2025 Horticulture

Program CIP: 01.0601 – Applied Horticulture/Horticultural Operations, General000

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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 contexts of curriculum development and revision, research, assessment, professional development, and industrial training.

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Acknowledgments

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Dr. Lance Evans, State Superintendent of Education, Executive Secretary
Mr. Glen V. East, Chair
Mr. Matt Miller, Vice-Chair
Dr. Ronnie L. McGehee
Mr. Bill Jacobs
Mr. Mike Pruitt
Ms. Mary Werner
Dr. Wendi Barrett
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Mr. Matt Mayo
Ms. Kate Riddle, Student Representative
Mr. Crosby Parker, Student Representative

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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, English II, and U.S. History from 1877, which could be integrated into the content of the units. Mississippi's CTE Horticulture is aligned to the following standards:

International Society for Technology in Education Standards (ISTE)

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/oae/college-and-career-readiness-standards

Framework for 21st Century Learning
In defining 21st-century learning, the Partnership for 21st Century Skills has embraced key themes and skill areas that represent the essential knowledge for the 21st century: global awareness; financial, economic, business, and entrepreneurial literacy; civic literacy; health literacy; environmental literacy; learning and innovation skills; information, media, and technology skills; and life and career skills.
battelleforkids.org/networks/p21/frameworks-resources

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
Horticulture is a pathway within the Agriculture Career Cluster. This program is designed to cater to students aspiring for entry-level employment or further education within the diverse realms of the horticulture industry. Over the course of two or four years, students will delve into a variety of topics essential to horticulture, including plant structure and growth, propagation techniques, pest management strategies, floral practices, greenhouse crop cultivation and management, olericulture principles, landscaping methods, landscape design, installation, and maintenance, as well as turfgrass management.

Recent trends in the horticulture discipline have introduced innovative approaches and technologies to the field. These trends include the increasing emphasis on sustainable horticultural practices, such as organic gardening and permaculture design. Additionally, there is a growing interest in urban horticulture, vertical gardening, and hydroponic systems, reflecting the evolving needs of urban populations and limited space availability. Furthermore, advancements in biotechnology have led to the development of genetically modified plants with enhanced traits, offering new opportunities and challenges for horticulture professionals. By incorporating these recent trends into the curriculum, students will gain a comprehensive understanding of contemporary horticultural practices and prepare themselves for success in this industry.

College, Career, and Certifications
No national industry-recognized certifications are known to exist at this time in the field of agriculture and natural resources. 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 9th-12th 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 with only one class with the teacher at a time.

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 and Test of Adult Basic Education (TABE) reading score (eighth grade or higher)

or

1. TABE reading and math score (eighth grade or higher)

2. 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/ese/approved-course-for-the-secondary-schools.

Teacher Licensure
The latest teacher licensure information can be found at mdek12.org/oel/apply-for-an-educator-license.

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 Outlines

Option 1—Four 1-Carnegie Unit Courses

This curriculum consists of four 1-credit courses that should be completed in the following sequence:

1. **Introduction to Horticulture—Course Code: 991402**
2. **Horticulture Plant Processes—Course Code: 991403**
3. **Horticulture Nursery—Course Code: 991404**
4. **Horticulture Landscape and Turfgrass—Course Code: 991405**

Course Description: Introduction to Horticulture
Introduction to Horticulture is a foundational course designed to provide students with a comprehensive understanding of the principles and practices within the horticulture industry. Throughout this course, students will explore various units covering essential topics ranging from basic plant structure and function to horticulture safety protocols and an introduction to the National FFA organization.

Course Description: Horticulture Plant Growth and Management
Horticulture Plant Growth and Management is a comprehensive course that delves into essential plant-related topics in horticulture, covering a wide range of crops, including fruits, vegetables, and herbs. Students will learn about various plant propagation methods, effective pest management techniques, and best practices for cultivating plant crops in both greenhouse and field settings. By mastering these foundational skills, students will gain knowledge needed for a variety of horticultural careers or further studies in the field.

Course Description: Horticulture Nursery
Horticulture Nursery is a comprehensive course covering leadership, careers, and safety while introducing students to plant identification in nursery and landscape settings. Additionally, students will learn about marketing strategies and business procedures relevant to horticulture, along with techniques for container and field crop production. This course prepares students for various roles within the horticulture industry.

Course Description: Application of Horticulture Practices
Application of Horticulture Practices is a course that covers landscape design, installation, construction, and maintenance as well as sustainable urban techniques and SAE for All. Students will learn how to install and care for turfgrass, as well as the basics of sustainable urban agricultural practices. This course gives students the skills they need for jobs in landscape design, turf maintenance, and sustainable horticulture fields.

Introduction to Horticulture—Course Code: 991402

Unit	Unit Title	Hours
1	Introduction to Horticulture	20
2	The National FFA Organization and Career Development	25
3	Basic Plant Structure and Function	50

4	Plant Growth Substrate (Media)	30
5	Greenhouse Structures	15
Total		**140**

Horticulture Plant Growth and Management—Course Code: 991403

Unit	Unit Title	Hours
6	Plant Propagation	20
7	Principles of Pest Management	40
8	Greenhouse Crops, Olericulture (Vegetable), Pomology (Fruit) Production	60
9	Herb Production	20
Total		**140**

Horticulture Nursery—Course Code: 991404

Unit	Unit Title	Hours
10	Horticulture Careers and FFA Leadership	30
11	Nursery and Landscape Plant Identification	40
12	Horticulture Marketing and Business Procedures	20
13	Floral Design	50
Total		**140**

Application of Horticulture Practices —Course Code: 991405

Unit	Unit Title	Hours
14	Landscape Design, Installation, Construction, and Maintenance	40
15	Turfgrass Installation and Maintenance	30
16	Sustainability and Urban Techniques	30
17	Immersion into FFA and Supervised Agriculture Experience (SAE) for All	40
Total		**140**

Option 2—Two 2-Carnegie Unit Courses

This curriculum consists of two 2-credit courses that should be completed in the following sequence:

1. **Horticulture I—Course Code: 991400**
2. **Horticulture II—Course Code: 991401**

Course Description: Horticulture I
Horticulture I is a foundational course designed to provide students with a comprehensive understanding of the principles and practices within the horticulture industry. Throughout this course, students will explore various units covering essential topics ranging from basic plant structure and function to horticulture safety protocols and an introduction to the FFA organization. Additionally, students will delve into essential plant-related topics, including various plant propagation methods, effective pest management techniques, and best practices for cultivating plant crops such as fruits, vegetables, and herbs in both greenhouse and field settings. By mastering these foundational skills, students will gain the knowledge needed for a variety of horticultural careers or further studies in the field.

Course Description: Horticulture II
Horticulture II builds upon foundational knowledge acquired in Horticulture I, offering students a deeper exploration of advanced topics within the horticulture industry. This comprehensive course encompasses leadership, careers, and safety in horticulture while also delving into plant identification in nursery and landscape settings. Additionally, students will learn about marketing strategies and business procedures relevant to horticulture, along with techniques for container and field crop production. Furthermore, students will gain practical skills in landscape design, installation, construction, and maintenance, as well as sustainable urban techniques and SAE integration. With a focus on turfgrass installation, maintenance, and sustainable urban agricultural practices, this course equips students with the advanced skills and knowledge needed for careers in landscape design, turf maintenance, and various sustainable horticulture fields.

Horticulture I—Course Code: 991400

Unit	Unit Title	Hours
1	Introduction to Horticulture	20
2	The National FFA Organization and Career Development	25
3	Basic Plant Structure and Function	50
4	Plant Growth Substrate (Media)	30
5	Greenhouse Structures	15
6	Plant Propagation	20
7	Principles of Pest Management	40
8	Greenhouse Crops, Olericulture (Vegetable), Pomology (Fruit) Production	60
9	Herb Production	20
Total		**280**

Horticulture II—Course Code: 991401

Unit	Unit Title	Hours
10	Horticulture Careers and FFA Leadership	30
11	Nursery and Landscape Plant Identification	40
12	Horticulture Marketing and Business Procedures	20
13	Floral Design	50
14	Landscape Design, Installation, Construction, and Maintenance	40
15	Turfgrass Installation and Maintenance	30
16	Sustainability and Urban Techniques	30
17	Immersion into FFA and Supervised Agriculture Experience (SAE) for All	40
Total		**280**

Career Pathway Outlook

Overview

Horticulture remains a thriving industry with unique opportunities shaped by various factors such as climate, landscapes, and cultural preferences. Professionals play vital roles in sustaining agricultural productivity, enhancing urban green spaces, and promoting environmental conservation. Careers in horticulture span diverse specialties, including landscape design and management, turfgrass management, research, education, and entrepreneurship. Landscape design and management are in high demand, with a focus on creating aesthetically pleasing and environmentally sustainable outdoor spaces. Given the popularity of recreational facilities, sports turf management presents significant career opportunities. Professionals in this field are responsible for maintaining high-quality turfgrass surfaces and implementing sustainable practices. Horticultural research and education programs drive innovation in crop production, pest control, and sustainable agriculture practices, offering opportunities for teaching, research, and extension services. Entrepreneurship is flourishing in horticulture, with small-scale farms, nurseries, and specialty crop producers meeting the growing demand for locally sourced, sustainably grown produce and plants. Overall, the horticulture industry offers rewarding careers that blend scientific expertise, creativity, and a passion for environmental stewardship, contributing to economic prosperity and quality of life.

Needs of the Future Workforce

According to the U.S. Bureau of Labor Statistics, employment in the agricultural technician field is expected to increase by 5% or more, faster than the national average from 2022 to 2032. It is projected to have 100,000 or more job openings over the same time period with an annual average income of $43,180. Nationally, the top 10% employed in agricultural technology earn $65,470, and the highest average pay in Mississippi, including the Memphis, TN-MS-AR area, is $51,140. Mississippi's farmwork and laborer, crop, nursery, and greenhouse occupations with the highest employment percentage and their respective annual mean wage include support activities for crop production (56%, $35,880), lawn and garden equipment and supplies retailers (7%, $34,840), and merchant wholesalers of nondurable goods (3%, $35,830). Regarding these fields, the northwesternmost portion of Mississippi, included in the Memphis, TN-MS-AR area, benefits from 900 employed individuals, with an average annual mean wage of $33,760. In terms of the highest employee earnings in these fields, the northeastern Mississippi nonmetropolitan area includes the top 10% in the state, accounting for nearly $60,000 annually. Also, Jackson, Mississippi's top 10% employed earn just above $45,000 annually. Each of these areas has bested the national top 10% annual incomes. The patterns of job growth shown in Table 1.1 relate to a range of horticulture-related occupations.

Table 1.1: Current and Projected Occupation Report

Description	Jobs, 2020	Projected Jobs, 2030	Change (Number)	Change (Percent)	Average Hourly Earnings, 2024
Biological Scientists, All Other	330	330	0	0%	$39.71
Biological Technicians	390	400	10	2.6%	$24.74

Chemical Technicians	480	480	0	0%	$24.78
Construction and Extraction Occupations	51,130	53,810	2,680	5.2%	$23.30
Farm and Home Management Advisors	90	100	10	11.1%	$36.07
Farm Equipment Mechanics and Service Technicians	670	700	30	4.5%	$21.34
Farming, Fishing, and Forestry Occupations	10,510	11,040	530	5%	$19.79
First-Line Supervisors of Farming, Fishing, and Forestry Workers	680	710	30	4.4%	$30.35
Graders and Sorters, Agricultural Products	590	680	90	15.3%	$15.53
Helpers, Construction Trades, All Other	190	200	10	5.3%	$14.56
Landscaping and Groundskeeping Workers	7,130	8,600	1,470	20.6%	$14.83
Log Graders and Scalers	110	110	0	0%	$20.31
Microbiologists	30	40	10	33.3%	$43.73
Outdoor Power Equipment and Other Small Engine Mechanics	180	180	0	0%	$18.40
Pest Control Workers	1,180	1,550	370	31.4%	$19.69
Pesticide Handlers, Sprayers, and Applicators, Vegetation	90	100	10	11.1%	$14.34
Soil and Plant Scientists	130	130	0	0%	$44.27
Tree Trimmers and Pruners	350	410	60	17.1%	$22.56
Vocational Education Teachers, Postsecondary	860	870	10	1.2%	$26.03
Zoologists and Wildlife Biologists	450	500	50	11.1%	$48.78

Source: Mississippi Department of Employment Security; mdes.ms.gov (2024).

Perkins V Requirements and Academic Infusion

The Horticulture curriculum meets Perkins V requirements of introducing students to and preparing them for high-skill, high-wage occupations in agriculture fields. It also offers students a program of study, including secondary, postsecondary, and institutions of higher learning courses, that will further prepare them for agriculture 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 Horticulture 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 (FFA) is the student organization with many outlets for agriculture. Student organizations provide 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 Horticulture 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. The Horticulture curriculum provides opportunities for students to work together and help each other complete complex tasks. There are many field experiences within the Horticulture curriculum that will allow and encourage collaboration with professionals currently in the horticulture field.

Work-Based Learning

Work-based learning is an extension of understanding competencies taught in the Horticulture classroom. The Horticulture program requires students to obtain a minimum of 35 clinical-type hours, which may include, but is not limited to, clinicals or worksite field experiences, entrepreneurships, 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 horticulture 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 of Agricultural Educators (MSAAE)
mississippiffa.org

Mississippi ACTE (MS ACTE)
mississippiacte.com

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 Horticulture 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 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: Introduction to Horticulture

Competencies and Suggested Objectives
1. Examine the nature of the horticulture industry. DOK1 a. Investigate the scope of the horticulture industry from a national and global perspective. b. Trace the development of agricultural sciences and technologies in the United States. c. Associate the major areas of horticulture with their products and practices. d. Investigate career opportunities in horticulture. (Ex. career fairs, job shadowing, industry visits, etc.)
2. Examine the relationships between the pure sciences, agriculture, and agriscience. DOK1 a. Associate the pure sciences with agriculture and agriscience areas. b. Identify a problem in agriculture and follow the steps of the scientific method to investigate a possible solution to the problem.
3. Apply standard horticulture safety practices. DOK2 a. Apply safety standards in the workplace. b. Apply safety standards in the agricultural classroom and laboratory. c. Interpret information on a safety data sheet (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 personal protective equipment (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 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 2: The National FFA Organization and Career Development

Competencies and Suggested Objectives

1. Explore the integral relationship between the FFA and agricultural education. DOK 2
   a. Discuss and be able to explain historical events that shaped school-based agricultural education.
      - Smith-Hughes Act (1917)
      - Establishment of the Future Farmers of America (FFA) (1928)
      - Mississippi FFA Association chartered (1934)
      - Establishment of New Farmers of America (NFA) (1935)
      - Public Law 740 (1950)
      - Merger of the FFA and NFA (1965)
      - Female membership (1969)
      - FFA changes its name to the National FFA Organization (1988)
   b. Identify types of FFA membership.
      - Active
      - Collegiate
      - Alumni
      - Honorary
   c. Distinguish among the degree levels of FFA membership and describe the requirements for each:
      - Discovery FFA degree
      - Greenhand FFA degree
      - Chapter FFA degree
      - State FFA degree
      - American FFA degree

2. Explore the role of the FFA in promoting leadership, personal growth, and career success through 21st-century skills standards. DOK2
   a. Explain the role of effective leadership.
   b. Self-evaluate personal leadership traits and develop a plan for improvement.
   c. Identify and put into practice FFA activities that promote personal and career development, teamwork, and leadership skills.
      - Public speaking and communication skills
      - Career development events (CDEs) and leadership development events (LDEs)
      - Proficiency awards
      - Community service activities
      - Conventions and leadership conferences
   d. Demonstrate basic parliamentary procedure.
      - Conducting a meeting
      - Stating a main motion
      - Discussing the main motion
      - Voting on a motion

- Understanding the use of the gavel

e. Distinguish between types of motions:
   - Main
   - Subsidiary
   - Incidental
   - Privileged

3. Describe the role of 21st-century skills, work ethic, and values in establishing and building a successful career. DOK3
   a. Define and describe universally accepted work ethics and values as applied to agricultural, food, and natural resources careers.
      - Trustworthiness
      - Respect
      - Responsibility
      - Fairness
      - Citizenship
   b. Identify career-related values and ethics promoted through FFA activities.
      - Attendance
      - Attitude
      - Achievement
      - Relationship building
      - Vision
      - Character
      - Awareness
      - Continuous improvement
      - Personal growth
      - Time management
      - Communication
      - Decision-making
      - Flexibility and adaptability
   c. Practice work ethic and values in:
      - Horticulture classroom and laboratory
      - Student organization activities
      - Experiential learning
      - Work-based learning

4. Develop a foundational SAE and maintain digital records in the state-approved record-keeping system. DOK4

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 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: Basic Plant Structure and Function

Competencies and Suggested Objectives

1. Explore plant structures and their functions. DOK 2
   a. Draw a diagram of a flowering plant, and label and describe the major parts (roots, stems, leaves, and flowers) and functions as related to plant growth (cell division, cell elongation, and cell differentiation).
   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).
2. Apply systems of plant classification. DOK1
   a. Examine the taxonomy of plants, including history, scientific classification, cultivars, and common nomenclature.
   b. Classify plants according to their life cycle, including annual, perennial, deciduous, evergreen, etc.
   c. Understand Plant Botanical Nomenclature.
      - Genus
      - Species
      - Cultivar
   d. Identify the scientific classification of the following shrubs:
      - Littleleaf boxwood / *Buxus microphylla*
      - Common camellia / *Camellia japonica*
      - Common gardenia / *Gardenia jasminoides* cv. 'Fortuniana'
      - Oakleaf hydrangea / *Hydrangea quercifolia*
      - Chinese holly / *Ilex cornuta*
      - Japanese holly / *Ilex crenata*
      - Chinese juniper / *Juniperus chinensis*
      - Creeping juniper / *Juniperus horizontalis*
      - Fountain grass / *Pennisetum ruppelia*
      - Lily-of-the-Valley Bush / *Pieris japonica*
      - Exbury hybrid azalea / *Rhododendron hybrid*
      - Yew / *Taxus baccata*
      - Chinese wisteria / *Wisteria sinensis*
   e. Interpret the scientific class classification of the following trees:
      - Red maple / *Acer rubrum*
      - Japanese maple / *Acer palmatum*
      - River birch / *Betula nigra*
      - Redbud / *Cercis canadensis*
      - Flowering dogwood / *Cornus florida*
      - Ginkgo, Maidenhair tree / *Ginkgo biloba*
      - Crape myrtle / *Lagerstroemia indica*
      - Sweet gum / *Liquidambar styraciflua*
      - Tulip poplar / *Liriodendron tulipifera*

- Southern magnolia / *Magnolia grandiflora*
- Colorado (blue) spruce / *Picea pungens*
- Japanese black pine / *Pinus thunbergiana*
- Kwanzan Japanese flowering cherry / *Prunus serrulata* cv.'Kwanzan'
- White oak / *Quercus alba*
- Pin oak / *Quercus palustris*
- Red oak / *Quercus rubra*
- Bald cypress / *Taxodium distichum*

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 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 4: Plant Growth Substrate (Media)

Competencies and Suggested Objectives
1. Describe and apply principles of plant growth substrate (media). DOK2 a. Identify and compare the components of natural soil (sand, silt, and clay) and soilless mix. List and explain the characteristics each one imparts to the root substrate. b. Prepare a growing substrate to specifications or identify the components and proportions in a commercially prepared root substrate.
2. Describe the characteristics of an ideal growing substrate, including nutrients, water- and air-holding capacity, water drainage, and potential of hydrogen (pH). DOK 1
3. Describe the use of soilless amendments, including vermiculite, perlite, bark, organic matter, and peat moss. DOK 1
4. Identify macronutrients and micronutrients and their effects on plant growth. DOK 2 a. Describe the effect of excesses and deficiencies of the macronutrients (nitrogen [N], phosphorus [P], potassium [K]). b. Predict the effect various pH levels will have on plant nutrition and growth. c. Analyze a growing substrate sample for nutrient deficiencies by using the scientific method. d. Calculate fertilizer application rates to meet nutritional requirements for a specific crop. e. Select fertilizer application methods for different plant enterprises to include broadcasting, injection systems, incorporating into substrate, and side dressing.

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Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 5: Greenhouse Structures

Competencies and Suggested Objectives
1. Describe the characteristics and features of different greenhouse structures. DOK2 a. Identify and compare the greenhouse structures, coverings, and auxiliary types (e.g., shade house, hot beds, high tunnels, and cold frame, Quonset, ridge and furrow, even span, and shade houses). b. Describe environmental controls including humidistat, thermostat, cooling, watering, lighting, and heating. c. Discuss water, fertigation, and chemigation management in growing plants. d. Identify and describe factors to consider in establishing a floor plan for a greenhouse, including sanitation, benching, flooring, potting facilities, chemical and dry storage, and traffic patterns.

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Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 6: Plant Propagation

Competencies and Suggested Objectives
1. Distinguish between sexual and asexual reproduction. DOK2 a. Describe sexual reproduction in plants. b. Describe the conditions needed for good seed germination. c. Plan and conduct a seed germination test. d. Interpret information found on a seed tag. e. Describe, discuss, or demonstrate how to propagate plants from scarified or stratified seeds. f. Identify and describe asexual reproduction techniques using grafting, budding, cuttings (root, stem, and leaf), layering, separation and division, and tissue culture methods. g. Identify common tools, such as hand shears, and chemicals, including hormones, used in asexual reproduction and demonstrate their safe use and care.

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Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 7: Principles of Pest Management

Competencies and Suggested Objectives

1. Assess the effects of pests on plant production. DOK2
   a. Identify the following types of insects and describe how insect affects production, control, and integrated pest management (IPM) practices:
      - Aphid
      - Bagworm
      - Borer
      - Fungus gnats
      - Japanese beetles
      - Leafhopper
      - Leaf miner
      - Mealybug
      - Scale
      - Spider mite
      - Snail/slug
      - Thrips
      - Whitefly
      - White grub

   b. Identify the following types of diseases and describe how each disease affects production, control, and IPM practices:
      - Anthracnose
      - Apple scab
      - Black spot
      - Botrytis
      - Canker
      - Rust
      - Cedar-apple rust
      - Crown gall
      - Damping off
      - Fire blight
      - Powdery mildew
      - Root rot

   c. Identify the following types of weeds and describe how each weed affects production, control, and IPM practices:
      - Annual bluegrass
      - Broadleaf plantain
      - Buckhorn plantain
      - Chickweed
      - Crabgrass
      - Dandelion
      - Henbit
      - Nutsedge
      - Oxalis
      - Purslane
      - Clovers

   d. Identify the following types of physiological problems and describe how each problem affects production, control, and IPM practices:
      - Frost-freeze injury
      - Leaf scorch (drought/winter burn)
      - Nutrient deficiencies
      - Pot-bound roots
      - String trimmer injury
      - 2, 4-D injury

   e. Design an IPM plan for a designated horticulture crop.

2. Identify, describe, and apply pesticide safety procedures. DOK1
   a. Interpret safety and first aid precautions, PPE, and formulations on pesticide labels (insecticide, herbicides, rodenticide, fungicide, miticide, molluscicide, and nematicides).
   b. Identify the following beneficial insects and discuss how they benefit plants:
      - Mealybug destroyer
      - Lacewing
      - Lady beetles

- Praying mantis
- Bees
- Spider
- Paper wasp

c. Discuss the relationship between biological, chemical, cultural, and mechanical control methods.
d. Discuss and apply general precautions for working with pesticides in relation to the requirements for pesticide applicator's certification/licensure.

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Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 8: Greenhouse Crops, Olericulture (Vegetable), Pomology (Fruit) Production

Competencies and Suggested Objectives

1. Describe and apply principles of greenhouse crop production. DOK2
   a. Identify and produce various common species of bedding plants, including but not limited to:
      - Coleus
      - Chrysanthemum
      - Dianthus
      - Geranium
      - Impatiens
      - Marigold
      - Pansy
      - Petunia
      - Salvia
      - Snapdragon
      - Verbena
      - Vinca
      - Wax begonia
      - Zinnia
   b. Identify and produce various common species of foliage/interior plants, including but not limited to:
      - African Violet
      - Angelica
      - Cacti
      - Caladium
      - Dracaena
      - Dumbcane
      - English ivy
      - Ferns (Boston, Kimberly, Macho, Sprengeri)
      - Orchid
      - Peace lily
      - Philodendron
      - Poinsettia
      - Schefflera
      - Snake plant
      - Spider plant
   c. Identify cultural considerations for fertilizer, water, growing substrate (medium), pest control, temperature, natural and chemical growth control and stimulation, and light control for common crops.

2. Describe and apply principles of olericulture production. DOK2
   a. Describe characteristics (i.e. cultural requirements, direct seeding versus transplanting, plant growth style, and growing season) of common vegetables grown for commercial production and distinguish between warm season and cool season crops, including but not limited to:
      - Beans
      - Broccoli
      - Brussel sprout
      - Cabbage
      - Carrots
      - Cauliflower
      - Chives
      - Corn
      - Cucumber
      - Eggplant
      - Lettuce
      - Okra
      - Onions
      - Peanuts
      - Peas
      - Pepper
      - Potato
      - Pumpkin
      - Spinach
      - Squash

- Garlic
- Kale
- Tomato

b. Identify and demonstrate the use of common tools and equipment used in gardening.
   - Hoes
   - Rakes
   - Shovels
   - Sprayers
   - Spreaders
   - Tillers
   - Watering devices

c. Identify and describe factors to consider in preparing a seedbed, including soil class and texture, use of soil amendments, and characteristics of a properly prepared seedbed.

d. Develop a plan for an intensive culture garden, including crop and variety selection, location and spacing of different crops, scheduling of crops, crop rotation, and harvesting and marketing of crops.

e. Discuss new and emerging technologies, trends, and issues concerning the production and marketing of vegetables in Mississippi.
   - Farm to table
   - Farmers' markets

f. Identify and discuss the roles of agencies and organizations that regulate the production and marketing of vegetables.

3. Describe and apply principles of fruit and berry production. DOK2
   a. Identify, discuss, and prepare a planting plan, cultural plan, and marketing plan of common fruits and berries produced in Mississippi to include the following:
      - Apples
      - Blackberries
      - Blueberries
      - Figs
      - Muscadines
      - Oranges
      - Peaches
      - Pears
      - Persimmons
      - Plums
      - Raspberries
      - Strawberries
   b. Identify, discuss, and describe the local marketing of fruits and vegetables as it relates to state, national, and international organizations that impact fruit and berry production.

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Note: This unit will be ongoing throughout the year. Time allotted for this unit will be

distributed over the entire year.

Unit 9: Herb Production

Competencies and Suggested Objectives
1. Identify common herb species based on their botanical characteristics, such as leaf shape, flower structure, and growth habits. DOK2 a. Explore common herbs. • Oregano • Basil • Cilantro • Lavender • Sage • Lemon grass • Dill • Mint • Rosemary • Thyme
2. Design, create, and maintain an herb garden. DOK4

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Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 10: Horticulture Careers and FFA Leadership

Competencies and Suggested Objectives
1. Review safety rules and behavior. DOK1 a. Identify safety rules and behavior for the classroom. b. Identify safety rules and behavior for the shop and laboratory areas.
2. Investigate and develop skills necessary for pursuing a career in horticulture. DOK2 a. Discover the careers available in horticulture. b. Build a personal résumé and cover letter for the purpose of applying for jobs. c. Perform a mock interview utilizing the personal résumé and cover letter.
3. Actively participate in the FFA chapter program of activities (POA). DOK3 a. Identify and participate in FFA activities and programs that contribute to career advancement and individual achievement. b. Select and document FFA activities and programs that contribute to personal development.
4. Develop and present a 3-to-5-minute presentation on a horticulture topic. DOK2 a. Discuss guidelines for preparing a successful presentation, including preparation, resource development, writing skills, and presentation skills.
5. Develop an immersion SAE and maintain digital records in the state-approved record-keeping system. DOK4

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Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 11: Nursery and Landscape Plant Identification

Competencies and Suggested Objectives
1. Review plant materials covered in Unit 3 (see associated list). DOK1
2. Explore the use of major plants associated with nursery and landscape operations. DOK1 a. Identify and describe the following plants: • Adam's Needle (Yucca) / *Yucca filamentosa* • Bayberry / *Myrica pensylvanica* • Big leaf hydrangea / *Hydrangea macrophylla* • Border forsythia / *Forsythia × intermedia* • Bumalda spirea / *Spiraea x bumalda* • Cherry laurel / *Prunus laurocerasus* • Chinese (saucer) magnolia / *Magnolia x soulangiana* • Common blanketflower / *Gaillardia aristata* • Eastern white pine / *Pinus strobus* • Firethorn / *Pyracantha coccinea* • Flowering crabapple / *Malus spp.* • Glossy abelia / *Abelia x grandiflora* • Heavenly bamboo / *Nandina domestica* • Hybrid tea rose / *Rosa spp.* • Japanese (flowering) quince / *Chaenomeles speciosa* • Lilyturf / *Liriope spp.* • London planetree / *Platanus × acerifolia* • Mentor barberry / *Berberis × mentorensis* • Oregon grape / *Mahonia aquifolia* • Plantain lily / *Hosta x hybrida* • Sour (black) gum / *Nyssa sylvatica* • Southern yew / *Podocarpus macrophyllus* • Thornless honey locust / *Gleditsia triacanthos var. inermis* • Washington hawthorn / *Crataegus phaenopyrum* • White ash / *Fraxinus americana* • Wintercreeper / *Euonymus fortunei*

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Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 12: Horticulture Marketing and Business Procedures

Competencies and Suggested Objectives
1. Describe and apply marketing and business practices associated with horticulture operations. DOK2 a. Maintain an inventory of plants and supplies for the horticulture program (ongoing throughout the year). b. Develop an annual calendar of activities/enterprises for a horticulture business, including ordering materials/supplies for an enterprise. c. Describe factors to consider in pricing products of an enterprise and complete a sales transaction that includes providing customer service. d. Describe factors to consider in marketing and advertising products.
2. Review basic employee responsibilities and how to communicate effectively in on-the-job situations. DOK3 a. Describe the following life skills: • Communication • Considerate • Cooperation • Dependability • Effective listening • Empathy • Enthusiasm • Gets along with others • Good manners • Honesty • Humility • Interpersonal skills • Loyalty • Open-mindedness • Positive self-concept • Problem-solving • Rational thinking • Respect for others • Responsibility • Self-motivated/determined • Sets priorities • Teamwork • Trustworthy • Work ethic
3. Discuss and explore business operations. DOK2 a. Marketing's four Ps (price, product, place, promotion) b. Forms of business organizations (sole proprietorship, corporations, partnerships, limited liability companies) c. Sources of capital (wholesale versus retail)

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Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 13: Floral Design

Competencies and Suggested Objectives
1. Describe and apply principles of floristry. DOK2 a. Demonstrate the procedures for receiving and storing (including the rotation of inventory) of floral materials. b. Apply basic elements of design with examples that include line, filler, form, and mass. c. Apply basic principles of design to include balance, transition, rhythm, focal point, proportion, and scale to achieve unity. d. Receive and process orders for floral products, including seasonal and event applications. e. Identify and demonstrate the safe and proper use of tools and supplies used in floristry. • Foam • Floral wire • Knives • Shears • Tape
2. Create floral arrangements using plant materials introduced in prior units. DOK4

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Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 14: Landscape Design, Installation, Construction, and Maintenance

Competencies and Suggested Objectives

1. Describe and apply principles of landscape design. DOK2
   a. Describe careers in the landscape design field.
   b. Identify and demonstrate the use of tools and equipment for landscape design.
   c. Identify and demonstrate the methods of lettering and symbols used in landscape design plans.
   d. Describe principles of design and design processes associated with landscaping, including simplicity, balance, and proportion.
   e. Prepare a simple landscape plan to scale for a given site, including plant selection and location.

2. Describe and apply basic principles of landscape installation and construction. DOK2
   a. Prepare site analysis/needs assessment for a given site.
   b. Identify and demonstrate the safe use of equipment, materials, and hand tools for landscape maintenance, including:
      - Bark mulch
      - Bow saw
      - Compressed air sprayer
      - Chainsaw
      - Edger (power or hand)
      - Edging
      - Erosion netting
      - Garden (spading) fork
      - Garden (bow) rake
      - Garden hoe
      - Gravity (drop) spreader
      - Hearing protection
      - Hedge shears
      - Hook-and-blade pruners
      - Landscape fabric
      - Leaf rake
      - Loppers
      - Mattock
      - Pickaxe
      - Pole pruner
      - Polyethylene pipe
      - Pop-up irrigation head
      - Post-hole digger
      - Pop-up irrigation head
      - Post-hole digger
      - Power blower
      - Power hedge trimmer
      - Pruning saw
      - Reel mower
      - Respirator
      - Rotary mower
      - Rototiller
      - Round point shovel
      - Scoop shovel
      - Shade fabric
      - Sharpening stone
      - Siphon proportioner
      - Soaker hose
      - Spade
      - Square point (flat) shovel
      - String trimmer
      - Trowel
      - T-square
   c. Discuss the essential elements of a landscape installation contract, including the warranty and an estimate.

d. Develop a contract and pricing estimate for the landscape plan. e. Describe and discuss procedures for preparing a planting site, installing plants, and providing posttransplant care according to a landscape plan. f. Describe licensing requirements for landscape installation. g. Discuss the installation and maintenance of a landscape irrigation system.
3. Describe and apply principles of landscape maintenance. DOK2 a. Identify and discuss the proper procedures for pruning trees and shrubs. b. Demonstrate the proper procedure for taking and testing a soil sample. c. Determine and discuss a cost estimate for fertilizer, pest control, and maintenance of trees, shrubs, and beds.

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Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 15: Turfgrass Installation and Maintenance

Competencies and Suggested Objectives

1. Describe and apply principles of turfgrass installation. DOK2
   a. Describe factors to consider in selecting a turfgrass for a specific area. Identify varieties of turfgrass and describe their characteristics, including the following:
      - Perennial Ryegrass (*Lolium perenne*)
      - Bermudagrass (*Cynodon dactylon*)
      - Centipede grass (*Eremochloa ophiuroides*)
      - Kentucky bluegrass (*Poa pratensis*)
      - St. Augustine grass (*Stenotaphrum secundatum*)
      - Tall fescue (*Festuca arundinacea*)
      - Zoysia (*Zoysia spp.*)
   b. Describe installation practices for different turfgrasses, including site preparation and initial care.
      - Seed
      - Sod
      - Plugs
      - Sprigs

2. Describe and apply principles of turfgrass maintenance. DOK2
   a. Identify and demonstrate the safe use and maintenance of equipment and tools used for turfgrass maintenance, including mower types, dethatchers, aerators, and other equipment.
   b. Use mowers, sprayers, or spreaders for a specific grass.
   c. Identify, analyze, and discuss control common turfgrass insects, including:
      - Armyworms
      - Mole cricket
      - Nematodes
      - White grubs
   d. Identify, analyze, and discuss control of common turfgrass diseases, including:
      - Algae
      - Brown patch
      - Dollar spot
      - Fairy ring
      - Pythium blight
      - Spring dead spot
   e. Identify, analyze, and discuss control of common turfgrass weeds, including:
      - Grassy weeds
        - Annual Bluegrass
        - Bahia grass
        - Carpet grass
        - Crabgrass
        - Goose grass

- Broadleaf weeds
  - Clovers
  - Virginia buttonweed
  - Buckhorn plantain
- Sedges
  - Kyllinga
  - Purple
  - Yellow

f. Identify and describe common irrigation methods for turfgrass.
g. Perform cultural practices, including aeration, topdressing, and dethatching.

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Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 16: Sustainability and Urban Techniques

Competencies and Suggested Objectives
1. Describe and apply principles of container and field crop production. DOK2 a. Describe advantages and disadvantages of container crop production versus field crop production.
2. Describe principles of hydroponic plant production. DOK3 a. Compare and contrast different hydroponic techniques of production. • Aeroponics • Nutrient film • Deep water • Dutch bucket • Wick systems • Tower/vertical systems b. Design and build a basic hydroponic system.
3. Describe and analyze how aquaponics relate to hydroponics. DOK2
4. Explore urban techniques. DOK2 a. Discuss sustainable urban production techniques. • Rooftop gardening • Vertical gardening • Raised bed gardening • Community gardening • Organic gardening • Composting

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Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 17: Immersion into FFA and Supervised Agriculture Experience(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) o Agronomy o Floriculture o Forestry o Nursery/Landscape • Leadership retreats or conferences • Industry-related seminars, workshops, or conferences • Other related FFA activities
2. Apply concepts learned from the foundational SAE program to continue the progression of immersion SAEs. DOK4 a. Redefine and adjust requirements of agreements between students, parents, supervisor, and/or employer. b. Update SAE digital records using the state-approved record-keeping system. • 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 • Student Recording of the WBL experiences on the approved state-approved digital record-keeping platform. o Ensure the hours recorded get evaluated by external supervisor (s) as required by the state of Mississippi. c. Complete degree and proficiency award applications as they apply to the SAE.

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Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Student Competency Profile

Student's Name: _____

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

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

Unit 1: Introduction to Horticulture		
	1.	Examine the nature of the horticulture industry.
	2.	Examine the relationships between the pure sciences, agriculture, and agriscience.
	3.	Apply standard horticulture safety practices.
Unit 2: The National FFA Organization and Career Development		
	1.	Explore the integral relationship between the FFA and agricultural education.
	2.	Explore the role of the FFA in promoting leadership, personal growth, and career success through 21st-century skills standards.
	3.	Describe the role of 21st-century skills, work ethic, and values in establishing and building a successful career.
	4.	Develop a foundational SAE and maintain digital records in the state-approved record-keeping system.
Unit 3: Basic Plant Structure and Function		
	1.	Explore plant structure and their functions.
	2.	Apply systems of plant classification.
Unit 4: Plant Growth Substrate (Media)		
	1.	Describe and apply principles of plant growth substrate (media).
	2.	Describe the characteristics of an ideal growing substrate, including nutrients, water- and air-holding capacity, water drainage, and potential of hydrogen (pH).
	3.	Describe the use of soilless amendments, including vermiculite, perlite, bark, organic matter, and peat moss.
	4.	Identify macronutrients and micronutrients and their effects on plant growth
Unit 5: Greenhouse Structures		
	1.	Describe the characteristics and features of different greenhouse structures.
Unit 6: Plant Propagation		
	1.	Distinguish between sexual and asexual reproduction
Unit 7: Principles of Pest Management		
	1.	Assess the effects of pests on plant production.

	2.	Identify, describe, and apply pesticide safety procedures.
Unit 8: Greenhouse Crops, Olericulture (Vegetable), Pomology (Fruit) Production		
	1.	Describe and apply principles of greenhouse crop production.
	2.	Describe and apply principles of olericulture production.
	3.	Describe and apply principles of fruit and berry production.
Unit 9: Herb Production		
	1.	Identify common herb species based on their botanical characteristics, such as leaf shape, flower structure, and growth habits.
	2.	Design, create, and maintain an herb garden.
Unit 10: Horticulture Careers and FFA Leadership		
	1.	Review safety rules and behavior.
	2.	Investigate and develop skills necessary for pursuing a career in horticulture.
	3.	Actively participate in the FFA chapter program of activities (POA).
	4.	Develop and present a 3-to 5-minute presentation on a horticulture topic
	5.	Develop an immersion SAE and maintain digital records in the state-approved record-keeping system.
Unit 11: Nursery and Landscape Plant Identification		
	1.	Review plant materials covered in Unit 3 (see associated list).
	2.	Explore the use of major plants associated with nursery and landscape operations.
Unit 12: Horticulture Marketing and Business Procedures		
	1.	Describe and apply marketing and business practices associated with horticulture operations.
	2.	Review basic employee responsibilities and how to communicate effectively in on-the-job situations.
	3.	Discuss and explore business operations.
Unit 13: Floral Design		
	1.	Describe and apply principles of floristry.
	2.	Create floral arrangements using plant materials introduced in prior units.
Unit 14: Landscape Design, Installation, Construction, and Maintenance		
	1.	Describe and apply principles of landscape design.
	2.	Describe and apply basic principles of landscape installation and construction.
	3.	Describe and apply principles of landscape maintenance.
Unit 15: Turfgrass Installation and Maintenance		
	1.	Describe and apply principles of turfgrass installation.
	2.	Describe and apply principles of turfgrass maintenance.
Unit 16: Sustainability and Urban Techniques		

	1.	Describe and apply principles of container and field crop production.
	2.	Describe principles of hydroponic plant production.
	3.	Describe and analyze how aquaponics relate to hydroponics.
	4.	Explore urban techniques.
Unit 17: Immersion into FFA and Supervised Agriculture Experience (SAE) for All		
	1.	Participate in local, state, and/or national FFA activities that provide opportunities for leadership development and career exploration.
	2.	Apply concepts learned from the foundational SAE program to continue the progression of immersion SAEs.

Appendix A: Industry Standards

Framework for AFNR Content Standards and Performance Elements Crosswalk for Agricultural and Natural Resources

	Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Standards																		
ABS		X	X	X	X	X			X		X		X		X	X	X	X
AS			X		X			X		X	X	X						X
BS		X	X	X	X		X	X	X	X	X				X	X		X
CRP		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CS		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ES			X	X	X	X		X	X		X			X	X	X	X	X
FPP			X					X	X	X	X						X	X
NRS		X	X	X	X	X	X	X			X			X	X	X	X	X
PS		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
PST			X			X		X	X		X		X		X	X	X	X

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ABS Agribusiness Systems

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), and business planning, 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:

- *Common Career Technical Core (CCTC) Standards* – These are the standards for Agribusiness Systems (AG-ABS) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- *Performance Indicators* – These statements distill each CCTC 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 CCTC Standard at the conclusion of a program of study in this area.

1. ABS.01. CCTC Standard: Apply management planning principles in AFNR businesses.
    a. ABS.01.01. Performance Indicator: Apply micro- and macroeconomic principles to plan and manage inputs and outputs in an AFNR business.
    b. ABS.01.02. Performance Indicator: Read, interpret, evaluate and write statements of purpose to guide business goals, objectives and resource allocation.
    c. ABS.01.03. Performance Indicator: Devise and apply management skills to organize and run an AFNR business in an efficient, legal and ethical manner.
    d. ABS.01.04. Performance Indicator: Evaluate, develop and implement procedures used to recruit, train and retain productive human resources for AFNR businesses.
2. ABS.02. CCTC Standard: Use record keeping to accomplish AFNR business objectives, manage budgets and comply with laws and regulations.
    a. ABS.02.01. Performance Indicator: 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.).
    b. ABS.02.02. Performance Indicator: 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.).
3. ABS.03. CCTC Standard: Manage cash budgets, credit budgets and credit for an AFNR business using generally accepted accounting principles.
    a. ABS.03.01. Performance Indicator: Develop, assess and manage cash budgets to achieve AFNR business goals.
    b. ABS.03.02. Performance Indicator: Analyze credit needs and manage credit budgets to achieve AFNR business goals.
4. ABS.04. CCTC Standard: Develop a business plan for an AFNR business.
    a. ABS.04.01. Performance Indicator: Analyze characteristics and planning requirements associated with developing business plans for different types of AFNR businesses.
    b. ABS.04.02. Performance Indicator: Develop production and operational plans for an AFNR business.
    c. ABS.04.03. Performance Indicator: Identify and apply strategies to manage or mitigate risk.
5. ABS.05. CCTC Standard: Use sales and marketing principles to accomplish AFNR business objectives.
    a. ABS.05.01. Performance Indicator: Analyze the role of markets, trade, competition and price in relation to an AFNR business sales and marketing plans.
    b. ABS.05.02. Performance Indicator: Assess and apply sales principles and skills to accomplish AFNR business objectives.
    c. ABS.05.03. Performance Indicator: Assess marketing principles and develop marketing plans to accomplish AFNR business objectives.

AS Animal Systems

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, and management and processing, 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:

- *Common Career Technical Core (CCTC) Standards* – These are the standards for Animal Systems (AG-AS) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- *Performance Indicators* – These statements distill each CCTC 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 CCTC Standard at the conclusion of a program of study in this area.

1. AS.01. CCTC Standard: Analyze historic and current trends impacting the animal systems industry.
    a. AS.01.01. Performance Indicator: Evaluate the development and implications of animal origin, domestication and distribution on production practices and the environment.
    b. AS.01.02. Performance Indicator: Assess and select animal production methods for use in animal systems based upon their effectiveness and impacts.
    c. AS.01.03. Performance Indicator: Analyze and apply laws and sustainable practices to animal agriculture from a global perspective.
2. AS.02. CCTC Standard: Utilize best-practice protocols based upon animal behaviors for animal husbandry and welfare.
    a. AS.02.01. Performance Indicator: Demonstrate management techniques that ensure animal welfare.
    b. AS.02.02. Performance Indicator: Analyze procedures to ensure that animal products are safe for consumption (e.g., use in food system, etc.).
3. AS.03. CCTC Standard: Design and provide proper animal nutrition to achieve desired outcomes for performance, development, reproduction and/or economic production.
    a. AS.03.01. Performance Indicator: Analyze the nutritional needs of animals.
    b. AS.03.02 Performance Indicator: Analyze feed rations and assess if they meet the nutritional needs of animals.
    c. AS.03.03 Performance Indicator: Utilize industry tools to make animal nutrition decisions.
4. AS.04. CCTC Standard: Apply principles of animal reproduction to achieve desired outcomes for performance, development and/or economic production.
    a. AS.04.01. Performance Indicator: Evaluate animals for breeding readiness and soundness.

b. AS.04.02. Performance Indicator: Apply scientific principles to select and care for breeding animals.
c. AS.04.03 Performance Indicator: Apply scientific principles to breed animals.

5. AS.05. CCTC Standard: Evaluate environmental factors affecting animal performance and implement procedures for enhancing performance and animal health.
   a. AS.05.01. Performance Indicator: Design animal housing, equipment and handling facilities for the major systems of animal production.
   b. AS.05.02. Performance Indicator: Comply with government regulations and safety standards for facilities used in animal production.
6. AS.06. CCTC Standard: Classify, evaluate and select animals based on anatomical and physiological characteristics.
   a. AS.06.01. Performance Indicator: Classify animals according to taxonomic classification systems and use (e.g. agricultural, companion, etc.).
   b. AS.06.02. Performance Indicator: Apply principles of comparative anatomy and physiology to uses within various animal systems.
   c. AS.06.03. Performance Indicator: Select and train animals for specific purposes and maximum performance based on anatomy and physiology.
7. AS.07. CCTC Standard: Apply principles of effective animal health care.
   a. AS.07.01. Performance Indicator: Design programs to prevent animal diseases, parasites and other disorders and ensure animal welfare.
   b. AS.07.02. Performance Indicator: Analyze biosecurity measures utilized to protect the welfare of animals on a local, state, national, and global level.
8. AS.08. CCTC Standard: Analyze environmental factors associated with animal production.
   a. AS.08.01. Performance Indicator: Design and implement methods to reduce the effects of animal production on the environment.
   b. AS.08.02. Performance Indicator: Evaluate the effects of environmental conditions on animals and create plans to ensure favorable environments for animals.

CRP Career Ready Practices

Common Career Technical Core Career Ready Practices Content Standards

The CCTC 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.).

DEFINITIONS: Within each pathway, the standards are organized as follows:

- *Common Career Technical Core (CCTC) Standards* – These are the standards for CRPs from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical

Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.

- *Performance Indicators* –These statements distill each CCTC 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 CCTC Standard at the conclusion of a CTE program of study.

1. CRP.01. CCTC Standard: Act as a responsible and contributing citizen and employee.
    a. CRP.01.01. Performance Indicator: Model personal responsibility in the workplace and community.
    b. CRP.01.02 Performance Indicator: Evaluate and consider the near-term and long-term impacts of personal and professional decisions on employers and community before taking action.
    c. CRP.01.03. Performance Indicator: Identify and act upon opportunities for professional and civic service at work and in the community.
2. CRP.02. CCTC Standard: Apply appropriate academic and technical skills.
    a. CRP.02.01. Performance Indicator: Use strategic thinking to connect and apply academic learning, knowledge and skills to solve problems in the workplace and community.
    b. CRP.02.02. Performance Indicator: Use strategic thinking to connect and apply technical concepts to solve problems in the workplace and community.
3. CRP.03. CCTC Standard: Attend to personal health and financial well-being.
    a. CRP.03.01. Performance Indicator: Design and implement a personal wellness plan.
    b. CRP.03.02. Performance Indicator: Design and implement a personal financial management plan.
4. CRP.04. CCTC Standard: Communicate clearly, effectively and with reason.
    a. CRP.04.01. Performance Indicator: Speak using strategies that ensure clarity, logic, purpose and professionalism in formal and informal settings.
    b. CRP.04.02. Performance Indicator: Produce clear, reasoned and coherent written and visual communication in formal and informal settings.
    c. CRP.04.03. Performance Indicator: Model active listening strategies when interacting with others in formal and informal settings.
5. CRP.05. CCTC Standard: Consider the environmental, social and economic impacts of decisions.
    a. CRP.05.01. Performance Indicator: Assess, identify and synthesize the information and resources needed to make decisions that positively impact the workplace and community.
    b. CRP.05.02. Performance Indicator: Make, defend and evaluate decisions at work and in the community using information about the potential environmental, social and economic impacts.
6. CRP.06. CCTC Standard: Demonstrate creativity and innovation.
    a. CRP.06.01. Performance Indicator: Synthesize information, knowledge and experience to generate original ideas and challenge assumptions in the workplace and community.

b. CRP.06.02. Performance Indicator: Assess a variety of workplace and community situations to identify ways to add value and improve the efficiency of processes and procedures.
c. CRP.06.03. Performance Indicator: Create and execute a plan of action to act upon new ideas and introduce innovations to workplace and community organizations.

7. CRP.07. CCTC Standard: Employ valid and reliable research strategies.
   a. CRP.07.01. Performance Indicator: Select and implement reliable research processes and methods to generate data for decision-making in the workplace and community.
   b. CRP.07.02. Performance Indicator: Evaluate the validity of sources and data used when considering the adoption of new technologies, practices and ideas in the workplace and community.
8. CRP.08. CCTC Standard: Utilize critical thinking to make sense of problems and persevere in solving them.
   a. CRP.08.01. Performance Indicator: Apply reason and logic to evaluate workplace and community situations from multiple perspectives.
   b. CRP.08.02. Performance Indicator: Investigate, prioritize and select solutions to solve problems in the workplace and community.
   c. CRP.08.03. Performance Indicator: Establish plans to solve workplace and community problems and execute them with resiliency.
9. CRP.09. CCTC Standard: Model integrity, ethical leadership and effective management.
   a. CRP.09.01. Performance Indicator: Model characteristics of ethical and effective leaders in the workplace and community (e.g. integrity, self-awareness, self-regulation, etc.).
   b. CRP.09.02. Performance Indicator: Implement personal management skills to function effectively and efficiently in the workplace (e.g., time management, planning, prioritizing, etc.).
   c. CRP.09.03. Performance Indicator: Demonstrate behaviors that contribute to a positive morale and culture in the workplace and community (e.g., positively influencing others, effectively communicating, etc.).
10. CRP.10. CCTC Standard: Plan education and career path aligned to personal goals.
    a. CRP.10.01. Performance Indicator: Identify career opportunities within a career cluster that match personal interests, talents, goals and preferences.
    b. CRP.10.02. Performance Indicator: Examine career advancement requirements (e.g., education, certification, training, etc.) and create goals for continuous growth in a chosen career.
    c. CRP.10.03. Performance Indicator: 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.
    d. CRP.10.04. Performance Indicator: Identify, prepare, update and improve the tools and skills necessary to pursue a chosen career path.
11. CRP.11. CCTC Standard: Use technology to enhance productivity.

a. CRP.11.01. Performance Indicator: Research, select and use new technologies, tools and applications to maximize productivity in the workplace and community.
b. CRP.11.02. Performance Indicator: Evaluate personal and organizational risks of technology use and take actions to prevent or minimize risks in the workplace and community.

12. CRP.12. CCTC Standard: Work productively in teams while using cultural/global competence.
    a. CRP.12.01. Performance Indicator: Contribute to team-oriented projects and builds consensus to accomplish results using cultural global competence in the workplace and community.
    b. CRP.12.02. Performance Indicator: 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.).

CS Agriculture Food and Natural Resources Cluster Skill

Agriculture, Food, and Natural Resources Cluster Skill Content Standards

The AFNR Cluster Skills (CS) encompasses the study of fundamental 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:

- *Common Career Technical Core (CCTC) Standards* – These are the standards for Agriculture, Food and Natural Resources Career Cluster® (AG) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- *Performance Indicators* –These statements distill each CCTC 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 CCTC Standard at the conclusion of a program of study in this area.

1. CS.01. CCTC Standard: Analyze how issues, trends, technologies and public policies impact systems in the Agriculture, Food & Natural Resources Career Cluster.
    a. CS.01.01. Performance Indicator: Research, examine and discuss issues and trends that impact AFNR systems on local, state, national and global levels.
    b. CS.01.02. Performance Indicator: Examine technologies and analyze their impact on AFNR systems.
    c. CS.01.03. Performance Indicator: Identify public policies and examine their impact on AFNR systems.

2. CS.02. CCTC Standard: 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.
    a. CS.02.01. Performance Indicator: Research and use geographic and economic data to solve problems in AFNR systems.
    b. CS.02.02. Performance Indicator: Examine the components of the AFNR systems and assess their impact on the local, state, national and global society and economy.
3. CS.03. CCTC Standard: Examine and summarize the importance of health, safety and environmental management systems in AFNR workplaces.
    a. CS.03.01. Performance Indicator: Identify and explain the implications of required regulations to maintain and improve safety, health and environmental management systems.
    b. CS.03.02. Performance Indicator: Develop and implement a plan to maintain and improve health, safety and environmental compliance and performance.
    c. CS.03.03. Performance Indicator: Apply health and safety practices to AFNR workplaces.
    d. CS.03.04. Performance Indicator: Use appropriate protective equipment and demonstrate safe and proper use of AFNR tools and equipment.
4. CS.04. CCTC Standard: Demonstrate stewardship of natural resources in AFNR activities.
    a. CS.04.01. Performance Indicator: Identify and implement practices to steward natural resources in different AFNR systems.
    b. CS.04.02. Performance Indicator: Assess and explain the natural resource related trends, technologies and policies that impact AFNR systems.
5. CS.05. CCTC Standard: Describe career opportunities and means to achieve those opportunities in each of the Agriculture, Food & Natural Resources career pathways.
    a. CS.05.01. Performance Indicator: 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.).
6. CS.06. CCTC Standard: Analyze the interaction among AFNR systems in the production, processing and management of food, fiber and fuel and the sustainable use of natural resources.
    a. CS.06.01. Performance Indicator: Examine and explain foundational cycles and systems of AFNR.
    b. CS.06.02. Performance Indicator: Analyze and explain the connection and relationships between different AFNR systems on a national and global level.

BS Biotechnology

Biotechnology Systems Career Pathway Content Standards

The Biotechnology Systems (BS) Career Pathway encompasses the study of using data and scientific techniques 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 the

application of 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:

- *National Council for Agricultural Education (NCAE) Standard** – 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 performance element 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 performance element at the conclusion of a program of study in this area.

1. BS.01. NCAE Standard: Assess factors that have influenced the evolution of biotechnology in agriculture (e.g., historical events, societal trends, ethical and legal implications, etc.).
    a. BS.01.01. Performance Indicator: Investigate and explain the relationship between past, current and emerging applications of biotechnology in agriculture (e.g., major innovators, historical developments, potential applications of biotechnology, etc.).
    b. BS.01.02. Performance Indicator: Evaluate the scope and implications of regulatory agencies on applications of biotechnology in agriculture and protection of public interests (e.g., health, safety, environmental issues, etc.).
    c. BS.01.03. Performance Indicator: Analyze the relationship and implications of bioethics, laws and public perceptions on applications of biotechnology in agriculture (e.g., ethical, legal, social, cultural issues).
2. BS.02. NCAE Standard: 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.).
    a. BS.02.01. Performance Indicator: Read, document, evaluate and secure accurate laboratory records of experimental protocols, observations and results.
    b. BS.02.02. Performance Indicator: Implement standard operating procedures for the proper maintenance, use and sterilization of equipment in a laboratory.
    c. BS.02.03. Performance Indicator: Apply standard operating procedures for the safe handling of biological and chemical materials in a laboratory.
    d. BS.02.04. Performance Indicator: Safely manage and dispose of biological materials, chemicals and wastes according to standard operating procedures.
    e. BS.02.05. Performance Indicator: Examine and perform scientific procedures using microbes, DNA, RNA and proteins in a laboratory.
3. BS.03. NCAE Standard: 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.).

a. BS.03.01. Performance Indicator: Apply biotechnology principles, techniques and processes to create transgenic species through genetic engineering.
b. BS.03.02. Performance Indicator: Apply biotechnology principles, techniques and processes to enhance the production of food through the use of microorganisms and enzymes.
c. BS.03.03. Performance Indicator: Apply biotechnology principles, techniques and processes to protect the environment and maximize use of natural resources (e.g., biomass, bioprospecting, industrial biotechnology, etc.).
d. BS.03.04. Performance Indicator: Apply biotechnology principles, techniques and processes to enhance plant and animal care and production (e.g., selective breeding, pharmaceuticals, biodiversity, etc.).
e. BS.03.05. Performance Indicator: Apply biotechnology principles, techniques and processes to produce biofuels (e.g., fermentation, transesterification, methanogenesis, etc.).
f. BS.03.06. Performance Indicator: Apply biotechnology principles, techniques and processes to improve waste management (e.g., genetically modified organisms, bioremediation, etc.).

ES Environmental Service Systems

Environmental Service Systems Career Pathway Content Standards

The Environmental Service Systems (ESS) Career Pathway encompasses the study of systems, instruments and technology used to monitor and minimize the impact of human activity on environmental systems. 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:

- *Common Career Technical Core (CCTC) Standards* – These are the standards for Environmental Service Systems (AG-ESS) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- *Performance Indicators* – These statements distill each CCTC 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 CCTC Standard at the conclusion of a program of study in this area.

1. ESS.01. CCTC Standard: Use analytical procedures and instruments to manage environmental service systems.
   a. ESS.01.01. Performance Indicator: Analyze and interpret laboratory and field samples in environmental service systems.
   b. ESS.01.02. Performance Indicator: Properly utilize scientific instruments in environmental monitoring situations (e.g., laboratory equipment, environmental monitoring instruments, etc.).
2. ESS.02. CCTC Standard: Evaluate the impact of public policies and regulations on environmental service system operations.

a. ESS.02.01. Performance Indicator: Interpret and evaluate the impact of laws, agencies, policies and practices affecting environmental service systems.
b. ESS.02.02. Performance Indicator: Compare and contrast the impact of current trends on regulation of environmental service systems (e.g., climate change, population growth, international trade, etc.).
c. ESS.02.03. Performance Indicator: Examine and summarize the impact of public perceptions and social movements on the regulation of environmental service systems.

3. ESS.03. CCTC Standard: Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.
   a. ESS.03.01. Performance Indicator: Apply meteorology principles to environmental service systems.
   b. ESS.03.02. Performance Indicator: Apply soil science and hydrology principles to environmental service systems.
   c. ESS.03.03. Performance Indicator: Apply chemistry principles to environmental service systems.
   d. ESS.03.04. Performance Indicator: Apply microbiology principles to environmental service systems.
   e. ESS.03.05. Performance Indicator: Apply ecology principles to environmental service systems.
4. ESS.04. CCTC Standard: Demonstrate the operation of environmental service systems (e.g., pollution control, water treatment, wastewater treatment, solid waste management and energy conservation).
   a. ESS.04.01. Performance Indicator: Use pollution control measures to maintain a safe facility and environment.
   b. ESS.04.02. Performance Indicator: Manage safe disposal of all categories of solid waste in environmental service systems.
   c. ESS.04.03. Performance Indicator: Apply techniques to ensure a safe supply of drinking water and adequate treatment of wastewater according to applicable rules and regulations.
   d. ESS.04.04. Performance Indicator: Compare and contrast the impact of conventional and alternative energy sources on the environment and operation of environmental service systems.
5. ESS.05. CCTC Standard: Use tools, equipment, machinery and technology common to tasks in environmental service systems.
   a. ESS.05.01. Performance Indicator: Use technological and mathematical tools to map land, facilities and infrastructure for environmental service systems.
   b. ESS.05.02. Performance Indicator: Perform assessments of environmental conditions using equipment, machinery and technology.

FPP Food Products and Processing Systems

Food Products and Processing Systems Career Pathway Content Standards

The Food Products and Processing Systems (FPP) Career Pathway encompasses the study of food safety and sanitation; nutrition, biology, microbiology, chemistry and human behavior in local and global food systems; food selection and 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:

- *Common Career Technical Core (CCTC) Standards* – These are the standards for Food Products and Processing Systems (AG-FPP) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- *Performance Indicators* – These statements distill each CCTC 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 CCTC Standard at the conclusion of a program of study in this area.

1. FPP.01. CCTC Standard: Develop and implement procedures to ensure safety, sanitation and quality in food product and processing facilities.
    a. FPP.01.01. Performance Indicator: Analyze and manage operational and safety procedures in food products and processing facilities.
    b. FPP.01.02. Performance Indicator: Apply food safety and sanitation procedures in the handling and processing of food products to ensure food quality.
    c. FPP.01.03. Performance Indicator: Apply food safety procedures when storing food products to ensure food quality.
2. FPP.02. CCTC Standard: Apply principles of nutrition, biology, microbiology, chemistry and human behavior to the development of food products.
    a. FPP.02.01. Performance Indicator: 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.
    b. FPP.02.02. Performance Indicator: 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.
    c. FPP.02.03. Performance Indicator: Apply principles of human behavior to develop food products to provide a safe, wholesome and nutritious food supply for local and global food systems.
3. FPP.03. CCTC Standard: Select and process food products for storage, distribution and consumption.
    a. FPP.03.01. Performance Indicator: Implement selection, evaluation and inspection techniques to ensure safe and quality food products.
    b. FPP.03.02. Performance Indicator: Design and apply techniques of food processing, preservation, packaging and presentation for distribution and consumption of food products.
    c. FPP.03.03. Performance Indicator: Create food distribution plans and procedures to ensure safe delivery of food products.

4. FPP.04. CCTC Standard: Explain the scope of the food industry and the historical and current developments of food product and processing.
    a. FPP.04.01. Performance Indicator: Examine the scope of the food industry by evaluating local and global policies, trends and customs for food production.
    b. FPP.04.02. Performance Indicator: Evaluate the significance and implications of changes and trends in the food products and processing industry in the local and global food systems.
    c. FPP.04.03. Performance Indicator: Identify and explain the purpose of industry organizations, groups and regulatory agencies that influence the local and global food systems.

NRS Natural Resource Systems

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:

- *Common Career Technical Core (CCTC) Standards* – These are the standards for Natural Resource Systems (AG-NRS) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- *Performance Indicators* – These statements distill each CCTC 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 CCTC Standard at the conclusion of a program of study in this area.

1. NRS.01. CCTC Standard: Plan and conduct natural resource management activities that apply logical, reasoned and scientifically based solutions to natural resource issues and goals.
    a. NRS.01.01. Performance Indicator: Apply methods of classification to examine natural resource availability and ecosystem function in a particular region.
    b. NRS.01.02. Performance Indicator: Classify different types of natural resources in order to enable protection, conservation, enhancement and management in a particular geographical region.
    c. NRS.01.03. Performance Indicator: Apply ecological concepts and principles to atmospheric natural resource systems.
    d. NRS.01.04. Performance Indicator: Apply ecological concepts and principles to aquatic natural resource systems.
    e. NRS.01.05. Performance Indicator: Apply ecological concepts and principles to terrestrial natural resource systems.

f. NRS.01.06. Performance Indicator: Apply ecological concepts and principles to living organisms in natural resource systems.

2. NRS.02. CCTC Standard: Analyze the interrelationships between natural resources and humans.
   a. NRS.02.01. Performance Indicator: Examine and interpret the purpose, enforcement, impact and effectiveness of laws and agencies related to natural resource management, protection, enhancement and improvement (e.g., water regulations, game laws, historic preservation laws, environmental policy, etc.).
   b. NRS.02.02. Performance Indicator: Assess the impact of human activities on the availability of natural resources.
   c. NRS.02.03. Performance Indicator: Analyze how modern perceptions of natural resource management, protection, enhancement and improvement change and develop over time.
   d. NRS.02.04. Performance Indicator: Examine and explain how economics affects the use of natural resources.
   e. NRS.02.05. Performance Indicator: Communicate information to the public regarding topics related to the management, protection, enhancement, and improvement of natural resources.
3. NRS.03. CCTC Standard: Develop plans to ensure sustainable production and processing of natural resources.
   a. NRS.03.01. Performance Indicator: Sustainably produce, harvest, process and use natural resource products (e.g., forest products, wildlife, minerals, fossil fuels, shale oil, alternative energy, recreation, aquatic species, etc.).
   b. NRS.03.02. Performance Indicator: Demonstrate cartographic skills, tools and technologies to aid in developing, implementing and evaluating natural resource management plans.
4. NRS.04. CCTC Standard: Demonstrate responsible management procedures and techniques to protect, maintain, enhance, and improve natural resources.
   a. NRS.04.01. Performance Indicator: Demonstrate natural resource protection, maintenance, enhancement and improvement techniques.
   b. NRS.04.02. Performance Indicator: Diagnose plant and wildlife diseases and follow protocols to prevent their spread.
   c. NRS.04.03. Performance Indicator: Prevent or manage introduction of ecologically harmful species in a particular region.
   d. NRS.04.04. Performance Indicator: Manage fires in natural resource systems.

PS Plant Systems

Plant Science Systems Career Pathway Content Standards

The Plant Systems (PS) Career Pathway encompasses the study of plant life cycles, classifications, functions, structures, reproduction, media and nutrients, as wells 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:

- *Common Career Technical Core (CCTC) Standards* – These are the standards for Plant Systems (AG-PS) from the 2012 version of the Common Career and Technical Core

Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.

- *Performance Indicators* – These statements distill each CCTC 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 CCTC Standard at the conclusion of a program of study in this area.

1. PS.01. CCTC Standard: Develop and implement a crop management plan for a given production goal that accounts for environmental factors.
    a. PS.01.01. Performance Indicator: Determine the influence of environmental factors on plant growth.
    b. PS.01.02. Performance Indicator: Prepare and manage growing media for use in plant systems.
    c. PS.01.03. Performance Indicator: Develop and implement a fertilization plan for specific plants or crops.
2. PS.02. CCTC Standard: Apply principles of classification, plant anatomy, and plant physiology to plant production and management.
    a. PS.02.01. Performance Indicator: Classify plants according to taxonomic systems.
    b. PS.02.02. Performance Indicator: Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.
    c. PS.02.03. Performance Indicator: Apply knowledge of plant physiology and energy conversion to plant systems.
3. PS.03. CCTC Standard: Propagate, culture and harvest plants and plant products based on current industry standards.
    a. PS.03.01. Performance Indicator: Demonstrate plant propagation techniques in plant system activities.
    b. PS.03.02. Performance Indicator: Develop and implement a management plan for plant production.
    c. PS.03.03. Performance Indicator: Develop and implement a plan for integrated pest management for plant production.
    d. PS.03.04. Performance Indicator: Apply principles and practices of sustainable agriculture to plant production.
    e. PS.03.05. Performance Indicator: Harvest, handle and store crops according to current industry standards.
4. PS.04. CCTC Standard: Apply principles of design in plant systems to enhance an environment (e.g. floral, forest landscape, and farm).
    a. PS.04.01. Performance Indicator: Evaluating, identifying and preparing plants to enhance an environment.
    b. PS.04.02. Performance Indicator: Create designs using plants.

PST Power, Structural, and Technical Systems

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, alternative fuel sources and precision technology, as well as woodworking, metalworking, welding 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:

- *Common Career Technical Core (CCTC) Standards* – These are the standards for Power, Structural and Technical Systems (AG-PST) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- *Performance Indicators* – These statements distill each CCTC 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 CCTC Standard at the conclusion of a program of study in this area.

1. PST.01. CCTC Standard: Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems.
    a. PST.01.01. Performance Indicator: Apply physical science and engineering principles to assess and select energy sources for AFNR power, structural and technical systems.
    b. PST.01.02. Performance Indicator: Apply physical science and engineering principles to design, implement and improve safe and efficient mechanical systems in AFNR situations.
    c. PST.01.03. Performance Indicator: Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).
2. PST.02. CCTC Standard: Operate and maintain AFNR mechanical equipment and power systems.
    a. PST.02.01. Performance Indicator: Perform preventative maintenance and scheduled service to maintain equipment, machinery and power units used in AFNR settings.
    b. PST.02.02. Performance Indicator: Operate machinery and equipment while observing all safety precautions in AFNR settings.
3. PST.03. CCTC Standard: Service and repair AFNR mechanical equipment and power systems.
    a. PST.03.01. Performance Indicator: Troubleshoot, service and repair components of internal combustion engines using manufacturers' guidelines.
    b. PST.03.02. Performance Indicator: Service electrical systems and components of mechanical equipment and power systems using a variety of troubleshooting and/or diagnostic methods.
    c. PST.03.03. Performance Indicator: Utilize manufacturers' guidelines to diagnose and troubleshoot malfunctions in machinery, equipment and power source systems (e.g., hydraulic, pneumatic, transmission, steering, suspension, etc.).

4. PST.04. CCTC Standard: Plan, build and maintain AFNR structures.
    a. PST.04.01. Performance Indicator: Create sketches and plans for AFNR structures.
    b. PST.04.02. Performance Indicator: Determine structural requirements, specifications and estimate costs for AFNR structures
    c. PST.04.03. Performance Indicator: Follow architectural and mechanical plans to construct, maintain and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).
    d. PST.04.04. Performance Indicator: Apply electrical wiring principles in AFNR structures.
5. PST.05. CCTC Standard: Use control, monitoring, geospatial and other technologies in AFNR power, structural and technical systems.
    a. PST.05.01. Performance Indicator: Apply computer and other technologies (e.g., robotics, CNC, UAS, etc.) to solve problems and increase the efficiency of AFNR systems.
    b. PST.05.02. Performance Indicator: Prepare and/or use electrical drawings to design, install and troubleshoot electronic control systems in AFNR settings.
    c. PST.05.03. Performance Indicator: Apply geospatial technologies to solve problems and increase the efficiency of AFNR systems.

Appendix B: Academic Standards

2018 Mississippi College and Career-Readiness Standards for Biology

	Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Standards																		
BIO1		X	X	X	X		X		X	X	X	X				X	X	X
BIO2			X	X	X	X	X	X	X		X			X	X	X	X	X
BIO3			X	X			X	X	X	X	X	X		X	X	X		X
BIO4		X	X		X	X		X	X		X	X		X		X	X	X
BIO5		X	X		X	X	X	X			X				X		X	X

BIO.1 Cells as a system

a. Students will demonstrate an understanding of the characteristics of life and biological organization.
b. Students will analyze the structure and function of the macromolecules that make up cells.
c. Students will relate the diversity of organelles to a variety of specialized cellular functions.
d. 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.
e. Students will develop and use models to explain the role of the cell cycle during growth, development, and maintenance in multicellular organisms.

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

BIO3 Reproduction and Heredity

a. Students will develop and use models to explain the role of meiosis in the production of haploid gametes required for sexual reproduction.
b. Students will analyze and interpret data collected from probability calculations to explain the variation of expressed traits within a population.
c. 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.4 Adaptations and Evolution - Students will analyze and interpret evidence to explain the unity and diversity of life.

BIO.5 Interdependence of Organisms and Their Environment - Students will Investigate and evaluate the interdependence of living organisms and their environment.