
   e. Use inquiry to investigate and discuss the physical and chemical processes of plants. (DOK 3)
      - Relationships among photosynthesis, cellular respiration, and translocation
      - Importance of soil type and soil profiles to plant survival
      - Mechanism of water movement in plants
      - Effects of environmental conditions for plant survival
      - Tropic responses of a plant organ to a given stimulus

3. **Demonstrate an understanding of plant reproduction.**
   a. Compare and contrast reproductive structures (e.g., cones, flowers). (DOK 2)
   b. Differentiate among the vegetative organs of monocots, herbaceous dicots, and woody dicots. (DOK 1)
   c. Differentiate between the structures and processes of sexual and asexual reproduction in plants. (DOK 1)
      - Reproductive structures, their modifications, and the mechanisms involved in plant reproduction
      - Functions of flower parts, seeds, cones
      - Spore production in bryophytes and ferns
   d. Explain and provide examples of the concept of alternation of generations and its examples. (DOK 2)
   e. Categorize types of fruits and methods of seed distribution in plants. (DOK 1)
   f. Research and compare various methods of plant propagation. (DOK 2)
4. **Draw conclusions about the factors that affect the adaptation and survival of plants.**
   a. List and assess several adaptations of plants to survive in a given biome. (DOK 2)
   b. Design and conduct an experiment to determine the effects of environmental factors on photosynthesis. (DOK 3)
   c. Explain how natural selection and the evolutionary consequences (e.g., adaptation or extinction) support scientific explanations for similarities of ancient life-forms in the fossil record and molecular similarities present in living organisms. (DOK 2)
   d. Research factors that might influence or alter plant stability, and propose actions that may reduce the negative impacts of human activity. (DOK 2)
5. **Relate an understanding of plant genetics to its uses in modern living.**
   a. Research, prepare, and present a position relating to issues surrounding the current botanical trends involving biotechnology. (DOK 3)
   b. Apply an understanding of the principles of plant genetics to analyze monohybrid and dihybrid crosses, and predict the potential effects the crosses might have on agronomy and agriculture. (DOK 3)
   c. Discuss the effects of genetic engineering of plants on society. (DOK 2)
   d. Describe the chemical compounds extracted from plants, their economical importance, and the impact on humans. (DOK 3)
      - Plant extracts, their function, and origin
      - Impact of the timber industry on local and national economy

Chemistry I

CHI Chemistry I

1. **Apply inquiry-based and problem-solving processes and skills to scientific investigations.**
   a. Use current technologies such as CD-ROM, DVD, Internet, and online data search to explore current research related to a specific topic. (DOK 3)
   b. Clarify research questions and design laboratory investigations. (DOK 3)
   c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
   d. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)
   e. Evaluate procedures, data, and conclusions to critique the scientific validity of research. (DOK 3)
   f. Formulate and revise scientific explanations and models using logic and evidence (data analysis). (DOK 3)
   g. Collect, analyze, and draw conclusions from data to create a formal presentation using available technology (e.g., computers, calculators, SmartBoard, CBLs, etc.). (DOK 3)
2. **Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.**
   a. Describe and classify matter based on physical and chemical properties and interactions between molecules or atoms. (DOK 1)
      - Physical properties (e.g., melting points, densities, boiling points) of a variety of substances

- Substances and mixtures
- Three states of matter in terms of internal energy, molecular motion, and the phase transitions between them

b. Research and explain crucial contributions and critical experiments of Dalton, Thomson, Rutherford, Bohr, de Broglie, and Schrődinger, and describe how each discovery contributed to the current model of atomic and nuclear structure. (DOK 2)

c. Develop a model of atomic and nuclear structure based on theory and knowledge of fundamental particles. (DOK 2)
   - Properties and interactions of the three fundamental particles of the atom
   - Laws of conservation of mass, constant composition, definite proportions, and multiple proportions

d. Write appropriate equations for nuclear decay reactions, describe how the nucleus changes during these reactions, and compare the resulting radiation with regard to penetrating ability. (DOK 1)
   - Three major types of radioactive decay (e.g., alpha, beta, 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. <u>Develop an understanding of the periodic table.</u>

a. Calculate the number of protons, neutrons, and electrons in individual isotopes using atomic numbers and mass numbers, write electron configurations of elements and ions following the Aufbau principle, and balance equations representing nuclear reactions. (DOK 1)

b. Analyze patterns and trends in the organization of elements in the periodic table, and compare their relationship to position in the periodic table. (DOK 2)
   - Atomic number, atomic mass, mass number, and number of protons, electrons, and neutrons in isotopes of elements
   - Average atomic mass calculations
   - Chemical characteristics of each region
   - Periodic properties (e.g., metal/nonmetal/metalloid behavior, electrical/heat conductivity, electronegativity, electron affinity, ionization energy, 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 I Organic Chemistry

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

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

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

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

Earth and Space Science

EI Earth and Space Science

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

a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
   - Safety rules and symbols
   - Proper use and care of the compound light microscope, slides, chemicals, 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. <u>Develop an understanding of the history and evolution of the universe and earth.</u>

a. Summarize the origin and evolution of the universe. (DOK 2)
   - Big bang theory
   - Microwave background radiation
   - The Hubble constant
   - Evidence of the existence of dark matter and dark energy in the universe and the history of the universe
b. Differentiate methods used to measure space distances, including astronomical unit, light-year, stellar parallax, Cepheid variables, and the red shift. (DOK 1)
c. Interpret how gravitational attraction played a role in the formation of the planetary bodies and how the fusion of hydrogen and other processes in "ordinary" stars and supernovae 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. <u>Discuss factors which are used to explain the geological history of earth.</u>

a. Develop an understanding of how plate tectonics create certain geological features, materials, and hazards. (DOK 1)
   - Plate tectonic boundaries (e.g., divergent, convergent, and transform)
   - Modern and ancient geological features to each kind of plate tectonic boundary
   - Production of particular groups of igneous and metamorphic rocks and mineral resources
   - Sedimentary basins created and destroyed through time
b. Compare and contrast types of mineral deposits/groups (e.g., oxides, carbonates, halides, sulfides, sulfates, silicates, 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. <u>Demonstrate an understanding of earth systems relating to weather and climate.</u>

a. Explain the interaction of earth systems that affect weather and climate. (DOK 1)
   - Latitudinal variations in solar heating
   - The effects of Coriolis forces on ocean currents, cyclones, anticyclones, ocean currents, topography, and air masses (e.g., warm fronts, cold fronts, stationary fronts, and occluded fronts).
b. Interpret the patterns in temperature and precipitation that produce the climate regions on earth, and relate them to the hazards associated with extreme weather events and climate change (e.g., hurricanes, tornadoes, El Niño/La Niña, global warming). (DOK 2)

c. Justify how changes in global climate and variation in earth/sun relationships contribute to natural and anthropogenic (human-caused) modification of atmospheric composition. (DOK 2)
d. Summarize how past and present actions of ice, wind, and water contributed to the types and distributions of erosional and depositional features in landscapes. (DOK 1)
e. Research and explain how external forces affect earth's topography. (DOK 2)
   - How surface water and groundwater act as the major agents of physical and chemical weathering
   - How soil results from weathering and biological processes
   - Processes and hazards associated with both sudden and gradual mass wasting

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

a. Draw conclusions about how life on earth shapes earth systems and responds to the interaction of earth systems (lithosphere, hydrosphere, atmosphere, and biosphere). (DOK 3)
   - Nature and distribution of life on earth, including humans, to the chemistry and availability of water
   - Distribution of biomes (e.g., terrestrial, freshwater, and marine) to climate regions through time
   - Geochemical and ecological processes (e.g., rock, hydrologic, carbon, 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

ESI Environmental Science

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

a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
   - Safety rules and symbols
   - Proper use and care of the compound light microscope, slides, chemicals, 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. <u>Develop an understanding of the relationship of ecological factors that affect an ecosystem.</u>

a. Compare ways in which the three layers of the biosphere change over time and their influence on an ecosystem's ability to support life. (DOK 2)
b. Explain the flow of matter and energy in ecosystems. (DOK 2)
   - Interactions between biotic and abiotic factors
   - Indigenous plants and animals and their roles in various ecosystems
   - Biogeochemical cycles within the environment

c. Predict the impact of the introduction, removal, and reintroduction of an organism on an ecosystem. (DOK 3)
d. Develop a logical argument explaining the relationships and changes within an ecosystem. (DOK 2)
   - How a species adapts to its niche
   - Process of primary and secondary succession and its effects on a population
   - How changes in the environment might affect organisms
e. Explain the causes and effects of changes in population dynamics (e.g., natural selection, exponential growth, 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. <u>Discuss the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.</u>

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

GI Genetics

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

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

2. <u>Review the structure and function of the cell as it applies to genetics. (L)</u>

a. Cite evidence to illustrate how the structure and function of cells are involved in the maintenance of life. (DOK 2)
b. Describe how organic components are integral to biochemical processes. (DOK 2)
c. Differentiate among the processes by which plants and animals reproduce. (DOK 1)
   - Cell cycle and mitosis
   - Meiosis, spermatogenesis, and oogenesis
d. Explain the significance of the discovery of nucleic acids. (DOK 1)
e. Analyze and explain the structure and function of DNA and RNA in replication, transcription, translation and DNA repair. (DOK 2)

f. Cite examples to compare the consequences of the different types of mutations. (DOK 1)
g. Draw conclusions about the importance and potential impacts of the process of gene transfer used in biotechnology. (DOK 3)

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

a. Cite evidence that supports the significance of Mendel's concept of "particulate inheritance" to explain the understanding of heredity. (DOK 1)
b. Apply 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

GEI Geology

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

a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
   - Safety rules and symbols
   - Proper use and care of the compound light microscope, slides, chemicals, 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. <u>Develop an understanding of plate tectonics and geochemical and ecological processes that affect earth.</u>

a. Differentiate the components of the earth's atmosphere and lithosphere. (DOK 1)
b. Research and summarize explanations of how earth acquired its initial atmosphere and oceans. (DOK 2)

c. Compare the causes and effects of internal and external components that shape earth's topography. (DOK 2)
   - Physical weathering (e.g., atmospheric, glacial, etc.)
   - Chemical weathering agents (e.g., acid precipitation, carbon dioxide, oxygen, water, etc.)
d. Develop an understanding of how plate tectonics create certain geologic features, materials, and hazards. (DOK 2)
   - Types of crustal movements and the resulting landforms (e.g., seafloor spreading, paleomagnetic measurements, and orogenesis)
   - Processes that create earthquakes and volcanoes
   - Asthenosphere
e. Summarize the theories of plate development and continental drift, and describe the causes and effects involved in each. (DOK 2)
f. Develop a logical argument to explain how geochemical and ecological processes (e.g., rock, hydrologic, carbon, 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

PSI Physical Science

1. <u>Apply inquiry-based and problem-solving processes and skills to scientific investigations.</u>
   a. Use appropriate laboratory safety symbols and procedures to design and conduct a scientific investigation. (DOK 2)
      - Safety symbols and safety rules in all laboratory activities
      - Proper use and care of the compound light microscope
      - Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
   b. Identify questions that can be answered through scientific investigations. (DOK 3)
   c. Identify and apply components of scientific methods in classroom investigations. (DOK 3)
      - Predicting, gathering data, 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. <u>Describe and explain how forces affect motion.</u>
   a. Demonstrate and explain the basic principles of Newton's three laws of motion including calculations of acceleration, force, and momentum. (DOK 2)

- Inertia and distance-time graphs to determine average speed
- Net force (accounting for gravity, friction, and air resistance) and the resulting motion of objects
- Effects of the gravitational force on objects on Earth and effects on planetary and lunar motion
- Simple harmonic motion (oscillation)

b. Explain the connection between force, work, and energy. (DOK 2)
- Force exerted over a distance (results in work done)
- Force-distance graph (to determine work)
- Network on an object that contributes to change in kinetic energy (work-to-energy theorem)

c. Describe (with supporting details and diagrams) how the kinetic energy of an object can be converted into potential energy (the energy of position) and how energy is transferred or transformed (conservation of energy). (DOK 2)

d. Draw and assess conclusions about charges and electric current. (DOK 2)
- Static/current electricity and direct current/alternating current
- Elements in an electric circuit that are in series or parallel
- Conductors and insulators
- Relationship between current flowing through a resistor and voltage flowing across a resistor

e. Cite evidence and explain the application of electric currents and magnetic fields as they relate to their use in everyday living (e.g., the application of fields in motors and generators and the concept of electric current using Ohm's Law). (DOK 2)

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

a. Differentiate among transverse, longitudinal, and surface waves as they propagate through a medium (e.g., string, air, water, 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. <u>Develop an understanding of the atom.</u>

a. Cite evidence to summarize the atomic theory. (DOK 1)
- Models for atoms
- Hund's rule and Aufbau process to specify the electron configuration of elements
- Building blocks of matter (e.g., proton, neutron, and electron) and elementary particles (e.g., positron, mesons, neutrinos, etc.)
- Atomic orbitals (s, p, d, f) and their basic shapes

b. Explain the difference between chemical and physical changes, and demonstrate how these changes can be used to separate mixtures and compounds into their components. (DOK 2)

c. Research the history of the periodic table of the elements, and summarize the contributions that led to the atomic theory. (DOK 2)
- Contributions of scientists (e.g., John Dalton, J.J. Thomson, Ernest Rutherford, Newton, Einstein, Neils, Bohr, Louis de Broglie, Erwin Schrödinger, etc.)
- Technology (e.g., X-rays, cathode-ray tubes, 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. <u>Investigate and apply principles of physical and chemical changes in matter.</u>

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

Physics I

PHYI Physics I

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

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. <u>Develop an understanding of concepts related to forces and motion.</u>

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

3. <u>Develop an understanding of concepts related to work and energy.</u>

a. Explain and apply the conservation of energy and momentum. (DOK 2)
    - Concept of work and applications
    - Concept of kinetic energy, using the elementary work-energy theorem
    - Concept of conservation of energy with simple examples
    - Concepts of energy, work, and power (qualitatively and quantitatively)
    - Principles of impulse in inelastic and elastic collisions

b. Analyze real-world applications to draw conclusions about mechanical potential energy (the energy of configuration). (DOK 3)
c. Apply the principles of impulse, and compare conservation of momentum and conservation of kinetic energy in perfectly inelastic and elastic collisions. (DOK 1)
d. Investigate and summarize the principles of thermodynamics. (DOK 2)
    - How heat energy is transferred from higher temperature to lower temperature until equilibrium is reached
    - Temperature and thermal energy as related to molecular motion and states of matter
    - Problems involving specific heat and heat capacity
    - First and second laws of thermodynamics as related to heat engines, refrigerators, and thermal efficiency
e. Develop the kinetic theory of ideal gases and explain the concept of Carnot efficiency. (DOK 2)

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

a. Describe and model the characteristics and properties of mechanical waves. (DOK 2)
    - Simple harmonic motion
    - Relationships among wave characteristics such as velocity, period, frequency, amplitude, phase, and wavelength
    - Energy of a wave in terms of amplitude and frequency.
    - Standing waves and waves in specific media (e.g., stretched string, water surface, air, etc.)
b. Differentiate and explain the Doppler effect as it relates to a moving source and to a moving observer. (DOK 1)
c. Explain the laws of reflection and refraction, and apply Snell's law to describe the relationship between the angles of incidence and refraction. (DOK 2)
d. Use ray tracing and the thin lens equation to solve real-world problems involving object distance from lenses. (DOK 2)
e. Investigate and draw conclusions about the characteristics and properties of electromagnetic waves. (DOK 2)

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

a. Analyze and explain the relationship between electricity and magnetism. (DOK 2)
    - Characteristics of static charge and how a static charge is generated
    - Electric field, electric potential, current, voltage, and resistance as related to Ohm's law
    - Magnetic poles, magnetic flux and field, Ampère's law and Faraday's law
    - Coulomb's law
b. Use schematic diagrams to analyze the current flow in series and parallel electric circuits, given the component resistances and the imposed electric potential. (DOK 2)
c. Analyze and explain the relationship between magnetic fields and electrical current by induction, generators, and electric motors. (DOK 2)

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

a. Analyze and explain the principles of nuclear physics. (DOK 1)
    - The mass number and atomic number of the nucleus of an isotope of a given chemical element
    - The conservation of mass and the conservation of charge
    - Nuclear decay
b. Defend the wave-particle duality model of light, using observational evidence. (DOK 3)
    - Quantum energy and emission spectra
    - Photoelectric and Compton effects

Spatial Information Science

SPI Spatial Information Science

1. <u>Demonstrate the basic concepts of global positioning systems (GPS). (E)</u>

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

ZOI Zoology

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

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

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

a. Explain how organisms are classified, and identify characteristics of major groups. (DOK 1)
   - Levels of organization of structures in animals (e.g., cells, tissues, organs, and systems)
   - Characteristics used to classify organisms (e.g., cell structure, biochemistry, anatomy, fossil record, and methods of reproduction)
b. Identify and describe characteristics of the major phyla. (DOK 1)
   - Symmetry and body plan
   - Germ layers and embryonic development
   - Organ systems (e.g., digestive, circulatory, excretory, and reproductive)
   - Locomotion and coordination
c. Distinguish viruses from bacteria and protists, and give examples. (DOK 1)
d. Differentiate among the characteristics of bacteria, archaea, and eucarya. (DOK 1)

- Phylogenic sequencing of the major phyla
- Invertebrate characteristics (e.g., habitat, reproduction, body plan, locomotion) of the following phyla: Porifera, Cnidarians, Nematoda, Annelida, Platyhelmenthes, 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. <u>Differentiate among animal life cycles, behaviors, adaptations, and relationships.</u>

a. Describe life cycles, alternation of generations, and metamorphosis of various animals, and evaluate the advantages and disadvantages of asexual and sexual reproduction. (DOK 1)

b. Describe and explain concepts of animal behavior, and differentiate between learned and innate behavior. (DOK 1)
   - Division of labor within a group of animals
   - Communication within 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. <u>Demonstrate an understanding of the principles of animal genetic diversity and evolution.</u>

a. Categorize and explain sources of genetic variation on the cellular level (e.g., mutations, crossing over, and nondisjunction) and the population level (e.g., 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 = ax2 + 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 nonnumerical) 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, and/or
    - 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, and/or
- Evaluating implications or complications of the issue, and/or
- 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: National 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 © 2011. 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.