

Title 7: Education K-12

Part 180: Mississippi Secondary Curriculum Frameworks in Career and Technical Education, Agriculture, Food & Natural Resources, Principals of Agriscience



2022 Principles of Agriscience

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Published by:

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

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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 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

The principles of agriscience curriculum was presented to the Mississippi State Board of Education on January 20, 2022. The following persons were serving on the state board at the time:

Dr. Carey M. Wright, state superintendent of education
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Mr. Bill Jacobs
Dr. Ronnie McGehee
Mr. Matt Miller
Ms. Mary Werner
Ms. Amy Zhang, student representative
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The following Mississippi Department of Education (MDE) and RCU managers and specialists assisted in the development of the principles of agriscience curriculum:

Wendy Clemons, the executive director of the MDE Office of Secondary Education and Professional Development, supported the RCU and teachers throughout the development of the framework and supporting materials.
Dr. Aimee Brown, the state director of the MDE Office of Career and Technical Education (CTE), supported the RCU and teachers throughout the development of the framework and supporting materials.
Courtney McCubbins, a project manager with the RCU, researched and coauthored this framework. helpdesk@rcu.msstate.edu

Special thanks are extended to the educators who contributed teaching and assessment materials that are included in the framework and supporting materials:

Bob Robinson, Pelahatchie High School, Pelahatchie
Abby Peterson, Brandon Middle and High School, Brandon
Eric Turbyfill, Wayne County Career and Technical Center, Waynesboro
Emily West, Perry County Vocational Technical Center, New Augusta
Mary Helen Lett, Forrest County Agricultural High School, Brooklyn
Amanda Taylor, Vardaman High School, Vardaman

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

Jill Wagner, agricultural education and FFA program supervisor for the MDE Office of CTE

Chris Shivers, Region 8 regional manager for the Mississippi Farm Bureau Federation

Dr. OP McCubbins, assistant professor of agricultural education at MSU

Betsey Smith, the director of the RCU

Sam Watts, the curriculum manager for the RCU

Standards

Standards and alignment crosswalks are referenced in the appendix. 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 principles of agriscience curriculum is aligned to the following standards:

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

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

thecouncil.ffa.org/afnr

International Society for Technology in Education Standards (ISTE)

Reprinted with permission from *ISTE Standards for Students* (2016). All rights reserved. Permission does not constitute an endorsement by ISTE.

iste.org

College- and Career-Ready 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/oe/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. *21 Framework Definitions* (2019).

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).

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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, call the RCU at 662.325.2510.

Executive Summary

Pathway Description

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

College, Career, and Certifications

No national industry-recognized certifications are known to exist at this time in the field of agriscience. Competencies and suggested performance indicators in the diversified agriculture courses have been correlated, however, to the *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 ninth or 10th graders. Exceptions to this are a district-level decision based on class size, enrollment numbers, and student maturity. A maximum of 25 students is recommended for classroom-based courses, while a maximum of 15 students is recommended for lab-based courses.

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 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/curriculumdownload.

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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 of training sessions provided, please contact the RCU at 662.325.2510.

Course Outlines

This curriculum consists of a one 1-credit course.

Principles of Agriscience—Course Code: 991000

Unit	Title	Hours
1	Introduction to Agriscience	8
2	Lab Safety and the Scientific Method	8
3	Agricultural Leadership and Career Development	16
4	SAE for All	12
5	Tools in Agriscience	12
6	Environmental and Soil Science	20
7	Introduction to Cells and Genetics	8
8	Introduction to the Science of Agricultural Plants	20
9	Introduction to the Science of Agricultural Animals	20
10	Introduction to Agribusiness and Entrepreneurship	16
Total		140

Career Pathway Outlook

Overview

The agricultural sciences career cluster covers the broad field of occupations related to the production and use of plants and animals for food, fiber, aesthetic, and environmental purposes. According to the U.S. Department of Agriculture (USDA), through 2025, 59,400 jobs are expected to open in food, agriculture, renewable natural resources, or the environment for graduates with bachelor's or higher degrees in those areas. Almost half of those jobs will be in management and business at 42%; 31% in science, technology, engineering, and math (STEM) in agriculture; 13% in sustainable food and biomaterials production; and 14% in education, communication, and government services. According to the USDA, agriculture, food, and related industries contributed \$1.1 trillion to the U.S. gross domestic product (GDP) in 2019. The Mississippi Department of Agriculture and Commerce (MDAC) reports that agriculture is Mississippi's number one industry at \$7.4 billion and employing approximately 17.4% of the state's workforce.

Diversified agriculture will target careers at the professional and technical levels in agriculture. Students enrolled in these courses should be better prepared to pursue degrees at the community college and four-year college levels.

Needs of the Future Workforce

Data for this synopsis were compiled from the Mississippi Department of Employment Security (MDES) (2016). Employment opportunities for each of the occupations are listed below:

Table 1.1: Current and Projected Occupation Report

Description	Jobs, 2016	Projected Jobs, 2026	Change (Number)	Change (Percent)	Average Yearly Earnings, 2020
Agricultural and Food Science Technicians	260	270	10	3.9%	\$39,270
Agricultural Sciences Teachers, Postsecondary	150	160	10	6.7%	\$93,260
Animal Trainers	100	110	10	10%	\$23,120
Career/Technical Education Teachers, Middle School	320	350	30	9.4%	\$47,270
Career/Technical Education Teachers, Secondary School	1220	1310	90	7.4%	\$50,370
Conservation Scientists	700	730	30	4.3%	\$54,950
Environmental Engineers	410	420	10	2.4%	\$75,940
Environmental Engineering Technicians	160	170	10	6.3%	\$46,790

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Environmental Scientists and Specialists, Including Health	620	670	50	8.1%	\$64,460
Environmental Science and Protection Technicians, Including Health	420	460	40	9.5%	\$38,780
Farm and Home Management Advisors	290	300	10	3.2%	\$38,650
Logging Equipment Operators	1,680	1,740	60	3.6%	\$41,840
Landscaping and Groundskeeping Workers	6,000	6,620	620	10.3%	\$25,630
Nonfarm Animal Caretakers	1,520	1,780	260	17.1%	\$24,030
Soil and Plant Scientists	110	110	0	0%	\$92,250
Farmers, Ranchers, and Other Agricultural Managers	1,790	1,840	20	2.8%	\$55,830
First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers	980	1,090	110	11.2%	\$40,270
First-Line Supervisors/Managers of Farming, Fishing, and Forestry Workers	940	990	50	5.3%	\$54,550
Fish and Game Wardens	40	40	0	0%	\$46,610
Foresters	190	200	10	5.3%	\$52,660
Surveyors	450	470	20	4.4%	\$48,600
Surveying and Mapping Technicians	530	550	20	3.8%	\$39,840
Tree Trimmers and Pruners	270	300	30	11.1%	\$44,920
Veterinarians	490	540	50	10.2%	\$81,950
Veterinary Assistants and Laboratory Animal Caretakers	970	1,090	120	12.4%	\$26,150
Veterinary Technologists and Technicians	570	630	60	10.5%	\$35,890
Zoologists and Wildlife Biologists	260	270	10	3.9%	\$70,200

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Source: Mississippi Department of Employment Security; mdes.ms.gov (2021).

Perkins V Requirements and Academic Infusion

The principles of agriscience curriculum meets Perkins V requirements of introducing students to and preparing them for high-skill, high-wage occupations in agricultural fields. It also offers students a program of study, including secondary, postsecondary, and institutions of higher learning courses, that will further prepare them for careers in agriculture. 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.

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Best Practices

Innovative Instructional Technologies

Classrooms should be equipped with tools that will teach today's digital learners through applicable and modern practices. The diversified agriculture 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 opportunity to succeed.

CTE Student Organizations

Teachers should investigate opportunities to sponsor a student organization. The National FFA Organization is the student organization for this pathway and will foster the types of learning expected from the diversified agriculture curriculum. FFA provides students with growth opportunities and competitive events and opens the doors to the world of agriculture and scholarship opportunities.

Cooperative Learning

Cooperative learning can help students understand topics when independent learning cannot. Therefore, you will see several opportunities in the 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 diversified agriculture curriculum provides opportunities for students to work together and help each other complete complex tasks. There are many field experiences within the curriculum that will allow and encourage collaboration with professionals currently in the agriscience field.

Work-Based Learning

Work-based learning is an extension of understanding competencies taught in the diversified agriculture classroom. This curriculum is designed in a way that necessitates active involvement by the students in the community around them and the global environment. These real-world connections and applications link to all types of students to knowledge, skills, and professional dispositions. Work-based learning should encompass ongoing and increasingly more complex involvement with local companies and agriscience professionals. Thus, supervised collaboration and immersion into the agriculture industry around the students are keys to students' success, knowledge, and skills development.

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Professional Organizations

American Association for Agricultural Education (AAAE)

aaaeonline.org

Association for Career and Technical Education (ACTE)

acteonline.org

Mississippi ACTE

mississippiacte.com

Mississippi FFA/ Mississippi Association of Vocational Agriculture Teachers (MAVAT)

mississippiffa.org

National FFA Organization

ffa.org

National Association of Agricultural Educators (NAAE)

naae.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

Teacher resources for this curriculum may be found in multiple places. Many program areas have teacher resource documents that accompany the curriculum and can be downloaded from the same site as the curriculum. The teacher resource document contains references, lesson ideas, websites, teaching and assessment strategies, scenarios, skills to master, and other resources divided by unit. This document could be updated periodically by RCU staff. Please check the entire document, including the entries for each unit, regularly for new information. If you have something you would like to add or have a question about the document, call or email the RCU's instructional design specialist for your program. The teacher resource document can be downloaded at rcu.msstate.edu/curriculum/curriculumdownload.aspx. All teachers should request to be added to the Canvas Resource Guide for their course. This is where all resources will be housed in the future if they are not already. 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. If the principles of agriscience program is currently using the Mississippi Career Planning and Assessment System (MS-CPAS) as a measure of accountability, the enrichment section of material will not be tested. If this is the case, it is suggested to use the enrichment material when needed or desired by the teacher and if time allows in the class. This material will greatly enhance the learning experiences for students. If, however, the principles of agriscience program is using a national certification, work-based learning, or other measure of accountability that aligns with Perkins V as a quality indicator, this material could very well be tested 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 Agriscience

Competencies and Suggested Objectives

1. Examine the impact of the agriculture and natural resources industry on society. ^{DOK1}
 - a. Investigate the scope of the agricultural and natural resources industry.
 - County
 - State
 - National
 - Global
 - b. Examine the history of agricultural practices and technologies utilized in animal and plant production.
 - c. Describe the major areas of agriculture and environmental science and technology.
 - Animal science
 - Plant science
 - Agricultural business
 - Environmental services
 - Food science
 - Agricultural mechanization and technology
 - Natural resources
 - Precision agriculture
2. Describe an application of science in agriculture and environmental science technology. ^{DOK2}
 - a. Describe basic and applied sciences that relate to agriscience.
 - b. Explore the impact of biotechnology on agriculture and environmental science.
 - Insulin (1922)
 - Discovery of DNA structure (1953)
 - Human Genome Project (1990)
 - Bt/Roundup Ready crops (1996)
 - Cloning (Dolly the sheep, 1996)
 - c. Examine current trends and technologies impacting modern agricultural and environmental practices.
 - d. Utilize the scientific method to design a research project on an area of study from within this course of study.

Unit 2: Lab Safety and the Scientific Method

Competencies and Suggested Objectives	
1. Analyze the basic rules of safety in the agriscience laboratory. ^{DOK1}	
a. Discuss the safe and proper use of items found in an agriscience laboratory.	<ul style="list-style-type: none">• Chemicals• Heat and fire• Laboratory equipment• Specimens and animals• Electrical equipment
b. Explore Occupational Safety and Health Administration (OSHA) safety standards as they relate to the agricultural classroom, laboratory, and workplace.	
c. Discuss the procedures for reporting an accident.	
d. Illustrate the use of a Safety Data Sheet (SDS).	
2. Demonstrate all safety equipment in the agriscience laboratory. ^{DOK2}	
a. Identify the location of safety equipment and discuss procedures for dealing with accidents, injuries, and spills.	
b. Describe general safety techniques using hand equipment and indicators.	<ul style="list-style-type: none">• Safety color codes• Fire extinguishers• First aid kits• Emergency exits
3. Practice safety concepts in laboratory activities. ^{DOK2}	
a. Use appropriate precautions when working with electrical applications, fire, poisons, and gas.	
b. Demonstrate the correct way to wear personal protective equipment (PPE).	
c. Safely work with animals and plants.	
d. Take steps to prevent a dangerous explosion.	
4. Discuss terms associated with the scientific method and conduct an experiment. ^{DOK3}	
a. Identify the problem or question to be answered.	
b. Gather data related to the problem or question.	
c. Formulate possible solutions.	
d. Implement the preferred solutions.	
e. Evaluate the results and pursue further research as needed.	

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: Agricultural Leadership and Career Development

Competencies and Suggested Objectives

1. Explore the integral relationship between the FFA and agricultural education. ^{DOK1}
 - a. Examine historical events that shaped school-based agricultural education.
 - Smith-Hughes Act (1917)
 - Establishment of the National FFA Organization (1928)
 - Mississippi FFA Association chartered (1934)
 - Establishment of the New Farmers of America (NFA) (1935)
 - Public Law 740 (1950)
 - Merger of the FFA and the NFA (1965)
 - Female membership (1969)
 - National FFA Organization name change (1988)
 - b. Identify types of FFA membership.
 - Active
 - Collegiate
 - Alumni
 - Honorary
 - c. Distinguish between 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. ^{DOK2}
 - a. Explain the role of effective leadership.
 - b. Have students self-evaluate their 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
 - Proficiency awards
 - Community service activities
 - Conventions and leadership conferences
 - d. Demonstrate basic parliamentary procedures.
 - Conducting a meeting

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<ul style="list-style-type: none">• Stating a main motion• Voting on a motion• Understanding the use of the gavel• Distinguishing between types of motions (i.e., main, subsidiary, incidental, privileged)
<p>3. Describe the role of 21st-century skills and concepts related to leadership when establishing and building a successful career. ^{DOK2}</p> <p>a. Describe leadership.</p> <p>b. Describe the traits of a good leader.</p> <ul style="list-style-type: none">• Integrity• Knowledge• Courage• Tactfulness• Enthusiasm• Unselfishness• Loyalty <p>c. Practice acceptable behaviors that are appropriate through FFA activities.</p> <ul style="list-style-type: none">• Introductions and greetings• Table manners• Expressing gratitude• Appropriate social media usage
<p>4. Investigate careers associated with the agricultural industry. ^{DOK1}</p> <p>a. Complete a project with details about a chosen career.</p> <ul style="list-style-type: none">• Description of the career• Educational/training requirements• Salary range• Job outlook

Unit 4: SAE for All

Competencies and Suggested Scenarios

1. Describe the purposes and requirements of the Supervised Agricultural Experience (SAE for All) program. ^{DOK1}
 - a. Establish objectives for the SAE program.
 - Personal growth
 - Career development
 - Responsible citizenship
 - Practical application of work experience and/or skill attainment
 - b. Determine the benefits of participation in an SAE program.
 - Assisting with career and personal choices
 - Applying business practices (e.g., record keeping, money management, etc.)
 - Nurturing individual talents and developing a cooperative attitude
 - Building character and encouraging citizenship and volunteerism
 - Providing an environment for practical learning
 - c. Describe the types of programs under SAE for All.
 - Explore concepts of a Foundational SAE.
 - Career exploration and planning
 - Employability skills for college and career readiness
 - Personal financial management and planning
 - Workplace safety
 - Agricultural literacy
 - Explore concepts of an Immersion SAE.
 - Placement/internship
 - Ownership/entrepreneurship
 - Research
 - Experimental
 - Analytical
 - Invention
 - School-based enterprise
 - Service learning
 - d. Explore the *Mississippi Work-Based Learning Teacher Resource Guide* as a companion to Immersion SAE.

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<p>2. Launch a Foundational SAE plan. ^{DOK2}</p> <ol style="list-style-type: none">a. Identify potential career interests.b. Determine the availability of time and money/resources to invest.c. Set short-range goals for the SAE program.d. Project long-range goals for the SAE program.e. Complete a training agreement for an SAE project.f. Establish the requirements of student, parents, supervisor, and/or employer.
<p>3. Develop a record-keeping system for an individual student's SAE program. ^{DOK2}</p> <ol style="list-style-type: none">a. Determine the types of records to keep.<ul style="list-style-type: none">• Hours worked/spent on a project or enterprise• Inventory of assets• Expenses• Income• Skills attained during a project or enterprise• Leadership record• Community service record• Journal of experiences• Picturesb. Maintain records using an electronic/computer-based system of record keeping for the SAE program.

Unit 5: Tools in Agriscience

Competencies and Suggested Objectives

1. Identify commonly used tools and measuring devices in agriscience. ^{DOK1}
 - a. Identify basic hand and power tools used in agriscience per the Mississippi FFA Tool Identification list.
 - b. Discuss and demonstrate the proper use of precision measuring devices to determine mass, weight, and volume.
 - Balance
 - Scale
 - Graduated cylinder
 - Standard measuring devices
 - Rulers
 - Tape measures
 - Micrometers
 - Dividers
 - Protractors
2. Apply proper hand- and power-tool operational procedures. ^{DOK2}
 - a. Demonstrate how to use hand and power tools.
 - Hammers (e.g., claw, ball peen)
 - Screwdrivers (e.g., Phillips, standard)
 - Tape measures
 - Saws (e.g., hand, coping, miter)
 - Drills
 - Assorted power tools (as applicable)

Unit 6: Environmental and Soil Science

Competencies and Suggested Objectives
1. Define the terms associated with alternative and sustainable energy. ^{DOK1} a. Define terms. <ul style="list-style-type: none">• Renewable• Nonrenewable• Fossil fuels• Conservation• Preservation
2. Define terms related to environmental resources, including air, water, and soil. ^{DOK1}
3. Discuss the composition of air, water, and soil. ^{DOK1} a. Investigate the factors affecting air quality. b. Investigate the factors affecting water quality. c. Investigate the factors affecting soil quality.
4. Describe soil and discuss the importance it plays in agricultural production. ^{DOK1}
5. Identify and describe the physical composition of soil, including air, water, organic matter, and mineral matter (e.g., sand, silt, clay, etc.). ^{DOK1}
6. Identify and describe the physical properties of soil. ^{DOK1} a. Describe the characteristics of various types of soil texture (e.g., sand, silt, clay, etc.). b. Describe the physical structure of soil. c. Discuss factors that influence the color of soil (e.g., mineral content, water, parent material).
7. Demonstrate how to use the USDA Textural Triangle to classify soil texture. ^{DOK2}
8. List the factors that impact soil formation. ^{DOK1} a. List the factors. <ul style="list-style-type: none">• Parent materials• Climate• Living organisms• Time• Topography
9. Describe a soil horizon and the horizons/layers of a typical soil profile, including O, A, B, C, and R. ^{DOK1}
10. Explore the basic concepts of natural resource conservation and management. ^{DOK1} a. Compare and contrast renewable and nonrenewable natural resources. b. Discuss the importance of stewardship and sustainability as related to natural resources and the environment.

Unit 7: Introduction to Cells and Genetics

Competencies and Suggested Objectives

1. Diagram the major components of an animal and plant cell and list their functions. ^{DOK1}
 - a. Diagram components of animal and plant cells.
 - Cell membrane
 - Cytoplasm
 - Endoplasmic reticulum
 - Golgi apparatus
 - Mitochondrion
 - Nucleus
 - Nucleolus
 - Ribosomes
 - Vacuoles
2. Explain animal growth and reproduction by cell mitosis and meiosis. ^{DOK1}
3. Define and explain basic concepts of heredity and genetics. ^{DOK1}
 - a. Define terms.
 - Genetics
 - Heredity
 - Genes
 - Homogeneous
 - Heterogeneous
 - Dominant
 - Recessive

Unit 8: Introduction to the Science of Agricultural Plants

Competencies and Suggested Objectives
<p>1. Explore the physiology of plants. ^{DOK1}</p> <ol style="list-style-type: none">Compare the physiological processes of respiration, photosynthesis, and transpiration as they affect plant growth.Examine the process of plant growth, including cell division, cell elongation, and cell differentiation.
<p>2. Investigate plant anatomy. ^{DOK1}</p> <ol style="list-style-type: none">Draw and label a diagram of the anatomy of a flowering plant.<ul style="list-style-type: none">RootsStemLeafFlowerDescribe the root systems of plants, including diagrams or drawings of the types of root systems, the structure of roots, and the function of roots on a plant.<ul style="list-style-type: none">Type (e.g., fibrous, taproot)Structure (e.g., root cap, root hair)Function (e.g., anchor the plant)Describe plant stems, including diagrams or drawings of the types of stems found on plants, the structure of stems, and the function of stems on plants.<ul style="list-style-type: none">Type (e.g., woody, herbaceous)Structures (e.g., xylem, phloem, lateral bud, terminal bud)Function (e.g., transport water and nutrients)Describe plant leaves, including their function, diagrams or drawings of leaf structures, and the various types of leaves found on plants.<ul style="list-style-type: none">Types (e.g., monocot, dicot, broadleaf, narrowleaf)Function (e.g., photosynthesis)Describe plant flowers, including their function, diagrams or drawings of flower parts, and a description of the various types of flowers found on plants.<ul style="list-style-type: none">Types (e.g., complete, incomplete)Structures (e.g., pistil, stamen, sepal, petal)Function (e.g., seed production, reproduction)
<p>3. Investigate common methods of plant reproduction. ^{DOK2}</p> <ol style="list-style-type: none">Compare and contrast sexual and asexual reproduction in plants.Examine the process of seed formation, including pollination and fertilization in sexual reproduction.Compare dicotyledonous and monocotyledonous seeds.

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<p>d. Identify the parts of a seed and associate each part with its function.</p> <ul style="list-style-type: none">• Epicotyl• Hypocotyl• Cotyledon• Seed coat• Endosperm• Radicle <p>e. Dissect a monocot and a dicot seed and describe the differences between the two.</p> <p>f. Describe and apply factors essential to seed germination.</p> <ul style="list-style-type: none">• Water• Light• Temperature• Air <p>g. Conduct a simple germination test on a packet of seeds including calculating the percentage of seeds that germinate and determine a germination ratio.</p> <p>h. Describe the methods of asexual reproduction in plants.</p> <ul style="list-style-type: none">• Cuttings• Grafting• Layering• Separation and division• Tissue culture/micropropagation
<p>4. Discuss classification methods for plants. ^{DOK1}</p> <p>a. Identify and describe the basic life cycles of a plant, including annual, biennial, and perennial.</p> <p>b. Describe the use of scientific classification systems in plant science, with an emphasis on the use of the genus, species, variety, and cultivar in plant names.</p>

Unit 9: Introduction to the Science of Agricultural Animals

Competencies and Suggested Objectives	
1. Explore common terminology associated with the agricultural animal industry. ^{DOK1}	
a. Identify the terms associated by species and stage of life.	<ul style="list-style-type: none">• Cattle (e.g., bull, calf, heifer, steer, cow)• Sheep (e.g., lamb, ewe, ram, wether)• Swine (e.g., piglet, gilt, sow, boar, barrow)• Goats (e.g., kid, doe, buck, wether)• Horses (e.g., foal, colt, filly, mare, stallion, gelding)• Chickens (e.g., chick, hen, rooster, pullet, capon, cockerel)• Fish (e.g., fry, fingerling, adult)
b. Describe types and breeds of livestock relevant to the local area.	
2. Investigate the anatomy and physiology of animals. ^{DOK1}	
a. Identify the basic body systems and their functions.	<ul style="list-style-type: none">• Skeletal• Muscular• Nervous• Respiratory• Circulatory• Reproductive• Digestive• Urinary• Endocrine
3. Describe important elements of digestion and nutrition in animals. ^{DOK2}	
a. Associate each of the six major classes of nutrients with its roles and functions.	<ul style="list-style-type: none">• Proteins• Carbohydrates• Vitamins• Fats• Water• Minerals
b. Compare and contrast the digestive systems and processes in monogastric, ruminant, pseudo-ruminant, modified monogastric (avian), and catfish.	
c. Discuss the use of roughages and concentrates as feedstuffs.	
4. Examine the role of genetics and breeding in animal production. ^{DOK2}	
a. Identify and explain the reproduction process in mammals, poultry, and catfish.	
b. Define and describe breeding processes, including natural mating, artificial insemination, and embryo transfer.	

Unit 10: Introduction to Agribusiness and Entrepreneurship

Competencies and Suggested Objectives

- | |
|--|
| <p>1. Explore the concept of agribusiness and its role in the economy. ^{DOK1}</p> <ul style="list-style-type: none">a. Explain agribusiness.b. Define terms related to agribusiness.<ul style="list-style-type: none">• Capital• Budgets• Assets• Liabilities• Income• Expensesc. Describe how agribusiness influences the economy.d. Describe how agribusiness principles fit into the agricultural industry as farmers input supplies into production agriculture, and agricultural services take the output to get the product to the consumer (i.e., farm-to-table concept).e. Identify local and statewide agribusinesses.f. Explore opportunities and challenges of e-commerce. |
| <p>2. Examine the principles of business organizations in agriculture. ^{DOK1}</p> <ul style="list-style-type: none">a. Compare the characteristics of the most commonly used business organizations in the agriculture and natural resources industry (e.g., proprietorships, partnerships, corporations, cooperatives). |

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 Agriscience		
	1.	Examine the impact of the agriculture and natural resources industry on society.
	2.	Describe an application of science in agriculture and environmental science technology.
Unit 2: Lab Safety and the Scientific Method		
	1.	Analyze the basic rules of safety in the agriscience laboratory.
	2.	Demonstrate all safety equipment in the agriscience laboratory.
	3.	Practice safety concepts in laboratory activities.
	4.	Discuss terms associated with the scientific method and conduct an experiment.
Unit 3: Agricultural Leadership 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.
	3.	Describe the role of 21st-century skills and concepts related to leadership when establishing and building a successful career.
	4.	Investigate careers associated with the agricultural industry.
Unit 4: SAE for All		
	1.	Describe the purposes and requirements of the Supervised Agricultural Experience (SAE For All) program.
	2.	Launch a Foundational SAE plan.
	3.	Develop a record-keeping system for an individual student's SAE program.
Unit 5: Tools in Agriscience		
	1.	Identify commonly used tools and measuring devices in agriscience.
	2.	Apply proper hand- and power-tool operational procedures.

Unit 6: Environmental and Soil Science	
1.	Define the terms associated with alternative and sustainable energy.
2.	Define terms related to environmental resources, including air, water, and soil.
3.	Discuss the composition of air, water, and soil.
4.	Describe soil and discuss the importance it plays in agricultural production.
5.	Identify and describe the physical composition of soil, including air, water, organic matter and mineral matter (e.g., sand, silt, clay, etc.).
6.	Identify and describe the physical properties of soil.
7.	Demonstrate how to use the USDA Textural Triangle to classify soil texture.
8.	List the factors that impact soil formation.
9.	Describe a soil horizon and the horizons/layers of a typical soil profile, including O, A, B, C, and R.
10.	Explore the basic concepts of natural resource conservation and management.
Unit 7: Introduction to Cells and Genetics	
1.	Diagram the major components of an animal and plant cell and list their functions.
2.	Explain animal growth and reproduction by cell mitosis and meiosis.
3.	Define and explain basic concepts of heredity and genetics.
Unit 8: Introduction to the Science of Agricultural Plants	
1.	Explore the physiology of plants.
2.	Investigate plant anatomy.
3.	Investigate common methods of plant reproduction.
4.	Discuss classification methods for plants.
Unit 9: Introduction to the Science of Agricultural Animals	
1.	Explore common terminology associated with the agricultural animal industry.
2.	Investigate the anatomy and physiology of animals.
3.	Describe important elements of digestion and nutrition in animals.
4.	Examine the role of genetics and breeding in animal production.
Unit 10: Introduction to Agribusiness and Entrepreneurship	
1.	Explore the concept of agribusiness and its role in the economy.
2.	Examine the principles of business organizations in agriculture.

Appendix: Industry Standards

Framework for AFNR Content Standards and Performance Elements Crosswalk for Principles of Agriscience

	Unit	1	2	3	4	5	6	7	8	9	10
AFNR											
ABS- Agribusiness Systems		X		X	X						X
AS- Animal Systems		X	X					X		X	
BS- Biotechnology		X	X								
CRP- Career Ready Practices		X	X	X	X	X	X	X	X	X	X
CS- AFNR Cluster Skill		X	X	X	X						
ES- Environmental Service Systems		X	X				X				
FPP- Food Products and Processing Systems		X									
NRS- Natural Resource Systems		X	X				X				
PS- Plant Systems		X	X					X	X		
PST- Power, Structural, and Technical Systems		X	X			X					

AFNR Pathway Content Standards and Performance Elements

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- ABS AGRIBUSINESS SYSTEMS**
- AS ANIMAL SYSTEMS**
- BS BIOTECHNOLOGY**
- CRP CAREER READY PRACTICES**
- CS AGRICULTURE FOOD AND NATURAL RESOURCES CLUSTER SKILL**
- ES ENVIRONMENTAL SERVICE SYSTEMS**
- FPP FOOD PRODUCTS AND PROCESSING SYSTEMS**
- NRS NATURAL RESOURCE SYSTEMS**
- PS PLANT SYSTEMS**
- PST POWER, STRUCTURAL, AND TECHNICAL 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.

ABS.01. CCTC Standard: Apply management planning principles in AFNR businesses.

ABS.01.01. Performance Indicator: Apply micro- and macroeconomic principles to plan and manage inputs and outputs in an AFNR business.

ABS.01.02. Performance Indicator: Read, interpret, evaluate and write statements of purpose to guide business goals, objectives and resource allocation.

ABS.01.03. Performance Indicator: Devise and apply management skills to organize and run an AFNR business in an efficient, legal and ethical manner.

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

ABS.02. CCTC Standard: Use record keeping to accomplish AFNR business objectives, manage budgets and comply with laws and regulations.

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.).

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.).

ABS.03. CCTC Standard: Manage cash budgets, credit budgets and credit for an AFNR business using generally accepted accounting principles.

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ABS.03.01. Performance Indicator: Develop, assess and manage cash budgets to achieve AFNR business goals.

ABS.03.02. Performance Indicator: Analyze credit needs and manage credit budgets to achieve AFNR business goals.

ABS.04. CCTC Standard: Develop a business plan for an AFNR business.

ABS.04.01. Performance Indicator: Analyze characteristics and planning requirements associated with developing business plans for different types of AFNR businesses.

ABS.04.02. Performance Indicator: Develop production and operational plans for an AFNR business.

ABS.04.03. Performance Indicator: Identify and apply strategies to manage or mitigate risk.

ABS.05. CCTC Standard: Use sales and marketing principles to accomplish AFNR business objectives.

ABS.05.01. Performance Indicator: Analyze the role of markets, trade, competition and price in relation to an AFNR business sales and marketing plans.

ABS.05.02. Performance Indicator: Assess and apply sales principles and skills to accomplish AFNR business objectives.

ABS.05.03. Performance Indicator: Assess marketing principles and develop marketing plans to accomplish AFNR business objectives.

Animal Systems Career Pathway Content Standards

The Animal Systems (AS) Career Pathway encompasses the study of animal systems, including content areas such as life processes, health, nutrition, genetics, 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.

AS.01. CCTC Standard: Analyze historic and current trends impacting the animal systems industry.

AS.01.01. Performance Indicator: Evaluate the development and implications of animal origin, domestication and distribution on production practices and the environment.

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AS.01.02. Performance Indicator: Assess and select animal production methods for use in animal systems based upon their effectiveness and impacts.

AS.01.03. Performance Indicator: Analyze and apply laws and sustainable practices to animal agriculture from a global perspective.

AS.02. CCTC Standard: Utilize best-practice protocols based upon animal behaviors for animal husbandry and welfare.

AS.02.01. Performance Indicator: Demonstrate management techniques that ensure animal welfare.

AS.02.02. Performance Indicator: Analyze procedures to ensure that animal products are safe for consumption (e.g., use in food system, etc.).

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

AS.03.01. Performance Indicator: Analyze the nutritional needs of animals.

AS.03.02. Performance Indicator: Analyze feed rations and assess if they meet the nutritional needs of animals.

AS.03.03. Performance Indicator: Utilize industry tools to make animal nutrition decisions.

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

AS.04.01. Performance Indicator: Evaluate animals for breeding readiness and soundness.

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

AS.04.03. Performance Indicator: Apply scientific principles to breed animals.

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

AS.05.01. Performance Indicator: Design animal housing, equipment and handling facilities for the major systems of animal production.

AS.05.02. Performance Indicator: Comply with government regulations and safety standards for facilities used in animal production.

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

AS.06.01. Performance Indicator: Classify animals according to taxonomic classification systems and use (e.g. agricultural, companion, etc.).

AS.06.02. Performance Indicator: Apply principles of comparative anatomy and physiology to uses within various animal systems.

AS.06.03. Performance Indicator: Select and train animals for specific purposes and maximum performance based on anatomy and physiology.

AS.07. CCTC Standard: Apply principles of effective animal health care.

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AS.07.01. Performance Indicator: Design programs to prevent animal diseases, parasites and other disorders and ensure animal welfare.

AS.07.02. Performance Indicator: Analyze biosecurity measures utilized to protect the welfare of animals on a local, state, national, and global level.

AS.08. CCTC Standard: Analyze environmental factors associated with animal production.

AS.08.01. Performance Indicator: Design and implement methods to reduce the effects of animal production on the environment.

AS.08.02. Performance Indicator: Evaluate the effects of environmental conditions on animals and create plans to ensure favorable environments for animals.

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.

CRP.01. CCTC Standard: Act as a responsible and contributing citizen and employee.

CRP.01.01. Performance Indicator: Model personal responsibility in the workplace and community.

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.

CRP.01.03. Performance Indicator: Identify and act upon opportunities for professional and civic service at work and in the community.

CRP.02. CCTC Standard: Apply appropriate academic and technical skills.

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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.

CRP.02.02. Performance Indicator: Use strategic thinking to connect and apply technical concepts to solve problems in the workplace and community.

CRP.03. CCTC Standard: Attend to personal health and financial well-being.

CRP.03.01. Performance Indicator: Design and implement a personal wellness plan.

CRP.03.02. Performance Indicator: Design and implement a personal financial management plan.

CRP.04. CCTC Standard: Communicate clearly, effectively and with reason.

CRP.04.01. Performance Indicator: Speak using strategies that ensure clarity, logic, purpose and professionalism in formal and informal settings.

CRP.04.02. Performance Indicator: Produce clear, reasoned and coherent written and visual communication in formal and informal settings.

CRP.04.03. Performance Indicator: Model active listening strategies when interacting with others in formal and informal settings.

CRP.05. CCTC Standard: Consider the environmental, social and economic impacts of decisions.

CRP.05.01. Performance Indicator: Assess, identify and synthesize the information and resources needed to make decisions that positively impact the workplace and community.

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.

CRP.06. CCTC Standard: Demonstrate creativity and innovation.

CRP.06.01. Performance Indicator: Synthesize information, knowledge and experience to generate original ideas and challenge assumptions in the workplace and community.

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.

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.

CRP.07. CCTC Standard: Employ valid and reliable research strategies.

CRP.07.01. Performance Indicator: Select and implement reliable research processes and methods to generate data for decision-making in the workplace and community.

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.

CRP.08. CCTC Standard: Utilize critical thinking to make sense of problems and persevere in solving them.

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CRP.08.01. Performance Indicator: Apply reason and logic to evaluate workplace and community situations from multiple perspectives.

CRP.08.02. Performance Indicator: Investigate, prioritize and select solutions to solve problems in the workplace and community.

CRP.08.03. Performance Indicator: Establish plans to solve workplace and community problems and execute them with resiliency.

CRP.09. CCTC Standard: Model integrity, ethical leadership and effective management.

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.).

CRP.09.02. Performance Indicator: Implement personal management skills to function effectively and efficiently in the workplace (e.g., time management, planning, prioritizing, etc.).

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.).

CRP.10. CCTC Standard: Plan education and career path aligned to personal goals.

CRP.10.01. Performance Indicator: Identify career opportunities within a career cluster that match personal interests, talents, goals and preferences.

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.

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.

CRP.10.04. Performance Indicator: Identify, prepare, update and improve the tools and skills necessary to pursue a chosen career path.

CRP.11. CCTC Standard: Use technology to enhance productivity.

CRP.11.01. Performance Indicator: Research, select and use new technologies, tools and applications to maximize productivity in the workplace and community.

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.

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

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.

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.).

Agriculture, Food, and Natural Resources Cluster Skill Content Standards

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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.

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

CS.01.01. Performance Indicator: Research, examine and discuss issues and trends that impact AFNR systems on local, state, national and global levels.

CS.01.02. Performance Indicator: Examine technologies and analyze their impact on AFNR systems.

CS.01.03. Performance Indicator: Identify public policies and examine their impact on AFNR systems.

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.

CS.02.01. Performance Indicator: Research and use geographic and economic data to solve problems in AFNR systems.

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.

CS.03. CCTC Standard: Examine and summarize the importance of health, safety and environmental management systems in AFNR workplaces.

CS.03.01. Performance Indicator: Identify and explain the implications of required regulations to maintain and improve safety, health and environmental management systems.

CS.03.02. Performance Indicator: Develop and implement a plan to maintain and improve health, safety and environmental compliance and performance.

CS.03.03. Performance Indicator: Apply health and safety practices to AFNR workplaces.

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CS.03.04. Performance Indicator: Use appropriate protective equipment and demonstrate safe and proper use of AFNR tools and equipment.

CS.04. CCTC Standard: Demonstrate stewardship of natural resources in AFNR activities.

CS.04.01. Performance Indicator: Identify and implement practices to steward natural resources in different AFNR systems.

CS.04.02. Performance Indicator: Assess and explain the natural resource related trends, technologies and policies that impact AFNR systems.

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

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.).

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.

CS.06.01. Performance Indicator: Examine and explain foundational cycles and systems of AFNR.

CS.06.02. Performance Indicator: Analyze and explain the connection and relationships between different AFNR systems on a national and global level.

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.

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.).

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.).

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.).

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).

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.).

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

BS.02.02. Performance Indicator: Implement standard operating procedures for the proper maintenance, use and sterilization of equipment in a laboratory.

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

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

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

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.).

BS.03.01. Performance Indicator: Apply biotechnology principles, techniques and processes to create transgenic species through genetic engineering.

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

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.).

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.).

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

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

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.

ESS.01. CCTC Standard: Use analytical procedures and instruments to manage environmental service systems.

ESS.01.01. Performance Indicator: Analyze and interpret laboratory and field samples in environmental service systems.

ESS.01.02. Performance Indicator: Properly utilize scientific instruments in environmental monitoring situations (e.g., laboratory equipment, environmental monitoring instruments, etc.).

ESS.02. CCTC Standard: Evaluate the impact of public policies and regulations on environmental service system operations.

ESS.02.01. Performance Indicator: Interpret and evaluate the impact of laws, agencies, policies and practices affecting environmental service systems.

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.).

ESS.02.03. Performance Indicator: Examine and summarize the impact of public perceptions and social movements on the regulation of environmental service systems.

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.

ESS.03.01. Performance Indicator: Apply meteorology principles to environmental service systems.

ESS.03.02. Performance Indicator: Apply soil science and hydrology principles to environmental service systems.

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ESS.03.03. Performance Indicator: Apply chemistry principles to environmental service systems.

ESS.03.04. Performance Indicator: Apply microbiology principles to environmental service systems.

ESS.03.05. Performance Indicator: Apply ecology principles to environmental service systems.

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).

ESS.04.01. Performance Indicator: Use pollution control measures to maintain a safe facility and environment.

ESS.04.02. Performance Indicator: Manage safe disposal of all categories of solid waste in environmental service systems.

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.

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.

ESS.05. CCTC Standard: Use tools, equipment, machinery and technology common to tasks in environmental service systems.

ESS.05.01. Performance Indicator: Use technological and mathematical tools to map land, facilities and infrastructure for environmental service systems.

ESS.05.02. Performance Indicator: Perform assessments of environmental conditions using equipment, machinery and technology.

Food Products and Processing Systems Career Pathway Content Standards

The Food Products and Processing Systems (FPP) Career Pathway encompasses the study of food safety 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.

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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.

FPP.01. CCTC Standard: Develop and implement procedures to ensure safety, sanitation and quality in food product and processing facilities.

FPP.01.01. Performance Indicator: Analyze and manage operational and safety procedures in food products and processing facilities.

FPP.01.02. Performance Indicator: Apply food safety and sanitation procedures in the handling and processing of food products to ensure food quality.

FPP.01.03. Performance Indicator: Apply food safety procedures when storing food products to ensure food quality.

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

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.

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.

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.

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

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

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

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

FPP.04. CCTC Standard: Explain the scope of the food industry and the historical and current developments of food product and processing.

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

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.

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.

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.

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.

NRS.01.01. Performance Indicator: Apply methods of classification to examine natural resource availability and ecosystem function in a particular region.

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.

NRS.01.03. Performance Indicator: Apply ecological concepts and principles to atmospheric natural resource systems.

NRS.01.04. Performance Indicator: Apply ecological concepts and principles to aquatic natural resource systems.

NRS.01.05. Performance Indicator: Apply ecological concepts and principles to terrestrial natural resource systems.

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

NRS.02. CCTC Standard: Analyze the interrelationships between natural resources and humans.

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.).

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

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NRS.02.03. Performance Indicator: Analyze how modern perceptions of natural resource management, protection, enhancement and improvement change and develop over time.

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

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

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

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.).

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

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

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

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

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

NRS.04.04. Performance Indicator: Manage fires in natural resource 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 well as growth and cultural practices through the study of crops, turf grass, trees, shrubs and/or ornamental plants. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of plant systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- **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

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demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

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

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

PS.01.02. Performance Indicator: Prepare and manage growing media for use in plant systems.

PS.01.03. Performance Indicator: Develop and implement a fertilization plan for specific plants or crops.

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

PS.02.01. Performance Indicator: Classify plants according to taxonomic systems.

PS.02.02. Performance Indicator: Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.

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

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

PS.03.01. Performance Indicator: Demonstrate plant propagation techniques in plant system activities.

PS.03.02. Performance Indicator: Develop and implement a management plan for plant production.

PS.03.03. Performance Indicator: Develop and implement a plan for integrated pest management for plant production.

PS.03.04. Performance Indicator: Apply principles and practices of sustainable agriculture to plant production.

PS.03.05. Performance Indicator: Harvest, handle and store crops according to current industry standards.

PS.04. CCTC Standard: Apply principles of design in plant systems to enhance an environment (e.g. floral, forest landscape, and farm).

PS.04.01. Performance Indicator: Evaluating, identifying and preparing plants to enhance an environment.

PS.04.02. Performance Indicator: Create designs using plants.

Power, Structural and Technical Systems Career Pathway Content Standards

The Power, Structural and Technical Systems (PST) Career Pathway encompasses the study of agricultural equipment, power systems, 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.

PST.01. CCTC Standard: Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems.

PST.01.01. Performance Indicator: Apply physical science and engineering principles to assess and select energy sources for AFNR power, structural and technical systems.

PST.01.02. Performance Indicator: Apply physical science and engineering principles to design, implement and improve safe and efficient mechanical systems in AFNR situations.

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.).

PST.02. CCTC Standard: Operate and maintain AFNR mechanical equipment and power systems.

PST.02.01. Performance Indicator: Perform preventative maintenance and scheduled service to maintain equipment, machinery and power units used in AFNR settings.

PST.02.02. Performance Indicator: Operate machinery and equipment while observing all safety precautions in AFNR settings.

PST.03. CCTC Standard: Service and repair AFNR mechanical equipment and power systems.

PST.03.01. Performance Indicator: Troubleshoot, service and repair components of internal combustion engines using manufacturers' guidelines.

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.

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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.).

PST.04. CCTC Standard: Plan, build and maintain AFNR structures.

PST.04.01. Performance Indicator: Create sketches and plans for AFNR structures.

PST.04.02. Performance Indicator: Determine structural requirements, specifications and estimate costs for AFNR structures

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.).

PST.04.04. Performance Indicator: Apply electrical wiring principles in AFNR structures.

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

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.

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

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