2026 Diversified Agriculture—Plants Core

Program CIP: 01.0000— Agriculture, General

Direct inquiries to:

Project Manager
Research and Curriculum Unit
Mississippi State University
P.O. Drawer DX
Mississippi State, MS 39762
662.325.2510
helpdesk@rcu.msstate.edu

Program Supervisor
Office of Career and Technical Education
and Workforce Development
Mississippi Department of Education
P.O. Box 771
Jackson, MS 39205
601.359.3974

Published by:

Office of Career and Technical Education
and Workforce Development
Mississippi Department of Education
Jackson, MS 39205

Research and Curriculum Unit
Mississippi State University
Mississippi State, MS 39762
helpdesk@rcu.msstate.edu

The Research and Curriculum Unit (RCU), located in Starkville, as part of Mississippi State University (MSU), was established to foster educational enhancements and innovations. In keeping with the land-grant mission of MSU, the RCU is dedicated to improving the quality of life for Mississippians. The RCU enhances the 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 context of curriculum development and revision, research, assessment, professional development, and industrial training.

Table of Contents

Acknowledgments

The Diversified Agriculture—Plants Core curriculum was presented to the Mississippi State Board of Education on January 15, 2026. The following people were serving on the state board at the time:

Dr. Lance Evans, State Superintendent of Education, Executive Secretary
Mr. Matt Miller, Southern Supreme Court District Representative, Chair
Mr. Matt Mayo, Central Supreme Court District Representative, Vice-Chair
Dr. Wendi Barrett, Teacher Representative
Mr. Glen East, Administrator Representative
Mr. Bill Jacobs, At-Large Representative
Dr. Ronnie McGehee, At-Large Representative
Mr. Mike Pruitt, At-Large Representative
Mrs. Billye Jean Stroud, Northern Supreme Court District Representative
Mrs. Mary Werner, At-Large Representative
Mr. Crosby Parker, Senior Student Representative
Ms. Michelle Xie, Junior Student Representative

The following Mississippi Department of Education (MDE) Office of Career and Technical Education (CTE) and Workforce Development (WD) and RCU managers and specialists assisted in the development of the Diversified Agriculture—Plants Core curriculum:

Brett Robinson, Associate State Superintendent, MDE Office of CTE and WD
Betsey Smith, Director, RCU
Abbigail Dugas, Agriculture Program Supervisor, MDE Office of CTE and WD
Courtney McCubbins, CTE Curriculum and Assessment Manager, RCU
Daniel Derrick, Mississippi FFA Program Manager, RCU
Tyler Gray, Project Manager, RCU

Special thanks are extended to the educators who contributed to the development and revision of this framework and supporting materials:

Catherine Avent, Lafayette High School, Oxford
Alan Leonard, West Point Career and Technology Center, West Point
Dr. Aaron Scammahorn, Millsaps Career and Technology Center, Starkville
Kayla Walters, Forrest County Agricultural High School, Brooklyn

Appreciation is expressed to the following professionals who provided guidance and insight throughout the development process:

Sydney Baker, MSU Agricultural Education student
Dr. OP McCubbins, Associate Professor of Agricultural Education, MSU
Ross Neles, MSU Agricultural and Extension Education graduate student
Dr. Barry Stewart, Associate Professor of Turfgrass Management, MSU
Lauren Woody, MSU Agricultural Education student

Standards

Standards and alignment crosswalks are referenced in the appendices. Depending on the curriculum, these crosswalks should identify alignment to the standards mentioned below, as well as possible related academic topics as required in the Subject Area Testing Program in Algebra I, Biology I, and English II, which could be integrated into the content of the units. Mississippi's CTE Diversified Agriculture—Plants Core curriculum is aligned to the following standards:

National Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards
The National AFNR Career Cluster Content Standards were developed by the National Council on Agricultural Education to serve as a guide for what students should know or be able to do through a study of agriculture in grades 9-12 and two-year postsecondary programs. The standards were extensively researched and reviewed by leaders in the agricultural industry, secondary and postsecondary instructors, and university specialists. The standards consist of a pathway content standard for each of the eight career pathways. For each content standard, performance elements representing major topic areas with accompanying performance indicators were developed. Measurements of assessment of the performance elements and performance indicators were developed at the basic, intermediate, and advanced levels. The National AFNR Career Cluster Content Standards are copyrighted by the National Council for Agricultural Education and are used with permission.
thecouncil.ffa.org/afnr

College- and Career-Readiness Standards
College- and Career-Readiness Standards emphasize critical thinking, teamwork, and problem-solving skills. Students will learn the skills and abilities demanded by the workforce of today and the future. Mississippi adopted Mississippi College- and Career-Readiness Standards (MCCRS) to provide a consistent, clear understanding of what students are expected to learn and so teachers and parents know what they need to do to help them.
mdek12.org/academiceducation/mississipp-college-and-career-readiness-standards/

Career and Technical Student Organizations (CTSOs)
Mississippi's Career and Technical Education (CTE) curricula are aligned with the programs, activities, and competitive events offered through Career and Technical Student Organizations (CTSOs). These organizations provide students with opportunities to apply classroom knowledge in real-world contexts, develop leadership and employability skills, and connect with industry and community partners. Each pathway includes an appendix identifying the CTSOs most closely connected to the curriculum, ensuring that students' classroom learning is reinforced through co-curricular experiences that prepare them for success in both post-secondary education and the workforce.
mdek12.org/cte/so/

Preface

Secondary CTE programs in Mississippi face many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing applied 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. This document provides information, tools, and solutions that will aid students, teachers, and schools in creating and implementing applied, interactive, and innovative lessons. Through best practices, alignment with national standards and certifications, community partnerships, and a hands-on, student-centered concept, educators will be able to truly engage students in meaningful and collaborative learning opportunities.

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; Strengthening Career and Technical Education for the 21st Century Act, 2019 [Perkins V]; and Every Student Succeeds Act, 2015).

Mississippi Teacher Professional Resources

The following are resources for Mississippi teachers:

Curriculum, Assessment, Professional Learning

- Program resources can be found at the RCU's website, rcu.msstate.edu.

Learning Management System: An Online Resource

- Learning management system information can be found at the RCU's website, under Professional Learning.

Should you need additional instructions, contact the RCU at 662.325.2510 or helpdesk@rcu.msstate.edu.

Executive Summary

Pathway Description
The Diversified Agriculture—Plants Core curriculum is a one-Carnegie unit course within the four-credit Diversified Agriculture pathway. All students must successfully complete the Principles of Agriscience prerequisite before enrolling in this course. This course is centered on agricultural plant growth, production, management, and harvesting, providing students the opportunity to explore plant production in various areas of agriculture, such as food and fiber crops, forestry, landscaping, ornamental horticulture, and alternative fuel crops.

College, Career, and Certifications
No national industry-recognized certifications are utilized in Mississippi pertaining to the agriculture industry. Competencies and suggested objectives in this course have been correlated, however, to the National AFNR Career Cluster Content Standards that have been reviewed and endorsed at the national level by the National Council on Agricultural Education.

Grade Level and Class Size Recommendations
It is recommended that students enter this program as tenth graders. Exceptions to this are a district-level decision based on class size, enrollment numbers, student maturity, and CTE delivery method. This is a hands-on, lab- or shop-based course. Therefore, a maximum of 15 students is recommended per class and teachers should only teach one subject per class period.

Student Prerequisites
For students to experience success in the program, the following student prerequisites are suggested:

1. C or higher in English (the previous year)
2. C or higher in high school-level math (last course taken, or the instructor can specify the level of math instruction needed)
3. Instructor approval

or

1. Instructor approval

Assessment
The latest assessment blueprint for the curriculum can be found at rcu.msstate.edu/curriculum/.

Applied Academic Credit
The latest academic credit information can be found at mdek12.org/secondaryeducation/approved-courses/.

Educator Licensure
The latest educator licensure information can be found at mdek12.org/licensure/.

Professional Learning
If you have specific questions about the content of any training sessions provided, please contact the RCU at 662.325.2510 or helpdesk@rcu.msstate.edu.

Course Outline

This curriculum consists of one 1-credit course.

Diversified Agriculture—Plants Core –Course Code: 993427

Unit	Title	Hours
1	Leadership and SAE for All	10
2	Safety	10
3	Plant Anatomy and Physiology	10
4	Classification	15
5	Growing Media	10
6	Environmental Factors	10
7	Propagation	20
8	Plant Nutrition and Fertilization	20
9	Planting Techniques	15
10	Greenhouse Management	10
11	Pest Management	10
Total		**140**

Career Pathway Outlook

Overview

The Agriculture career cluster encompasses a wide range of occupations focused on the production and use of plants and animals for food, fiber, aesthetic, and environmental purposes. A USDA-funded study (Purdue University, 2024–2025) is producing updated five-year national projections for employment opportunities in food, agriculture, renewable natural resources, and the environment for graduates with bachelor's degrees or higher. According to the U.S. Bureau of Labor Statistics (2023), employment of agricultural and food scientists is projected to grow 8% from 2023 to 2033, with approximately 3,100 annual openings primarily due to retirements and occupational transfers. As in previous USDA reports, nearly half of the employment openings are expected in management and business (approximately 42%), followed by science, technology, engineering, and math (31%), sustainable production and biomaterials (13%), and education, communication, and government services (14%) (Purdue University, 2020).

Agriculture, food, and related industries contributed $1.1 trillion to the U.S. gross domestic product (GDP) in 2019 (USDA Economic Research Service, 2020). Projections through 2033 forecast continued growth in farm income, trade, and sector indicators (USDA Economic Research Service, 2024). In Mississippi, agriculture remains the top industry. The total value of agricultural production increased to approximately $9 billion in 2024 (Mississippi State University Extension, 2024), up from $7.8 billion in 2022. The agriculture, forestry, fishing, and hunting sector contributed $4.156 billion to the state's GDP in Q4 2024 (Federal Reserve Bank of St. Louis, 2024). According to the Mississippi Department of Agriculture and Commerce (2024), agriculture directly or indirectly employs about 11.4% of Mississippi's workforce.

Needs of the Future Workforce

Data for this synopsis were compiled from the Mississippi Department of Employment Security (MDES) (2025). Employment opportunities for each of the occupations are listed below.

Table 1.1: Current and Projected Occupation Report

Description	Jobs, 2022	Projected Jobs, 2032	Change (Number)	Change (Percent)	Average Yearly Earnings, 2025
Agricultural and Food Science Technicians	250	270	20	8.0%	$42,081
Agricultural Sciences Teachers, Postsecondary	150	160	10	6.7%	$93,622
Animal Trainers	100	110	10	10%	$29,230
Career/Technical Education Teachers, Middle School	230	240	10	4.3%	$51,425
Career/Technical Education Teachers, Secondary School	1220	1310	90	7.4%	$51,416
Conservation Scientists	1250	1260	10	0.8%	$54,950
Environmental Engineers	410	420	10	2.4%	$75,940

Environmental Engineering Technicians	70	70	—	—	$46,790
Environmental Scientists and Specialists, Including Health	270	280	10	3.7%	$64,460
Environmental Science and Protection Technicians, Including Health	30	30	—	—	$38,780
Farm and Home Management Advisors	290	300	10	3.2%	$38,650
Logging Equipment Operators	1,680	1,740	60	3.6%	$41,840
Landscaping and Groundskeeping Workers	6,000	6,620	620	10.3%	$25,630
Nonfarm Animal Caretakers	1,520	1,780	260	17.1%	$24,030
Soil and Plant Scientists	110	110	—	—	$92,250
Farmers, Ranchers, and Other Agricultural Managers	6730	6930	200	3.0%	$55,830
First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers	980	1090	110	11.2%	$40,270
First-Line Supervisors/Managers of Farming, Fishing, and Forestry Workers	940	990	50	5.3%	$54,550
Fish and Game Wardens	40	40	—	—	$46,610
Foresters	180	180	—	—	$52,660
Surveyors	380	410	30	7.9%	$48,600
Surveying and Mapping Technicians	670	720	50	7.5%	$39,840
Tree Trimmers and Pruners	270	300	30	11.1%	$44,920
Veterinarians	490	540	50	10.2%	$81,950
Veterinary Assistants and Laboratory Animal Caretakers	970	1090	120	12.4%	$26,150
Veterinary Technologists and Technicians	570	630	60	10.5%	$35,890
Zoologists and Wildlife Biologists	230	250	20	8.7%	$70,200

Source: Mississippi Department of Employment Security; mdes.ms.gov (2025).

Perkins V Requirements and Academic Infusion

The Diversified Agriculture—Plants Core curriculum meets Perkins V requirements of introducing students to and preparing them for high-skill, high-wage occupations in agricultural fields. It also offers students a program of study, including secondary, postsecondary, and higher education courses, that will further prepare them for agricultural careers. Additionally, this curriculum is integrated with academic college- and career-readiness standards. Lastly, it focuses on ongoing and meaningful professional development for teachers as well as relationships with industry.

Transition to Postsecondary Education

The latest articulation information for secondary to postsecondary can be found at the Mississippi Community College Board website, mccb.edu.

Best Practices

Innovative Instructional Technologies

Classrooms should be equipped with tools that will teach today's digital learners through applicable and modern practices. The Diversified Agriculture—Plants Core educator's goal should be to include teaching strategies that incorporate current technology. To make use of the latest online communication tools—wikis, blogs, podcasts, and social media platforms, for example—the classroom teacher is encouraged to use a learning management system that introduces students to education in an online environment and places more of the responsibility of learning on the student.

Differentiated Instruction

Students learn in a variety of ways, and numerous factors—students' background, emotional health, and circumstances, for example—create unique learners. By providing various teaching and assessment strategies, students with various learning preferences can have more opportunities to succeed.

CTE Student Organizations

Teachers should investigate opportunities to sponsor a student organization. The National FFA Organization is the student organization for this pathway and will foster the types of learning expected from the Diversified Agriculture—Plants Core curriculum. FFA provides participants and members with growth opportunities and competitive events. They also open the doors to the world of agriculture careers and scholarship opportunities.

Cooperative Learning

Cooperative learning can help students understand topics when independent learning cannot. Therefore, you will see several opportunities in the Diversified Agriculture—Plants Core curriculum for group work. To function in today's workforce, students need to be able to work collaboratively with others and solve problems without excessive conflict. This curriculum provides opportunities for students to work together and help each other complete complex tasks. There are many field experiences within the Diversified Agriculture—Plants Core curriculum that will allow and encourage collaboration with professionals currently in the agriculture field.

Work-Based Learning

Work-based learning is an extension of understanding competencies taught in the Diversified Agriculture—Plants Core classroom. The Diversified Agriculture pathway requires students to obtain clinical-type hours during Capstone, which may include, but are not limited to, clinicals, worksite field experiences, entrepreneurship, internships, pre-apprenticeships, school-based enterprises, job placements, and simulated worksites. These real-world connections and applications provide a link to all types of students regarding knowledge, skills, and professional dispositions. Thus, supervised collaboration and immersion into the

agriculture industry are keys to students' success, knowledge, and skills development. For more information on embedded WBL, visit the Mississippi Work-Based Learning Manual on the RCU website, rcu.msstate.edu.

Professional Organizations

American Association for Agricultural Education (AAAE)
aaaeonline.org

Association for Career and Technical Education (ACTE)
acteonline.org

Mississippi Association for Career and Technical Education (MSACTE)
mississippiacte.com

Mississippi Association of Agricultural Educators (MSAAE)
mississippiffa.org

National Association of Agricultural Educators (NAAE)
naae.org

National FFA Organization
ffa.org

Using This Document

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

Teacher Resources
All teachers should request to be added to the Canvas Resource Guide for their course. For questions or to be added to the guide, send a Help Desk ticket to the RCU by emailing helpdesk@rcu.msstate.edu.

Perkins V Quality Indicators and Enrichment Material
Some of the units may include an enrichment section at the end. This material will greatly enhance the learning experiences of students. If the Diversified Agriculture—Plants Core program is using a national certification, work-based learning, or another measure of accountability that aligns with Perkins V as a quality indicator, this material could very well be assessed on that quality indicator. It is the responsibility of the teacher to ensure all competencies for the selected quality indicator are covered throughout the year.

Unit 1: Leadership and SAE for All

Competencies and Suggested Objectives
1. Participate in local, state, and/or national FFA activities that provide opportunities for leadership development and career exploration. DOK3 a. Actively participate in FFA activities. • Leadership Development Events (LDE) • Career Development Events (CDE) ○ Agronomy ○ Floriculture ○ Nursery/Landscape • Leadership retreats or conferences • Industry-related seminars, workshops, or conferences • Other related FFA activities
2. Identify potential college and career opportunities in plant science. DOK2 a. Identify and demonstrate 21st-century skills, including but not limited to: • Communication • Collaboration • Employability skills • Financial literacy • Problem solving • Responsibility • Social skills b. Research postsecondary institutions that offer studies in plant science or a related field and prepare a two- to three-minute speech on their programs and potential career choices. c. Complete applications for college admission and scholarships. d. Revise a personal résumé for the purpose of applying for a specific job. e. Complete a job application for employment. f. Participate in a mock or real interview.
3. Review the types of programs under Supervised Agricultural Experience (SAE) for All. DOK1 a. Explore concepts of a Foundational SAE. • Career exploration and planning • Employability skills for college and career readiness • Personal financial management and planning • Workplace safety • Agricultural literacy b. Explore concepts of an Immersion SAE. • Placement/internship • Ownership/entrepreneurship • Research ○ Experimental ○ Analytical ○ Invention • School-based enterprise • Service learning

4. Review individual plans for student Foundational SAE programs. DOK 2
    a. Assess goal attainment in SAE from the previous year.
    b. Review and update short- and long-range goals pertaining to the SAE program.
5. Develop an Immersion SAE and maintain agricultural records. DOK 2
    a. Redefine and adjust requirements of agreements between the student, parent(s), supervisor, and/or employer.
    b. Utilize an electronic/computer-based system of record keeping.
    c. Update SAE records.
        - SAE program goals
        - Student inventory related to the SAE program
        - Expense records
        - Income/gift and scholarship records
        - Skill-attainment records
        - Leadership-activity records and participation in FFA activities
        - Community service hours
    d. Complete degree and proficiency award applications as they apply to the SAE.

Unit 2: Safety

Competencies and Suggested Objectives
1. Apply and demonstrate general safety procedures for plant production enterprises. DOK2 a. Describe the procedures for working in and maintaining a safe, orderly workplace. b. Identify the actions associated with safe personal behavior and conduct. c. Describe work site and laboratory organization procedures. d. Demonstrate the procedures for the safe use of chemicals and other hazardous materials in the laboratory and greenhouse, including the use of safety data sheets (SDS) and personal protective equipment (PPE). e. Read, interpret, and apply the directions on a pesticide label. • Active ingredients • Safety precautions • Hazardous statements • Trade name • Storage and disposal
2. Apply horticulture safety practices in workplace, classroom, and laboratory environments. DOK 2 a. Apply safety standards in the workplace. b. Apply safety standards in the agricultural classroom and laboratory. c. Interpret information on an SDS. d. Describe the use of general-safety hand equipment and indicators, including, but not limited to, the following: safety color codes, fire extinguishers, first aid kits, emergency exits, etc. e. Apply safety precautions related to dress and PPE. f. Select procedures for dealing with different classes of fires.

Note: Safety is to be taught as an ongoing part of the program. Students are required to complete a written safety test with 100% accuracy before entering the shop for lab simulations and projects. This test should be geared toward the specific school's needs, tools, facilities, etc. This test should be documented in each student's file.
Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 3: Plant Anatomy and Physiology

Competencies and Suggested Objectives
1. Analyze plant structures, functions, and reproduction methods, and explain factors affecting plant growth. DOK2 a. Draw a diagram of a flowering plant, and label and describe the major parts (roots, stems, leaves, flowers, and seeds) and functions as related to plant growth (cell division, cell elongation, and cell differentiation). b. Describe the process of respiration, photosynthesis, and transpiration. c. Describe the relationship of environmental and cultural factors to plant growth (water, light, temperature, soil, USDA climatic zones). d. Recognize plants according to life cycle, including annual, perennial, deciduous, evergreen, etc. e. Describe sexual reproduction in plants. f. Describe the conditions needed for good seed germination. g. Identify and describe asexual reproduction techniques using grafting, budding, cuttings (root, stem, and leaf), layering, separation and division, and tissue culture methods.

Mississippi Career Connections
Plant structures, reproduction, and growth processes are crucial to many of Mississippi's largest industries, including row-crop agriculture, forestry, nursery and greenhouse production, turf management, and landscape services. As students explore how plants grow, reproduce, and respond to environmental conditions, they can connect these concepts to high-demand careers such as crop production specialists, greenhouse and nursery managers, landscape technicians, foresters, turfgrass managers, and extension agents. By diagramming plant structures, examining photosynthesis and transpiration, and evaluating germination and propagation techniques, students learn the same skills used by professionals who grow Mississippi's corn, soybeans, cotton, timber, nursery crops, and ornamental plants. Understanding cultural and environmental factors such as light, water, temperature, and soil health mirrors the decisions these professionals make daily to maximize plant health, increase yields, and manage Mississippi's diverse growing zones. This unit helps students see how plant science knowledge directly supports major sectors of Mississippi's economy and prepares them for careers in agriculture, horticulture, and natural resources.

Unit 4: Classification

Competencies and Suggested Objectives
1. Classify agricultural and herbaceous plants by their morphological characteristics and scientific naming systems. [DOK2] a. Life cycles b. Growth habit c. Plant use d. Monocotyledons vs. dicotyledons e. Woody vs. herbaceous

Mississippi Career Connections
Students will assume the role of a crop consultant working for a Mississippi farm, nursery, or landscape company. Using a set of local plant samples or images, students will classify each plant by its life cycle, growth habit, plant use, whether it is a monocot or dicot, and whether it is woody or herbaceous. Students must justify each classification by identifying key morphological traits such as leaf structure, venation patterns, stems, seeds, and overall growth form. This quick activity mirrors the real skills used by agronomists, foresters, nursery managers, and landscape technicians across Mississippi to manage crops, diagnose plant issues, and maintain healthy agricultural and horticultural environments.

Unit 5: Growing Media

Competencies and Suggested Objectives
1. Identify and describe the major forms of growing media used in plant production. DOK1 a. Describe the use of soil in plant production. b. Describe using hydroponic systems as growing media. c. Describe different types of greenhouse potting mixes and their appropriate use. d. Describe rockwool and other synthetic substrates.
2. Identify and describe the physical characteristics of growing media and soil textures. DOK1 a. Identify and compare the components of natural soil (sand, silt, and clay) and soilless mix. b. Identify and compare the physical characteristics of growing media (unit weight, texture, composition, water-holding capacity). c. List and explain how these characteristics influence growth and root development. d. Prepare a growing substrate to specifications or identify the components and proportions in a commercially prepared rooting substrate.
3. Explain how differences in growing media can affect drainage. DOK2 a. Identify practices and structures that influence drainage (e.g., drain tile, surface drainage, tillage, porosity, irrigation, etc.).

Unit 6: Environmental Factors

Competencies and Suggested Objectives
1. Explain how color, intensity, and duration of light affect plant growth. DOK2
2. Analyze how environmental conditions such as air movement, temperature, and humidity affect plant growth. DOK2
3. Describe how water quality factors, including potential of hydrogen (pH) and dissolved solids, affect plant growth. DOK2

Mississippi Career Connections

Provide students with three sample plant profiles commonly grown in Mississippi (e.g., bedding plants, vegetable transplants, greenhouse ornamentals). Using these profiles, students should research the following:

- Light conditions necessary for each plant, including color spectrum, intensity, and duration.
- Ideal environmental factors such as temperature range, air flow needs, and humidity level.
- Water quality needs, including acceptable pH range and dissolved solids levels.

After their research process, students should justify their findings to explain how horticultural businesses use these factors to produce high-quality and healthy plants in Mississippi's nursery and greenhouse industry.

Plant Profile Example: Poinsettia (Holiday Crop)

Light Needs

- Prefers moderate light levels
- Requires 12-13 hours of uninterrupted darkness each day for the bracts to change color
- Even small amounts of stray light can interfere with coloration

Environmental Conditions

- Grows best between 65-70°F
- Likes higher humidity
- Needs light, steady air movement to prevent mold, avoid strong drafts

Water Quality

- Ideal pH range is 5.8–6.4
- Performs best with water low in dissolved salts
- Water well, then allow the soil to partially dry before watering again.

Unit 7: Propagation

Competencies and Suggested Objectives
1. Apply and demonstrate the process of plant pollination and fertilization. DOK2
2. Analyze factors that affect seed viability, vigor, and germination rates. DOK2
3. Conduct and interpret seed-quality evaluations for agronomic and horticultural crops. DOK 3 a. Differentiate between agronomic and horticultural crops. b. Interpret the information and data found on an agronomic seed tag. • Seed company • Kind and variety • Date tested • Purity and germination percentage • Percentage of weed seed • Percentage of inert matter • Net weight (in pounds) of seed in the bag • State where the seed was grown c. Interpret the information and data found on a horticultural seed tag. • Seed company • Kind and variety • Date tested • Purity and germination percentage d. Assess seed samples and complete a seed tag. • Calculate the purity and germination percentage. • Calculate the percentage of weed seed. • Calculate the percentage by weight of inert matter. • Calculate the percentage by weight of other agricultural seeds. e. Select a plant variety for production based on tillage (if applicable), production system, marketability, cost, and germination rate.
4. Demonstrate asexual plant propagation techniques, including cuttings, division, separation, layering, budding, and grafting. DOK2
5. Examine and explain aseptic micropropagation techniques. DOK2
6. Compare and contrast the potential risks and advantages associated with genetically modified agricultural and ornamental plants. DOK2

Unit 8: Plant Nutrition and Fertilization

Competencies and Suggested Objectives
1. Analyze how fertilizers and soil amendments improve plant productivity. DOK3 a. Identify macronutrients and micronutrients and their effects on plant growth. • Describe the effect of excesses and deficiencies of the macronutrients (nitrogen [N], phosphorus [P], potassium [K]). • Analyze a growing substrate sample for nutrient deficiencies by using the scientific method. b. Examine the impact of soil pH on nutrient availability (e.g., mineral availability from iron, calcium, etc.) c. List the types of soil amendments used to improve soil or growing media. • Organic soil amendments (e.g., leaf matter, peat moss, bark) • Inorganic soil amendments (e.g., perlite, vermiculite) d. Classify the types of materials used to make fertilizers. • Inorganic • Natural organic • Synthetic organic fertilizers e. Analyze a fertilizer label and calculate application rates to meet nutritional requirements for specific crops. f. Identify the forms of fertilizers. • Granular • Water soluble • Slow release • Organic g. Describe the different fertilizer application methods. • Top dressing • Broadcast • Band application • Side dressing • Foliar feeding • Fertigation

Unit 9: Planting Techniques

Competencies and Suggested Objectives
1. Explain and compare the steps of crop production. DOK2 a. Describe the steps of growing crops, including seed selection and sowing, irrigation, fertilizing, and harvesting. b. Describe how these steps influence crop production for the following categories: • Vegetables • Fruits • Nuts • Ornamentals • Forages • Turf • Agronomics

Mississippi Career Connections
Mississippi's farms, nurseries, and turf operations rely on an efficient crop-production process to keep plants healthy and profitable. To help students see how these steps connect to real agricultural careers, have them take on the role of a crop production assistant for a local grower. • Provide students with a short description of a Mississippi-grown crop (sweet potatoes, blueberries, pecans, ornamentals, bermudagrass, soybeans, etc.). Students should outline the steps required to produce that crop, including: • Seed or plant selection and sowing • Irrigation plans (how and when water is applied) • Fertilizer needs for that specific crop type • Best timing for harvest Next, compare how those steps change across different categories (e.g., vegetables, fruits, nuts, ornamentals, forages, turf, and agronomic crops). Students can then make connections about why each crop type requires its own production plan and why professionals in the horticulture industry must understand these differences to make successful business decisions.

Unit 10: Greenhouse Management

Competencies and Suggested Objectives
1. Research the use of various plant-growing structures and their environmental control systems. DOK2 a. Compare and contrast the types of growing structures and greenhouses. • Lathe house • High tunnels • Greenhouses (e.g., Quonset, ridge and furrow, lean-to, gothic, even span) b. Identify and discuss the coverings used on greenhouses. • Fiberglass • Polyethylene • Acrylic sheets • Polycarbonate • Shade cloth c. Differentiate between environmental control systems. • Cooling • Watering • Ventilation • Temperature control
2. Design and implement a management plan for a hydroponics growing system. DOK4 a. Research and formulate management practices for hydroponic plant production. b. Construct a hydroponics plant system that will support plant production. c. Design a small-scale farm that includes hydroponics, urban farming, or rooftop gardens.
3. Discuss the benefits and uses of irrigation in plant production. DOK2 a. Describe the history and development of irrigation methods in agriculture. b. Explain the use of irrigation for various types of crops. c. Differentiate between water management methods in plant production. • Hand watering • Overhead irrigation • Drip irrigation • Sprinkle irrigation d. Describe irrigation scheduling. e. Relate the importance of water quality to irrigation. f. List and describe the sources of water irrigation. • Public water system • Private well • Pond/lake • Flowing water

Unit 11: Pest Management

Competencies and Suggested Objectives
1. Analyze the effects of pests on plant production. DOK 2 a. Describe a healthy plant. b. Explain how plant pests cause loss in plant production. c. Categorize common weeds, insect pests, fungal, viral, bacterial, and infectious and noninfectious plant diseases. • Insects ○ Siphoning mouthparts ○ Chewing mouthparts ○ Sucking mouthparts ○ Piercing mouthparts • Diseases ○ Fungi ○ Viruses ○ Bacteria • Weeds ○ Annuals ○ Perennials ○ Biennials
2. Examine concepts of plant pest management. DOK 2 a. Describe the characteristics of an agroecosystem as it relates to pest management in plant production. b. Identify beneficial and harmful insects and discuss how each affects plants. c. Describe the role of genetically modified crops in pest management. d. Discuss environmental protection practices regarding pesticide use.
3. Explain the concept and practices of integrated pest management (IPM) in plant production. DOK 2 a. Explain the specific steps of an IPM plan (identification, prevention, avoidance, monitoring, suppression). b. Determine the benefits of IPM to plant production. c. List and describe the various pest management methods used within IPM. • Biological • Chemical • Cultural • Mechanical

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 (MM/YY/DD) on which the student mastered the competency.

Unit 1: Leadership and SAE for All		
	1.	Participate in local, state, and/or national FFA activities that provide opportunities for leadership development and career exploration.
	2.	Identify potential college and career opportunities in plant science.
	3.	Review the types of programs under Supervised Agricultural Experience (SAE) for All.
	4.	Review individual plans for student Foundational SAE programs.
	5.	Develop an Immersion SAE and maintain agricultural records.
Unit 2: Safety		
	1.	Apply and demonstrate general safety procedures for plant production enterprises.
	2.	Apply horticulture safety practices in workplace, classroom, and laboratory environments.
Unit 3: Plant Anatomy and Physiology		
	1.	Analyze plant structures, functions, and reproduction methods, and explain factors affecting plant growth.
Unit 4: Classification		
	1.	Classify agricultural and herbaceous plants by their morphological characteristics and scientific naming systems.
Unit 5: Growing Media		
	1.	Identify and describe the major forms of growing media used in plant production.
	2.	Identify and describe the physical characteristics of growing media and soil textures.
	3.	Explain how differences in growing media can affect drainage.
Unit 6: Environmental Factors		
	1.	Explain how color, intensity, and duration of light affect plant growth.
	2.	Analyze how environmental conditions such as air movement, temperature, and humidity affect plant growth.
	3.	Describe how water quality factors, including potential of hydrogen (pH) and dissolved solids, affect plant growth.
Unit 7: Propagation		
	1.	Apply and demonstrate the process of plant pollination and/or fertilization.
	2.	Analyze factors that affect seed viability, vigor, and germination rates.

	3.	Conduct and interpret seed-quality evaluations for agronomic and horticultural crops.
	4.	Demonstrate asexual plant propagation techniques, including cuttings, division, separation, layering, budding, and grafting.
	5.	Examine and explain aseptic micropropagation techniques.
	6.	Compare and contrast the potential risks and advantages associated with genetically modified agricultural and ornamental plants.
Unit 8: Plant Nutrition and Fertilization		
	1.	Analyze how fertilizers and soil amendments improve plant productivity.
Unit 9: Planting Techniques		
	1.	Explain and compare the steps of crop production.
Unit 10: Greenhouse Management		
	1.	Research the use of various plant-growing structures and their environmental control systems.
	2.	Design and implement a management plan for a hydroponics growing system.
	3.	Discuss the benefits and uses of irrigation in plant production.
Unit 11: Pest Management		
	1.	Analyze the effects of pests on plant production.
	2.	Examine concepts of plant pest management.
	3.	Explain the concept of integrated pest management (IPM) in plant production.

Appendix A: Industry Standards

AFNR Pathway
Content Standards and Performance Elements

The AFNR Pathway Content Standards and Performance Elements are adapted from *AFNR Agriculture, Food, and Natural Resources Content Standards.* Reprinted with permission from the National Council for Agricultural Education, 6060 FFA Drive Indianapolis, IN 46268, 317.802.4206. Copyright © 2024. A complete copy of the national standards can be downloaded from the Team Ag Ed Learning Center at thecouncil.ffa.org/afnr/.

	Units										
Standards	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
ABS - Agribusiness Systems	X									X	
AS - Animal Systems											
BS - Biotechnology Systems			X	X			X				X
CRP - Career Ready Practices	X	X									
ECL - Education, Communication, and Leadership	X										
ESS - Environmental Sustainability Systems		X	X		X	X		X	X	X	X
FPP - Food Products and Processing Systems		X									X
FPS - Foundational Pathway Skills	X	X	X	X	X	X	X	X	X	X	X
NRS - Natural Resource Systems					X	X		X		X	X
PS - Plant Systems			X	X	X	X	X	X	X	X	X
PST - Power, Structural, and Technical Systems		X							X	X	

Agribusiness Systems
Career Pathway Content Standards

The Agribusiness Systems (ABS) Career Pathway encompasses the study of agribusinesses and their management including, but not limited to, record keeping, budget management (cash and credit), business planning, introduction to micro- and macroeconomic principles, and sales and marketing. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the planning, development, application, and management of agribusiness systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Standards***– These are the standards owned by Advance CTE and used here with permission. The standards defined the scope and guided the development of the updated indicators and sample measurements.
- ***Performance Indicators*** – These statements distill each standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related standard at the conclusion of a program of study in this area.

ABS.01. Apply management planning principles in AFNR businesses.

ABS.01.01. Apply economic principles to plan and manage inputs and outputs in an AFNR business.
ABS.01.02. Evaluate and create statements of purpose and business goals for AFNR businesses.
ABS.01.03. Develop and apply skills to manage an AFNR business in an efficient, legal, and ethical manner.

ABS.01.04. Evaluate, develop, and implement procedures used to recruit, train, and retain productive human resources for AFNR businesses.

ABS.02. Use record keeping to accomplish AFNR business objectives, manage budgets and comply with laws and regulations.
ABS.02.01. Apply fundamental accounting principles, systems, tools, and applicable laws and regulations to record, track, and audit AFNR business transactions (e.g., accounts, debits, credits, assets, liabilities, equity, etc.).
ABS.02.02. Assemble, interpret, and analyze financial information and reports to monitor AFNR business performance and support decision-making (e.g., income statements, balance sheets, cash-flow analysis, inventory reports, break-even analysis, return on investment, taxes, etc.).

ABS.03. Manage cash budgets, credit budgets and credit for an AFNR business using generally accepted accounting principles.
ABS.03.01. Manage cash budgets, assets, Employment Tax Incentive opportunities for credits, loans, etc. to achieve AFNR business goals.
ABS.03.02. Analyze credit needs and manage credit budgets to achieve AFNR business goals.

ABS.04. Develop a business plan for an AFNR business.
ABS.04.01. Analyze characteristics and planning requirements associated with developing business plans for different types of AFNR businesses.
ABS.04.02. Develop production and operational plans for an AFNR business.
ABS.04.03. Identify and apply strategies to manage or mitigate risk.

ABS.05. Use sales and marketing principles to accomplish AFNR business objectives.
ABS.05.01. Determine the role of markets, trade, competition, and price in relation to AFNR business sales and marketing plan.
ABS.05.02. Assess and apply sales principles and skills to accomplish AFNR business objectives.
ABS.05.03. Assess marketing principles and develop marketing plans to accomplish AFNR business objectives.

Animal Systems
Career Pathway Content Standards

The Animal Systems (AS) Career Pathway encompasses the study of animal systems, including content areas such as life processes, health, nutrition, genetics, management, processing, and veterinary science, as applied to small animals, aquaculture, exotic animals, livestock, dairy, horses and/or poultry. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of animal systems in AFNR settings.

Within each pathway, the standards are organized as follows:
- ***Standards***– These are the standards owned by Advance CTE and used here with permission. The standards defined the scope and guided the development of the updated indicators and sample measurements.
- ***Performance Indicators*** – These statements distill each standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related standard at the conclusion of a program of study in this area.

AS.01. Analyze historic and current trends impacting the animal systems industry.
AS.01.01. Evaluate the development and implications of animal origin, domestication, and distribution on production practices and the environment.
AS.01.02. Assess and select animal production, marketing, and management methods based upon effectiveness and potential social and environmental impacts.
AS.01.03. Analyze laws and sustainable practices that impact animal agriculture from a local, tribal, state, national, and global perspective.

AS.02. Utilize best-practice protocols based upon animal behaviors for animal husbandry and welfare.
AS.02.01. Explain management techniques that ensure animal welfare.
AS.02.02. Analyze procedures to ensure that animal products are safe for consumption.

AS.03. Design and provide proper animal nutrition to achieve desired outcomes for performance, development, reproduction and/or economic production.

AS.03.01. Analyze the nutritional needs of animals.
AS.03.02. Analyze feed rations and assess if they meet the nutritional needs of animals.
AS.03.03. Utilize tools, equipment, techniques, and technology to make animal nutrition decisions.

AS.04. Apply principles of animal reproduction to achieve desired outcomes for performance, development and/or economic production.

AS.04.01. Evaluate animals for breeding readiness and soundness.
AS.04.02. Apply scientific principles to select and care for breeding animals.
AS.04.03. Apply scientific principles to animal breeding.

AS.05. Evaluate environmental factors affecting animal performance and implement procedures for enhancing performance and animal health.

AS.05.01. Design and evaluate animal housing, equipment, and handling facilities for the major systems of animal production.
AS.05.02. Comply with government regulations and safety standards for facilities used in animal production.

AS.06. Classify, evaluate and select animals based on anatomical and physiological characteristics.

AS.06.01. Classify animals according to taxonomic classification systems and use (e.g., agricultural, companion, etc.).
AS.06.02. Apply principles of comparative anatomy and physiology to uses within various animal systems.
AS.06.03. Select animals for specific purposes and maximum performance based on anatomy and physiology.

AS.07. Apply principles of effective animal health care.

AS.07.01. Design programs to prevent animal diseases, parasites, and other disorders and ensure animal welfare.
AS.07.02. Analyze biosecurity measures utilized to protect the welfare of animals and health of humans on a local, state, national, and global level.

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

AS.08.01. Design management practices related to animal agriculture to enhance the environment.
AS.08.02. Evaluate the effects of environmental conditions on animals.

Biotechnology Systems
Career Pathway Content Standards

The Biotechnology Systems (BS) Career Pathway encompasses the study of using scientific techniques to gather and analyze data to solve problems concerning living organisms with an emphasis on applications to agriculture, food, and natural resource systems. Students completing a program of study in this pathway will demonstrate competence in principles and techniques for the development, application, and management of biotechnology in the context of AFNR.

Within each pathway, the standards are organized as follows:

- ***Standards***– These are the standards set forth by the National Council for Agricultural Education for Biotechnology Systems. They define what students should know and be able to do after completing instruction in a program of study focused on applying Biotechnology to AFNR systems.
- ***Performance Indicators*** – These statements distill each standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related standard at the conclusion of a program of study in this area.

BS.01. Assess factors that have influenced the evolution of biotechnology in agriculture (e.g., scientific technologies, historical events, societal trends, ethical and legal implications, etc.).

BS.01.01. Investigate and explain the relationships in the timeline of developing biotechnology applications and techniques in agriculture (e.g., major innovators, historical developments, potential applications of biotechnology, etc.).
BS.01.02. Evaluate the roles, scope, and implications of regulatory agencies on applications of biotechnology in agriculture and the protection of public interests (e.g., health, safety, environmental issues, etc.).

BS.01.03. Analyze the relationship and implications of bioethics, laws, and public perceptions on applications of biotechnology in agriculture (e.g., ethical, legal, social, cultural issues).

BS.02. Demonstrate proficiency by safely applying appropriate laboratory skills to complete tasks in a biotechnology research and development environment (e.g., standard operating procedures, record keeping, aseptic technique, equipment maintenance, etc.).

BS.02.01. Read, document, evaluate, and secure accurate laboratory records of experimental protocols, observations, and results.

BS.02.02. Identify and apply standard laboratory procedures and equipment maintenance to create and maintain reliable data BS.02.01. Read, document, evaluate, and secure accurate laboratory records of experimental protocols, observations, and results.

BS.02.03. Apply standard operating procedures for the safe handling of biological and chemical materials in a laboratory.

BS.02.04. Safely manage and dispose of biological materials, chemicals, and wastes according to standard operating procedures.

BS.02.05. Examine and perform scientific procedures using microbes, DNA, RNA and proteins in a laboratory.

BS.03. Demonstrate the application of biotechnology to solve problems in Agriculture, Food and Natural Resources (AFNR) systems (e.g., bioengineering, food processing, waste management, horticulture, forestry, livestock, crops, etc.).

BS.03.01. Apply biotechnology principles, techniques, and processes to modify a species.

BS.03.02. Apply biotechnology principles, techniques, and processes to enhance the production of food through the use of microorganisms and enzymes.

BS.03.03. Apply biotechnology principles, techniques, and processes to protect the environment and maximize use of natural resources (e.g., biomass, bioprospecting, industrial biotechnology, etc.).

BS.03.04. Apply biotechnology principles, techniques, and processes to enhance plant and animal care and production (e.g., selective breeding, pharmaceuticals, biodiversity, etc.).

BS.03.05. Apply biotechnology principles, techniques, and processes to produce bioproducts (e.g., fermentation, transesterification, methanogenesis, etc.).

BS.03.06. Apply biotechnology principles, techniques, and processes to improve waste management (e.g., genetically modified organisms, bioremediation, etc.).

Career Ready Practices Content Standards

Career Ready Practices (CRPs) encompass fundamental skills and practices that all students should acquire to be career ready such as: responsibility, productivity, healthy choices, maintaining personal finances, communication, decision-making, creativity and innovation, critical-thinking, problem-solving, integrity, ethical leadership, management, career planning, technology use and cultural/global competency. Students completing a program of study in any AFNR career pathway will demonstrate the knowledge, skills and behaviors that are important to career ready through experiences in a variety of settings (e.g., classroom, CTSO, work-based learning, community etc.).

Within each pathway, the standards are organized as follows:

- ***Standards*** – These are the standards owned by Advance CTE and used here with permission. The standards defined the scope and guided the development of the updated indicators and sample measurements.
- ***Performance Indicators*** – These statements distill each standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related standard at the conclusion of a program of study in this area.

CRP.01. Act as a responsible and contributing citizen and employee.

CRP.01.01. Model personal responsibility in the workplace and community.

CRP.01.02. Explain the short-term and long-term impacts of personal and professional decisions on employers and community before taking action.

CRP.01.03. Identify and act upon opportunities for professional and community service at the workplace.

CRP.02. Apply appropriate academic and technical skills.

CRP.02.01. Use strategic thinking to connect and apply academic learning, technical knowledge, and skills to solve problems in the workplace and community.

CRP.03. Attend to personal health and financial well-being.
- **CRP.03.01.** Design and implement a personal wellness plan.
- **CRP.03.02.** Design and implement a personal financial management plan.

CRP.04. Communicate clearly, effectively and with reason.
- **CRP.04.01.** Communicate using strategies that ensure clarity, logic, purpose and professionalism in formal and informal settings.
- **CRP.04.02.** Produce clear, reasoned, and coherent written and visual communication in formal and informal settings.
- **CRP.04.03.** Model active listening strategies when interacting with others in formal and informal settings.

CRP.05. Consider the environmental, social and economic impacts of decisions.
- **CRP.05.01.** Assess, identify, and synthesize the information and resources needed to make decisions that positively impact the workplace and community.
- **CRP.05.02.** Make, defend, and evaluate decisions at work and in the community using information about the potential environmental, social, and economic impacts.

CRP.06. Demonstrate creativity and innovation.
- **CRP.06.01.** Synthesize information, knowledge, and experience to generate original ideas and challenge assumptions in the workplace and community.
- **CRP.06.02.** Assess a variety of workplace and community situations to identify ways to add value and improve the efficiency of processes and procedures.
- **CRP.06.03.** Create and execute a plan of action for new ideas and introduce innovations to workplace and community organizations.

CRP.07. Employ valid and reliable research strategies.
- **CRP.07.01.** Select and implement reliable research processes and methods to generate data for decision making in the workplace and community.
- **CRP.07.02.** Evaluate the validity of sources and data used when considering the adoption of new technologies, practices, and ideas in the workplace and community.

CRP.08. Utilize critical thinking to make sense of problems and persevere in solving them.
- **CRP.08.01.** Apply reason and logic to evaluate workplace and community situations from multiple perspectives.
- **CRP.08.02.** Investigate, prioritize and select solutions to solve problems in the workplace and community.
- **CRP.08.03.** Establish plans to solve workplace and community problems and execute them with resiliency.

CRP.09. Model integrity, ethical leadership and effective management.
- **CRP.09.01.** Model characteristics of ethical and effective leaders in the workplace and community (e.g. integrity, self-awareness, self-regulation, etc.).
- **CRP.09.02.** Implement personal management skills to function effectively and efficiently in the workplace (e.g., time management, planning, prioritizing, etc.).
- **CRP.09.03.** Demonstrate behaviors that contribute to a positive morale and culture in the workplace and community (e.g., positively influencing others, effectively communicating, etc.).

CRP.10. Plan education and career path aligned to personal goals.
- **CRP.10.01.** Identify career opportunities within a career cluster that match personal interests, talents, goals and preferences.
- **CRP.10.02.** Examine career advancement requirements (e.g., education, certification, training, etc.) and create goals for continuous growth in a chosen career.
- **CRP.10.03.** Develop relationships with and assimilate input and/or advice from experts (e.g., counselors, mentors, etc.) to plan career and personal goals in a chosen career area.
- **CRP.10.04.** Identify, prepare, update and improve the tools and skills necessary to pursue a chosen career path.

CRP.11. Use technology to enhance productivity.
- **CRP.11.01.** Research, select and use new technologies, tools and applications to maximize productivity in the workplace and community.

CRP.11.02. Evaluate personal and organizational risks of technology use and take actions to prevent or minimize risks in the workplace and community.

CRP.01.03. Identify and act upon opportunities for professional and community service at the workplace.

CRP.12. Work productively in teams while using cultural/global competence.

CRP.12.01. Contribute to team-oriented projects and build consensus to accomplish results using cultural global competence in the workplace and community.

CRP.12.02. Create and implement strategies to engage team members to work toward team and organizational goals in a variety of workplace and community situations (e.g., meetings, presentations, etc.).

Education, Communication, and Leadership Career Pathway Content Standards

The Education, Communication, and Leadership (ECL) Career Pathway joins together three disciplines that focus on ways to best inform, educate and advance the agricultural industry. Students completing a program of study in this pathway will demonstrate an understanding of effective education, leadership, and strategic communication in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Standards***– These are the standards set forth by the National Council for Agricultural Education for Education, Communication, and Leadership. They define what students should know and be able to do after completing instruction in a program of study focused on applying Education, Communication, and Leadership to AFNR systems.
- ***Performance Indicators*** – These statements distill each standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related standard at the conclusion of a program of study in this area.

ECL.01. Develop a plan for an educational workshop or lesson - recognizing the breadth of opportunities in agricultural education - that informs, educates and promotes a topic or concept relevant to AFNR.

ECL.01.01. Explore the breadth of opportunities in agricultural education (e.g., using state or national resources, Teach Ag, university program information, professional associations, etc.).

ECL.01.02. Apply fundamental understanding of AFNR and agricultural education - including experiential learning - to the development of a workshop or lesson.

ECL.02. Apply curriculum development and effective instructional techniques to create, teach and evaluate an agricultural education lesson.

ECL.02.01. Develop and deliver a workshop or lesson using a variety of methods and best practices in instruction and facilitation.

ECL.02.02. Evaluate facilitation or presentation strategies that encourage appropriate social interactions, embrace diversity, promote equity and build a positive learning environment that is welcoming to all individuals.

ECL.02.03. Demonstrate impactful leadership as a credible resource for AFNR.

ECL.03. Evaluate the effectiveness of various communication strategies with related methods and platforms used by organizations across AFNR industries.

ECL.03.01. Identify the methods and characteristics of effective verbal, nonverbal, written, and visual communication.

ECL.03.02. Analyze the use of verbal, nonverbal, written, and visual communication platforms in AFNR.

ECL.03.03. Analyze similarities and differences between verbal, nonverbal, written, and visual communication methods.

ECL.04. Develop a written communication plan using various communication methods (e.g. news releases, social media, speaking opportunities, blogs, podcasts, etc.) to convey a message to an intended AFNR audience.

ECL.04.01. Develop a communications plan that includes purpose, target audience, message, medium, and outcome evaluation.

ECL.04.02. Identify, apply and demonstrate communication skills and methods per the communications plan.

ECL.05. Model characteristics of ethical, efficient, and effective leaders in the workplace and community (e.g. integrity, collaboration, self-awareness, self-regulation, etc.).

ECL.05.01. Identify characteristics and behaviors that constitute ethical, efficient, and effective leadership.

ECL.05.02. Demonstrate leadership through advocacy for AFNR-related issues.

Environmental Sustainability Systems
Career Pathway Content Standards

The Environmental Service Systems (ESS) Career Pathway encompasses the study of systems, instruments and technology, and sustainable practices used to monitor and minimize the impact of human activity on environmental systems in the supply chain. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of environmental service systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Standards***– These are the standards owned by Advance CTE and used here with permission. The standards defined the scope and guided the development of the updated indicators and sample measurements.
- ***Performance Indicators*** – These statements distill each standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related standard at the conclusion of a program of study in this area.

ESS.01. Use analytical procedures and instruments to manage environmental service systems.
- **ESS.01.01.** Analyze and interpret laboratory and field samples in environmental sustainability systems.
- **ESS.01.02.** Properly utilize scientific instruments in environmental monitoring situations (e.g., laboratory equipment, environmental monitoring instruments, etc.).

ESS.02. Evaluate the impact of public policies and regulations on environmental service system operations.
- **ESS.02.01.** Interpret and evaluate the impact of laws, agencies, policies, practices, and consumer preferences affecting environmental service systems.
- **ESS.02.02.** Compare and contrast the impact of current trends on regulation of environmental sustainability systems.
- **ESS.02.03.** Examine and summarize the impact of public perceptions and social movements on the regulation of environmental sustainability systems.

ESS.03. Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.
- **ESS.03.01.** Apply meteorology principles to environmental sustainability systems.
- **ESS.03.02.** Apply soil science and hydrology principles to environmental sustainability systems.
- **ESS.03.03.** Apply chemistry principles to environmental sustainability systems.
- **ESS.03.04.** Apply microbiology principles to environmental sustainability systems.
- **ESS.03.05.** Apply ecology principles to environmental sustainability systems.

ESS.04. Demonstrate the operation of environmental service systems (e.g., pollution control, water treatment, wastewater treatment, solid waste management and energy conservation).
- **ESS.04.01.** Develop systems of sustainability management for all categories of solid waste in environmental sustainability systems.
- **ESS.04.02.** Sustainably manage solid waste in environmental service systems.
- **ESS.04.03.** Apply techniques to ensure a safe supply of drinking water and adequate treatment of wastewater according to applicable rules and regulations.
- **ESS.04.04.** Compare and contrast the impact of conventional and alternative energy sources on the environment and operation of environmental sustainability systems.

ESS.05. Use tools, equipment, machinery and technology common to tasks in environmental service systems.
- **ESS.05.01.** Use technological and mathematical tools to map land, facilities, and infrastructure for environmental sustainability systems.
- **ESS.05.02.** Perform assessments of environmental conditions using equipment, machinery, and technology.

Food Products and Processing Systems
Career Pathway Content Standards

The Food Products and Processing Systems (FPP) Career Pathway encompasses the study of food safety, sanitation, nutrition, biology, microbiology, chemistry, human behavior in local and global food systems, food selection, processing for storage, distribution and consumption, and the historical and current development of the food industry. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application, and management of food products and processing systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Standards***– These are the standards owned by Advance CTE and used here with permission. The standards defined the scope and guided the development of the updated indicators and sample measurements.
- ***Performance Indicators*** – These statements distill each standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related standard at the conclusion of a program of study in this area.

FPP.01. Develop and implement procedures to ensure safety, sanitation and quality in food products and processing facilities.

FPP.01.01. Distinguish between various food safety programs and management systems in food products and processing facilities.

FPP 01.02. Apply food safety and quality assurance procedures in the harvesting, handling and processing of food products.

FPP.01.03. Apply food safety procedures during storage and distribution to ensure food quality.

FPP.02. Apply principles of nutrition, biology, microbiology, chemistry and human behavior to the development of food products.

FPP.02.01. Apply principles of nutrition and biology to develop food products that provide a safe, wholesome, and nutritious food supply for local and global food systems.

FPP.02.02. Apply principles of microbiology and chemistry to develop food products to provide a safe, wholesome, and nutritious food supply for local and global food systems.

FPP.02.03. Apply principles of human behavior to develop food products to provide a safe, wholesome, and nutritious food supply for local and global food systems.

FPP.03. Select and process food products for storage, distribution and consumption.

FPP.03.01. Implement selection, evaluation, and inspection techniques to ensure safe and quality food products.

FPP.03.02. Design and apply techniques of food processing, preservation, packaging, and presentation for distribution and consumption of food products.

FPP.03.03. Create food distribution plans and procedures to ensure safe delivery of food products.

FPP.04. Explain the scope of the food industry and the historical and current developments of food products and processing.

FPP.04.01. Examine the scope of the food industry by evaluating local and global policies, trends, and customs for food production.

FPP.04.02. Evaluate the significance and implications of changes and trends in the food products and processing industry in the local and global food systems.

FPP.04.03. Identify the purpose of industry organizations, groups, and regulatory agencies that influence the local and global food systems.

FPP.04.04. Evaluate the effectiveness of current sustainability practices in their role to food products and processing.

Foundational Pathway Skills
Content Standards

The Agriculture, Food, and Natural Resources (AFNR) Foundational Pathway Skills (FPS) encompasses the study of essential knowledge and skills related to all AFNR professions. Students completing a program of study in any AFNR career pathway will demonstrate fundamental knowledge of the nature, scope and relationships of AFNR systems and the skills necessary for analysis of current and historical issues and trends; application of technologies; safety, health, and environmental practices; stewardship of natural resources; and exploration of career opportunities.

Within each pathway, the standards are organized as follows:

- ***Standards 1-6*** – These are the standards owned by Advance CTE and used here with permission. The standards defined the scope and guided the development of the updated indicators and sample measurements.
- ***Standards 7-14*** – These are the standards set forth by the National Council for Agricultural Education for Foundational Pathway Skills. They define what students should know and be able to do after completing instruction in a program of study focused on applying Foundational Pathway Skills to AFNR systems.
- ***Performance Indicators*** – These statements distill each standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related standard at the conclusion of a program of study in this area.

FPS.01. Analyze how issues, trends, technologies and public policies impact systems in the Agriculture, Food & Natural Resources Career Cluster.

FPS.01.01. Research, examine, and discuss issues and trends that impact AFNR systems on local, state, national, and global levels.
FPS.01.02. Examine technologies and analyze their impact on AFNR systems.
FPS.01.03. Identify public policies and examine their impact on AFNR systems.

FPS.02. Evaluate the nature and scope of the Agriculture, Food & Natural Resources Career Cluster and the role of agriculture, food and natural resources (AFNR) in society and the economy.

FPS.02.01. Research and use geographic and economic data to solve problems in AFNR systems.
FPS.02.02. Examine the impact of AFNR on the local, state, national, and global society and economy.

FPS.03. Examine and summarize the importance of health, safety and environmental management systems in AFNR workplaces.

FPS.03.01. Identify and explain the implications of required regulations to maintain and improve safety, health, and environmental management systems.
FPS.03.02. Develop and implement a plan to maintain and improve health, safety, and environmental compliance and performance.
FPS.03.03. Apply health and safety practices to AFNR workplaces.
FPS.03.04. Use appropriate protective equipment and demonstrate safe and proper use of AFNR tools and equipment.

FPS.04. Demonstrate stewardship of natural resources in AFNR activities.

FPS.04.01. Identify and implement practices to steward natural resources in different AFNR systems.
FPS.04.02. Assess and explain the natural resource related trends, technologies and policies that impact AFNR systems.

FPS.05. Describe career opportunities and means to achieve those opportunities in each of the Agriculture, Food & Natural Resources career pathways.

FPS.05.01. Evaluate and implement the steps and requirements to pursue a career opportunity in each of the AFNR career pathways (e.g., goals, degrees, certifications, resumes, cover letter, portfolios, interviews, etc.).
FPS.05.02. Examine and choose career opportunities that are matched to personal skills, talents, and career goals in an AFNR pathway of interest.

FPS.06. Analyze the interaction among AFNR systems in the production, processing and management of food, fiber and fuel and the sustainable use of natural resources.

FPS.06.01. Examine and explain foundational cycles and systems of AFNR.

FPS.07. Recognize the value of a Supervised Agricultural Experience (SAE) as Work-Based Learning.

FPS.07.01. Evaluate the value of an SAE.
FPS.07.02. Connect SAE involvement to lifelong learning and career skills.
FPS.07.03. Define and summarize the foundational and immersion SAEs and the relationship between the two.

FPS.08. Utilize critical thinking to make sense of problems and persevere in solving them.

FPS.08.01. Explore career opportunities and create a plan to prepare for a chosen career.
FPS.08.02. Develop employability skills needed to be successful in a chosen career field.
FPS.08.03. Engage in personal financial practices that lead to financial independence.
FPS.08.04. Assess the importance of health and safety in the AFNR workplace.
FPS.08.05. Evaluate the nature and role that agriculture plays in society, the environment, and the economy.

FPS.09. Recognize the options within and participate in immersive supervised agricultural experiences.
FPS.09.01. Develop AFNR technical knowledge and skills through a personal immersion SAE.
FPS.09.02. Engage in record-keeping practices that promote financial literacy.

FPS.10. Analyze the history of the National FFA Organization and how this timeline has allowed the organization to remain relevant.
FPS.10.01. Evaluate the importance of key events within the organization's history.

FPS.11. Evaluate the structure and value of agricultural education.
FPS.11.01. Interpret the interaction of the three components of agricultural education.
FPS.11.02. Summarize the importance of classroom instruction within agricultural education.
FPS.11.03. Summarize the importance of the National FFA Organization within agricultural education.
FPS.11.04. Summarize the importance of Supervised Agricultural Experiences (SAE) within agricultural education.

FPS.12. Examine the key components providing directional leadership to the National FFA Organization.
FPS.12.01. Identify the importance of the FFA Creed.
FPS.12.02. Identify the importance of the FFA Emblem.
FPS.12.03. Identify the importance of the FFA Mission statement.
FPS.12.04. Identify the importance of a Program of Activities.

FPS.13. Analyze the structures and procedures to effectively and professionally run and manage a meeting.
FPS.13.01. Utilize parliamentary resources to solve problems of organizational management and operations.
FPS.13.02. Present a logical, realistic, and convincing debate on motions.
FPS.13.03. Evaluate agendas, minutes, the constitution, bylaws, and other organizational documents.

FPS.14. Evaluate opportunities to develop leadership, citizenship, and career skills.
FPS.14.01. Evaluate the importance and value of leadership skills.
FPS.14.02. Evaluate the importance and value of citizenship skills.
FPS.14.03. Evaluate the importance and value of career skills.
FPS.14.04. Connect opportunities in leadership, citizenship, and career skills to student development.

Natural Resource Systems
Career Pathway Content Standards

The Natural Resource Systems (NRS) Career Pathway encompasses the study of the management, protection, enhancement and improvement of soil, water, wildlife, forests, and air as natural resources. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application, and management of natural resource systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Standards***– These are the standards owned by Advance CTE and used here with permission. The standards defined the scope and guided the development of the updated indicators and sample measurements.
- ***Performance Indicators*** – These statements distill each standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related standard at the conclusion of a program of study in this area.

NRS.01. Plan and conduct natural resource management activities that apply logical, reasoned and scientifically based solutions to natural resource issues and goals.
NRS.01.01. Examine natural resource availability and ecosystem function in a particular region.
NRS.01.02. Classify different types of natural resources in order to enable protection, conservation, enhancement, and management in a particular geographical region.
NRS.01.03. Apply ecological concepts and principles (e.g., weather, air quality, UV protection, atmospheric pressure, etc.) to the interaction of atmospheric and natural resource systems.
NRS.01.04. Apply ecological concepts and principles to aquatic natural resource systems.
NRS.01.05. Apply ecological concepts and principles to terrestrial natural resource systems.
NRS.01.06. Apply ecological concepts and principles to biotic organisms in natural resource systems.

NRS.02.01. Analyze the interrelationships between natural resources and humans.

NRS.02.01. Examine and interpret the purpose, enforcement, impact, and effectiveness of laws, agencies, and private and public organizations related to natural resource management, protection, enhancement, and improvement (e.g., water regulations, game laws, environmental policy, local, state, and national conservation organizations, agricultural extension service, etc.).

NRS.02.02. Assess the impact of human activities on the availability of natural resources.

NRS.02.03. Analyze how social perceptions of natural resource management, protection, enhancement, and improvement change and develop over time.

NRS.02.04. Examine and explain how economics affects the use of natural resources.

NRS.02.05. Communicate information to the public regarding topics related to the management, protection, enhancement, and improvement of natural resources.

NRS.03. Develop plans to ensure sustainable production and processing of natural resources.

NRS.03.01. Sustainably produce, harvest, process, and use natural resource products (e.g., forest and rangeland products, wildlife, minerals, fossil fuels, shale oil, alternative energy, recreation, aquatic species, etc.).

NRS.03.02. Demonstrate cartographic skills, tools, and technologies to aid in developing, implementing and evaluating natural resource management plans.

NRS.04. Demonstrate responsible management procedures and techniques to protect, maintain, enhance, and improve natural resources.

NRS.04.01. Demonstrate natural resource protection, maintenance, enhancement, and improvement techniques.

NRS.04.02. Diagnose plant and wildlife diseases and follow protocols to prevent their spread.

NRS.04.03. Prevent or manage introduction of ecologically harmful species in a particular region.

NRS.04.04. Manage fires in natural resource systems.

Plant Systems
Career Pathway Content Standards

The Plant Systems (PS) Career Pathway encompasses the study of plant life cycles, classifications, functions, plant structures, greenhouse and nursery structures, field conditions, reproduction, media and nutrients, as well as growth and cultural practices through the study of crops, turf grass, trees, shrubs and/or ornamental plants. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of plant systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Standards***– These are the standards owned by Advance CTE and used here with permission. The standards defined the scope and guided the development of the updated indicators and sample measurements.
- ***Performance Indicators*** – These statements distill each standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related standard at the conclusion of a program of study in this area.

PS.01. Develop and implement a crop management plan for a given production goal that accounts for environmental factors.

PS.01.01. Determine the influence of environmental factors on plant growth.

PS.01.02. Prepare and adjust growing media for use in plant systems.

PS.01.03. Demonstrate planting techniques and create the conditions needed for seed germination.

PS.01.04. Develop and implement a nutrient management and/or fertilizer plan for specific plants or crops.

PS.02. Apply principles of classification, plant anatomy, and plant physiology to plant production and management.

PS.02.01. Classify plants according to taxonomic systems.

PST.02.02. Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.

PS.02.03. Apply knowledge of plant physiology and energy conversion to plant systems.

PS.03. Propagate, culture and harvest plants and plant products based on current industry standards.

PS.03.01. Demonstrate plant propagation techniques in plant system activities.

PS.03.02. Develop and implement a management plan for plant production.
PS.03.03. Develop and implement a plan for integrated pest management for plant production.
PS.03.04. Apply principles and practices of sustainable agriculture to plant production.
PS.03.05. Harvest crops according to industry standards.
PS.03.06. Haul and store crops according to industry standards.

PS.04. Apply principles of design in plant systems to enhance an environment (e.g. floral, forest landscape, and farm).
PS.04.01. Evaluate, identify, and prepare plants to enhance an environment.
PS.04.02. Create designs using plants.

Power, Structural, and Technical Systems Career Pathway Content Standards

The Power, Structural and Technical Systems (PST) Career Pathway encompasses the study of agricultural equipment, power systems, sustainable fuel sources and precision technology, as well as woodworking, metalworking, welding, electrification, and project planning for agricultural structures. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of power, structural and technical systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Standards***– These are the standards owned by Advance CTE and used here with permission. The standards defined the scope and guided the development of the updated indicators and sample measurements.
- ***Performance Indicators*** – These statements distill each standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related standard at the conclusion of a program of study in this area.

PST.01. Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems.
PST.01.01. Apply physical science and engineering principles to assess and select energy sources for AFNR power, structural, and technical systems.
PST.01.02. Apply physical science and engineering principles to design, implement and improve safe and efficient mechanical systems in AFNR situations.
PST.01.03. Apply physical science and engineering principles to metal fabrication using a variety of welding and cutting processes and equipment (e.g., SMAW, GMAW, GTAW, Oxy-fuel, CNC, and plasma arc torch, etc.).

PST.02. Operate and maintain AFNR mechanical equipment and power systems.
PST.02.01. Perform preventative maintenance and scheduled service to maintain equipment, machinery, and power units used in AFNR settings.
PST.02.02. Operate machinery and equipment while observing all safety precautions in AFNR settings.

PST.03. Service and repair AFNR mechanical equipment and power systems.
PST.03.01. Troubleshoot, service, and repair components of internal combustion engines using manufacturers' guidelines.
PST.03.02. Service electrical systems and components of mechanical equipment and power systems using a variety of troubleshooting and/or diagnostic methods.
PST.03.03. Utilize manufacturers' guidelines to diagnose and troubleshoot malfunctions in machinery, equipment, and power source systems (e.g., hydraulic, pneumatic, transmission, steering, powertrain, suspension, etc.).

PST.04. Plan, build and maintain AFNR structures.
PST.04.01. Create plans for AFNR structures.
PST.04.02. Determine structural requirements, specifications, customer needs, and estimate costs for AFNR structures.
PST.04.03. Apply best practices and safety guidelines for use of hand and power tools associated with constructing and maintaining AFNR structures.
PST.04.04. Follow architectural and mechanical plans to construct, maintain and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, surveying, electrical, plumbing, concrete/masonry, etc.).
PST.04.05. Apply electrical wiring principles in AFNR structures.

PST.05. Use control, monitoring, geospatial and other technologies in AFNR power, structural, and technical systems.

PST.05.01. Apply current and/or identify emerging technologies (e.g., robotics, CNC, UAS, etc.) to solve problems and increase the efficiency of AFNR systems.

PST.05.02. Prepare and/or use electrical drawings to design, install, and troubleshoot electronic control systems in AFNR settings.

PST.05.03. Apply geospatial principles and technologies to solve problems and increase the efficiency of AFNR systems.

Mississippi College- and Career-Readiness Standards (MS CCRS)
Biology

	Units										
Standards	1	2	3	4	5	6	7	8	9	10	11
BIO.1A.1			X								
BIO.1A.2			X								
BIO.1A.3			X								
BIO.1A.4											
BIO.1B.1			X					X			
BIO.1B.2								X			
BIO.1C.1			X								
BIO.1C.2			X								
BIO.1C.3											
BIO.1D.1			X								
BIO.1D.2			X								
BIO.1E.1			X				X				
BIO.1E.2			X				X				
BIO.1E.3							X				
BIO.1E.4											
BIO.2.1			X								
BIO.2.2			X								
BIO.2.3			X								
BIO.2.4			X								
BIO.2.5								X			
BIO.2.6											
BIO.3A.1							X				
BIO.3A.2							X				
BIO.3A.3											
BIO.3B.1							X				
BIO.3B.2											
BIO.3B.3							X				
BIO.3B.4											
BIO.3C.1							X				
BIO.3C.2											
BIO.3C.3							X				
BIO.3C.4							X				
BIO.3C.5											

	Units										
Standards	1	2	3	4	5	6	7	8	9	10	11
BIO.4.1											
BIO.4.2				X							
BIO.4.3				X							
BIO.4.4											
BIO.4.5				X							
BIO.4.6											
BIO.4.7											
BIO.5.1						X			X		
BIO.5.2						X		X			
BIO.5.3						X					
BIO.5.4						X					
BIO.5.5											X
BIO.5.6						X					
BIO.5.7						X					
BIO.5.8											
BIO.5.9										X	

Cells in a System

BIO.1A Students will demonstrate an understanding of the characteristics of life and biological organization.

BIO.1A.1 Develop criteria to differentiate between living and non-living things.

BIO.1A.2 Describe the tenets of cell theory and the contributions of Schwann, Hooke, Schleiden, and Virchow.

BIO.1A.3 Using specific examples, explain how cells can be organized into complex tissues, organs, and organ systems in multicellular organisms.

BIO.1A.4 Use evidence from current scientific literature to support whether a virus is living or non-living.

BIO.1B Students will analyze the structure and function of the macromolecules that make up cells.

BIO.1B.1 Develop and use models to compare and contrast the structure and function of carbohydrates, lipids, proteins, and nucleic acids (DNA and RNA) in organisms.

BIO.1B.2 Design and conduct an experiment to determine how enzymes react given various environmental conditions (i.e., pH, temperature, and concentration). Analyze, interpret, graph, and present data to explain how those changing conditions affect the enzyme activity and the rate of the reactions that take place in biological organisms.

BIO.1C Students will relate the diversity of organelles to a variety of specialized cellular functions.

BIO.1C.1 Develop and use models to explore how specialized structures within cells (e.g., nucleus, cytoskeleton, endoplasmic reticulum, ribosomes, Golgi apparatus, lysosomes, mitochondria, chloroplast, centrosomes, and vacuoles) interact to carry out the functions necessary for organism survival.

BIO.1C.2 Investigate to compare and contrast prokaryotic cells and eukaryotic cells, and plant, animal, and fungal cells.

BIO.1C.3 Contrast the structure of viruses with that of cells and explain why viruses must use living cells to reproduce.

BIO.1D Students will describe the structure of the cell membrane and analyze how the structure is related to its primary function of regulating transport in and out of cells to maintain homeostasis.

BIO.1D.1 Plan and conduct investigations to prove that the cell membrane is a semi-permeable, allowing it to maintain homeostasis with its environment through active and passive transport processes.

BIO.1D.2 Develop and use models to explain how the cell deals with imbalances of solute concentration across the cell membrane (i.e., hypertonic, hypotonic, and isotonic conditions, sodium/potassium pump).

BIO.1E Students will develop and use models to explain the role of the cell cycle during growth, development, and maintenance in multicellular organisms.

BIO.1E.1 Construct models to explain how the processes of cell division and cell differentiation produce and maintain complex multicellular organisms.

BIO.1E.2 Identify and describe the changes that occur in a cell during replication. Explore problems that might occur if the cell does not progress through the cycle correctly (cancer).

BIO.1E.3 Relate the processes of cellular reproduction to asexual reproduction in simple organisms (i.e., budding, vegetative propagation, regeneration, binary fission). Explain why the DNA of the daughter cells is the same as the parent cell.

BIO.1E.4 Enrichment: Use an engineering design process to investigate the role of stem cells in regeneration and asexual reproduction, then develop applications of stem cell research to solve human medical conditions.

Energy Transfer

BIO.2 Students will explain that cells transform energy through the processes of photosynthesis and cellular respiration to drive cellular functions.

BIO.2.1 Use models to demonstrate that ATP and ADP are cycled within a cell as a means to transfer energy.

BIO.2.2 Develop models of the major reactants and products of photosynthesis to demonstrate the transformation of light energy into stored chemical energy in cells. Emphasize the chemical processes in which bonds are broken and energy is released, and new bonds are formed and energy is stored.

BIO.2.3 Develop models of the major reactants and products of cellular respiration (aerobic and anaerobic) to demonstrate the transformation of the chemical energy stored in food to the available energy of ATP. Emphasize the chemical processes in which bonds are broken and energy is released, and new bonds are formed and energy is stored.

BIO.2.4 Conduct scientific investigations or computer simulations to compare aerobic and anaerobic cellular respiration in plants and animals, using real world examples.

BIO.2.5 Enrichment: Investigate variables (e.g., nutrient availability, temperature) that affect anaerobic respiration and current real-world applications of fermentation.

BIO.2.6 Enrichment: Use an engineering design process to manipulate factors involved in fermentation to optimize energy production.

Reproduction and Heredity

BIO.3A Students will develop and use models to explain the role of meiosis in the production of haploid gametes required for sexual reproduction.

BIO.3A.1 Model sex cell formation (meiosis) and combination (fertilization) to demonstrate the maintenance of chromosome number through each generation in sexually reproducing populations. Explain why the DNA of the daughter cells is different from the DNA of the parent cell.

BIO.3A.2 Compare and contrast mitosis and meiosis in terms of reproduction.

BIO.3A.3 Investigate chromosomal abnormalities (e.g., Down syndrome, Turner's syndrome, and Klinefelter syndrome) that might arise from errors in meiosis (nondisjunction) and how these abnormalities are identified (karyotypes).

BIO.3B Students will analyze and interpret data collected from probability calculations to explain the variation of expressed traits within a population.

BIO.3B.1 Demonstrate Mendel's law of dominance and segregation using mathematics to predict phenotypic and genotypic ratios by constructing Punnett squares with both homozygous and heterozygous allele pairs.

BIO.3B.2 Illustrate Mendel's law of independent assortment using Punnett squares and/or the product rule of probability to analyze monohybrid crosses.

BIO.3B.3 Investigate traits that follow non-Mendelian inheritance patterns (e.g., incomplete dominance, codominance, multiple alleles in human blood types, and sex-linkage).

BIO.3B.4 Analyze and interpret data (e.g., pedigrees, family, and population studies) regarding Mendelian and complex genetic traits (e.g., sickle-cell anemia, cystic fibrosis, muscular dystrophy, color-blindness, and hemophilia) to determine patterns of inheritance and disease risk.

BIO.3C Students will construct an explanation based on evidence to describe how the structure and nucleotide base sequence of DNA determines the structure of proteins or RNA that carry out essential functions of life.

BIO.3C.1 Develop and use models to explain the relationship between DNA, genes, and chromosomes in coding the instructions for the traits transferred from parent to offspring.

BIO.3C.2 Evaluate the mechanisms of transcription and translation in protein synthesis.

BIO.3C.3 Use models to predict how various changes in the nucleotide sequence (e.g., point mutations, deletions, and additions) will affect the resulting protein product and the subsequent inherited trait.

BIO.3C.4 Research and identify how DNA technology benefits society. Engage in scientific argument from evidence over the ethical issues surrounding the use of DNA technology (e.g., cloning, transgenic organisms, stem cell research, and the Human Genome Project, gel electrophoresis).

BIO.3C.5 Enrichment: Investigate current biotechnological applications in the study of the genome (e.g., transcriptome, proteome, individualized sequencing, and individualized gene therapy).

Adaptations and Evolution

BIO.4 Students will analyze and interpret evidence to explain the unity and diversity of life.

BIO.4.1 Use models to differentiate between organic and chemical evolution, illustrating the steps leading to aerobic heterotrophs and photosynthetic autotrophs.

BIO.4.2 Evaluate empirical evidence of common ancestry and biological evolution, including comparative anatomy (e.g., homologous structures and embryological similarities), fossil record, molecular/biochemical similarities (e.g., gene and protein homology), and biogeographic distribution.

BIO.4.3 Construct cladograms/phylogenetic trees to illustrate relatedness between species.

BIO.4.4 Design models and use simulations to investigate the interaction between changing environments and genetic variation in natural selection leading to adaptations in populations and differential success of populations.

BIO.4.5 Use Darwin's Theory to explain how genetic variation, competition, overproduction, and unequal reproductive success acts as driving forces of natural selection and evolution.

BIO.4.6 Construct explanations for the mechanisms of speciation (e.g., geographic and reproductive isolation).

BIO.4.7 Enrichment: Construct explanations for how various disease agents (bacteria, viruses, chemicals) can influence natural selection.

Interdependence of Organisms and Their Environment

BIO.5 Students will Investigate and evaluate the interdependence of living organisms and their environment.

BIO.5.1 Illustrate levels of ecological hierarchy, including organism, population, community, ecosystem, biome, and biosphere.

BIO.5.2 Analyze models of the cycling of matter (e.g., carbon, nitrogen, phosphorus, and water) between abiotic and biotic factors in an ecosystem and evaluate the ability of these cycles to maintain the health and sustainability of the ecosystem.

BIO.5.3 Analyze and interpret quantitative data to construct an explanation for the effects of greenhouse gases on the carbon dioxide cycle and global climate.

BIO.5.4 Develop and use models to describe the flow of energy and amount of biomass through food chains, food webs, and food pyramids.

BIO.5.5 Evaluate symbiotic relationships (e.g., mutualism, parasitism, and commensalism) and other co-evolutionary (e.g., predator-prey, cooperation, competition, and mimicry) relationships within specific environments.

BIO.5.6 Analyze and interpret population data, both density-dependent and density-independent, to define limiting factors. Use graphical representations (growth curves) to illustrate the carrying capacity within ecosystems.

BIO.5.7 Investigate and evaluate factors involved in primary and secondary ecological succession using local, real-world examples.

BIO.5.8 Enrichment: Use an engineering design process to create a solution that addresses changing ecological conditions (e.g., climate change, invasive species, loss of biodiversity, human population growth, habitat destruction, biomagnification, or natural phenomena).

BIO.5.9 Enrichment: Use an engineering design process to investigate and model current technological uses of biomimicry to address solutions to real-world problems.

FFA Career and Leadership Development Events Alignment

Agronomy		
Unit	**Competency/Objective**	**CDE/LDE Alignment**
Unit 1: Leadership and SAE for All	1. Participate in local, state, and/or national FFA activities that provide opportunities for leadership development and career exploration. 1a. Actively participate in FFA activities.	Entire Event
Unit 3: Plant Anatomy and Physiology	1. Explore plant structure and their functions. 1a. Draw a diagram of a flowering plant, and label and describe the major parts and functions as related to plant growth. 1b. Describe the process of respiration, photosynthesis, and transpiration. 1c. Describe the relationship of environmental and cultural factors to plant growth. 1d. Recognize plants according to life cycle, including annual, perennial, deciduous, evergreen, etc. 1e. Describe sexual reproduction in plants.	Team Event (Team Activity) Individual Practicums (General Knowledge Examination; Identification)
Unit 4: Classification	1. Classify the morphological characteristics and systems used to identify agricultural and herbaceous plants by common and scientific names.	Individual Practicums (Identification)
Unit 5: Growing Media	1. Describe the major forms of growing media. 4b. Interpret the information and data found on an agronomic seed tag. 4d. Assess seed samples and complete a seed tag.	Team Event (Team Activity) Individual Practicums (General Knowledge Examination)
Unit 6: Environmental Factors	1. Describe the three measurements of light – color, intensity, and duration – that affect plant growth. 2. Identify the effects of environmental conditions on plant growth. 3. Describe the effects of water quality on plant growth.	Team Event (Team Activity) Individual Practicums (General Knowledge Examination)
Unit 7: Propagation	2. Examine factors that affect seed viability, vigor, and germination rates. 3. Demonstrate asexual plant propagation techniques.	Team Event (Team Activity) Individual Practicums (General Knowledge Examination)
Unit 8: Plant Nutrition and Fertilization	1a. Identify macronutrients and micronutrients and their effects on plant growth. 1b. Examine the impact of soil pH on nutrient availability.	Team Event (Team Activity) Individual Practicums (General Knowledge Examination; Soils)
Unit 9: Planting Techniques	1. Describe the steps to growing crops including crop selection, land preparation, seed selection, seed sowing, irrigation, fertilizing, and harvesting.	Team Event (Team Activity) Individual Practicums (General Knowledge Examination)
Unit 11: Pest Management	1. Assess the effects of pests on plant production. 1a. Describe a healthy plant. 1b. Explain how plant pests cause loss in plant production. 1c. Categorize common weeds, insect pests, fungal, viral, bacterial, and infectious and noninfectious plant diseases. 3. Describe the concept of integrated pest management (IPM) in plant production.	Team Event (Team Activity) Individual Practicums (General Knowledge Examination; Pest Management)

Floriculture		
Unit	**Competency/Objective**	**CDE/LDE Alignment**
Unit 1: Leadership and SAE for All	1. Participate in local, state, and/or national FFA activities that provide opportunities for leadership development and career exploration. 1a. Actively participate in FFA activities.	Entire Event
Unit 3: Plant Anatomy and Physiology	1. Explore plant structure and their functions. 1a. Draw a diagram of a flowering plant, and label and describe the major parts and functions as related to plant growth. 1b. Describe the process of respiration, photosynthesis, and transpiration. 1g. Identify and describe asexual reproduction techniques using grafting, budding, cuttings, layering, separation and division, and tissue culture methods.	Team Activity Individual Activities (Identification of Plant Material, Equipment, and Disorders; Annual Practicums)
Unit 4: Classification	1. Classify the morphological characteristics and systems used to identify agricultural and herbaceous plants by common and scientific names. 1a. life cycles 1b. growth habit 1c. plant use	Individual Activities (Identification of Plant Material, Equipment, and Disorders)
Unit 5: Growing Media	1. Describe the major forms of growing media. 2. Identify the physical characteristics of growing media and soil texture. 2a. Identify and compare the components of natural soil and soilless mix. 2b. Prepare a growing substrate to specifications or identify the components and proportions in a commercially prepared rooting substrate.	Team Activity Individual Activities (Growing Procedures; Greenhouse Maintenance and Management Practices)
Unit 6: Environmental Factors	1. Describe the three measurements of light – color, intensity, and duration – that affect plant growth. 2. Identify the effects of environmental conditions on plant growth. 3. Describe the effects of water quality on plant growth.	Individual Activities (Greenhouse Maintenance and Management Practices)
Unit 7: Propagation	1a. Apply pollination/fertilization process 3a. Demonstrate asexual-propagation techniques 4a. Examine aseptic micro-propagation	Individual Activities (Annual Practicums)
Unit 8: Plant Nutrition and Fertilization	1. Explain how fertilizers and soil amendments can be added to growing media to improve plant productivity. 1a. Identify macronutrients and micronutrients and their effects on plant growth. 1e. Analyze a fertilizer label.	Individual Activities (Annual Practicums; Greenhouse Maintenance and Management Practices)
Unit 9: Planting Techniques	1. Describe the steps to growing crops including crop selection, land preparation, seed selection, seed sowing, irrigation, fertilizing, and harvesting.	Individual Activities (Annual Practicums)
Unit 10: Greenhouse Management	1. Research the use of various plant-growing structures and their environmental control systems. 2. Create a management plan for a hydroponics growing system. 3. Discuss the benefits and uses of irrigation in plant production.	Individual Activities (Annual Practicums; Greenhouse Maintenance and Management Practices)
Unit 11: Pest Management	1. Assess the effects of pests on plant production. 1a. Describe a healthy plant.	Individual Activities (General Knowledge and Problem-Solving Examination; Annual Practicums;

	1b. Explain how plant pests cause loss in plant production. 1c. Categorize common weeds, insect pests, fungal, viral, bacterial, and infectious and noninfectious plant diseases. 3. Describe the concept of integrated pest management (IPM) in plant production. 3a. Explain the specific steps of an IPM plan.	Greenhouse Maintenance and Management Practices)

Nursery/Landscape		
Unit	**Competency/Objective**	**CDE/LDE Alignment**
Unit 1: Leadership and SAE for All	1. Participate in local, state, and/or national FFA activities that provide opportunities for leadership development and career exploration. 1a. Actively participate in FFA activities.	Entire Event
Unit 2: Safety	1. Demonstrate general safety procedures for plant production enterprises. 1a. Describe the procedures for working in and maintaining a safe, orderly workplace. 1d. Demonstrate the procedures for the safe use of chemicals and other hazardous materials in the laboratory and greenhouse, including the use of safety data sheets (SDS) and personal protective equipment (PPE). 2. Apply standard horticulture safety practices. 2a. Apply safety standards in the workplace.	Team Interactive Events (Phase 1-A: Team Skills Challenge) Individual Events (Phase 6: Nursery Propagation or Potting)
Unit 3: Plant Anatomy and Physiology	1. Explore plant structure and their functions. 1a. Draw a diagram of a flowering plant, and label and describe the major parts and functions as related to plant growth. 1b. Describe the process of respiration, photosynthesis, and transpiration.	Individual Events (Phase 2: General Knowledge Examination; Phase 3: Identification of Plants, Pests, Disorders, and Beneficial Insect)
Unit 4: Classification	1. Classify the morphological characteristics and systems used to identify agricultural and herbaceous plants by common and scientific names.	Individual Events (Phase 3: Identification of Plants, Pests, Disorders, and Beneficial Insect)
Unit 5: Growing Media	1. Describe the major forms of growing media. 2b. Prepare a growing substrate to specifications or identify the components and proportions in a commercially prepared rooting substrate.	Team Interactive Events (Phase 1-A: Team Skills Challenge) Individual Events (Phase 6: Nursery Propagation or Potting)
Unit 6: Environmental Factors	1. Describe the three measurements of light – color, intensity, and duration – that affect plant growth. 2. Identify the effects of environmental conditions on plant growth. 3. Describe the effects of water quality on plant growth.	Individual Events (Phase 2: General Knowledge Examination)
Unit 7: Propagation	3. Demonstrate asexual plant propagation techniques.	Individual Events (Phase 6: Nursery Propagation or Potting)
Unit 8: Plant Nutrition and Fertilization	1. Explain how fertilizers and soil amendments can be added to growing media to improve plant productivity. 1a. Identify macronutrients and micronutrients and their effects on plant growth. 1e. Analyze a fertilizer label.	Team Interactive Events (Phase 1-A: Team Skills Challenge) Individual Events (Phase 2: General Knowledge Examination)
Unit 9: Planting Techniques	1. Describe the steps to growing crops including crop selection, land preparation, seed selection, seed sowing, irrigation, fertilizing, and harvesting.	Team Interactive Events (Phase 1-A: Team Skills Challenge)

		Individual Events (Phase 4: Landscape Estimating)
Unit 10: Greenhouse Management	1. Research the use of various plant-growing structures and their environmental control systems	Individual Events (Phase 2: General Knowledge Examination)
Unit 11: Pest Management	1. Assess the effects of pests on plant production. 1a. Describe a healthy plant. 1b. Explain how plant pests cause loss in plant production. 1c. Categorize common weeds, insect pests, fungal, viral, bacterial, and infectious and noninfectious plant diseases. 3. Describe the concept of integrated pest management (IPM) in plant production. 3a. Explain the specific steps of an IPM plan.	Team Interactive Events (Phase 1-A: Team Skills Challenge) Individual Events (Phase 3: Identification of Plants, Pests, Disorders, and Beneficial Insect)