2024 Agriculture Power and Machinery

Program CIP: 01.0204 – Agricultural Power Machinery Operation

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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 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

The Agriculture Power and Machinery curriculum was presented to the Mississippi State Board of Education on February 15, 2024. The following persons were serving on the state board at the time:

Dr. Ray Morgigno, interim 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
Mrs. Mary Werner
Dr. Wendi Barrett
Mr. Charlie Frugé, student representative
Ms. Kate Riddle, student representative

The following Mississippi Department of Education (MDE) and RCU managers and specialists assisted in the development of the agricultural power and machinery:

Wendy Clemons, the associate state superintendent of the MDE Office of Secondary, Professional Development, and Career Technical Education, supported the RCU and teachers throughout the development of the framework and supporting materials.
Brett Robinson, 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.
Abbigail Dugas, the agriculture, food, and natural resources program supervisor for the MDE Office of CTE, supported the RCU and teachers throughout the development of the framework and supporting materials.
Betsey Smith, the director of the RCU, supported RCU staff and teachers throughout the development of this framework and supporting materials.
Courtney McCubbins, the curriculum manager of the RCU, supported RCU staff and teachers throughout the development of this framework and supporting materials.
Rob Fyke, a project manager with the RCU, researched and co-authored this framework.

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

Adam Berry, Choctaw County Career and Technical Center, Ackerman
John Evans, Tishomingo Career and Technical Center, Tishomingo
Thomas Hall, Newton County Career and Technical Center, Newton
Jimmy Rushing, Louisville Career and Technology Center, Louisville
Matt Powell, Pontotoc Ridge Career and Technical Center, Pontotoc

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

Justin Hall, Instructor, Mississippi State University
David Little, Eastern Region Manager, Wade Incorporated
Tom Simmonds, Mississippi Regional Sales Manager, Thompson Machinery
Dudley Vance, CTE Director, Choctaw County Career and Technical Center

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 agriculture power and machinery 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 (NCAE) 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. A complete copy of the standards can be accessed at thecouncil.ffa.org/afnr. The national *AFNR Career Cluster Content Standards* are copyrighted to the NCAE and are used by permission.

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-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
Agriculture Power and Machinery (APM) is a pathway designed to provide basic skills for students to become employed in the industry of agricultural power mechanics or to continue their education in postsecondary institutions. Skills taught in this pathway relate to the selection, operation, service, maintenance, and repair of a variety of agricultural power units and agricultural machinery and equipment. This pathway also includes instruction in diesel engines, advanced cutting and welding skills, hydraulics, pneumatics, and other advanced equipment and power systems. Students in the pathway will participate in active learning exercises including integral activities of the FFA organization and supervised experiences.

Students who successfully complete the competencies in this pathway will possess fundamental knowledge and skills that can be used to secure entry-level employment or as a foundation for continuing their education. Industry standards are adapted from the publication *Career Cluster Resources for Agriculture, Food, and Natural Resources*, developed by the National Association of State Directors of Career and Technical Education.

College, Career, and Certifications
No national industry-recognized certifications are known to exist at this time in this field. Competencies and suggested performance indicators in the Agriculture Power and Machinery 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 from 9th through 11th grade depending on the school's choice of course option. 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 https://www.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 Agriculture Technology and Mechanical Systems (ATMS)—Course Code: 991302**
2. **Basic Equipment Systems, Maintenance and Repair—Course Code: 991303**
3. **APM: Diesel and Hydraulic Systems and Advanced Cutting—Course Code: 991304**
4. **APM: Advanced Equipment Systems, Maintenance, and Repair—Course Code: 991305**

Course Description: Introduction to Agriculture Technology and Mechanical Systems (ATMS)
This course focuses on introducing students to leadership and career preparation, supervised agricultural work experience, safety, measurements, and basic oxyfuel cutting skills. Students will leave the class with a firm foundation of knowledge in the areas of employability skills, safety, and basic tool knowledge. Additionally, students will learn about the FFA and supervised agricultural experiences (SAE).

Course Description: Basic Equipment Systems, Maintenance, and Repair
This course introduces students to basic welding, compact engines, and equipment and systems maintenance. Students will master skills related to the safe operation, maintenance, and repair of these systems.

Course Description: APM: Diesel and Hydraulic Systems and Advanced Cutting
This course is designed to further develop student skills in metal cutting and welding, as well as broaden student knowledge of hydraulic and pneumatic systems and the operation, maintenance, and repair of diesel engines. An emphasis on following workplace safety guidelines is incorporated throughout the course, and workforce development skills and career options are emphasized.

Course Description: **APM: Advanced Equipment Systems, Maintenance, and Repair**
This course will offer students the opportunity to examine electrical and electronic systems found on modern agricultural equipment. Additionally, students will learn skills related to agricultural power equipment maintenance and operation. Students will also explore advanced and emerging technologies in the agricultural power and machinery industry. Students will conclude a supervised agricultural experience (SAE) that will be recorded in an organized digital portfolio. The experience within this course will serve to transition the secondary student into a post-secondary institution or into the workforce directly.

Introduction to Agriculture Technology and Mechanical Systems (ATMS)—Course Code: 991302

Unit	Unit Title	Hours
1	Introduction to Leadership and Career Preparation	15
2	Safety	25
3	SAE for All	20
4	Measurement and Industry-Related Math Skills	30
5	Oxyfuel Cutting	50
Total		**140**

Basic Equipment Systems, Maintenance and Repair—Course Code: 991303

Unit	Unit Title	Hours
6	Shielded Metal Arc Welding (SWAW)	50
7	Compact Engine Inspection, Service, Repair	60
8	Equipment and Systems Maintenance	30
Total		**140**

APM: Diesel and Advanced Cutting—Course Code: 991304

Unit	Unit Title	Hours
9	Orientation, Safety, and Career Preparation	20
10	Advanced Cutting and Welding	60
11	Diesel Engines	60
Total		**140**

APM: Advanced Equipment Systems, Maintenance, and Repair—Course Code: 991305

Unit	Unit Title	Hours
12	Electrical Systems in Agricultural Mechanics	40
13	Agricultural Power Equipment Maintenance and Operation	50
14	Advanced Technology in Agricultural Mechanics	25
15	Immersion into FFA and Supervised Agriculture Experiences (SAE) for All	25
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. **Agriculture Technology and Mechanical Systems —Course Code: 991300**
2. **Agriculture Power and Machinery —Course Code: 991301**

Course Description: Agriculture Technology and Mechanical Systems (ATMS)
This course focuses on introducing students to leadership and career preparation, supervised agricultural work experience, safety, measurements, and basic oxyfuel skills. Students will leave the class with a firm foundation of knowledge in the areas of employability skills, safety, and basic tool knowledge. Students will learn about the National FFA Organization and Supervised Agricultural Experience (SAE). Additionally, this course will introduce students to basic welding, compact engines, equipment and systems maintenance. Students will master skills related to the safe operation, maintenance, and repair of these systems.

Course Description: Agriculture Power and Machinery (APM)
This course is designed to further develop student skills in metal work, and the operation, maintenance, and repair of diesel engines. An emphasis on following workplace safety guidelines is incorporated throughout the course, and workforce development skills and career options are highlighted. This course will also offer students the opportunity to examine electrical and electronic systems found on modern agricultural equipment and structures. Additionally, students will learn skills related to agricultural power equipment maintenance and operation. Students will also explore advanced and emerging technologies in the Agriculture Power and Machinery industry. Students will track a supervised agricultural experience throughout this course and record their experiences in a Mississippi approved digital platform.

Agriculture Technology and Mechanical Systems (ATMS)—Course Code: 991300

Unit	Unit Title	Hours
1	Introduction to Leadership and Career Preparation	10
2	Safety	20
3	SAE For All	10
4	Measurement and Industry-Related Math Skills	20
5	Oxyfuel Cutting	40
6	Shielded Metal Arc Welding (SMAW)	60
7	Compact Engine Inspection, Service, Repair	80
8	Equipment and Systems Maintenance	40
Total		**280**

Agriculture Power and Machinery —Course Code: 991301

Unit	Unit Title	Hours
9	Orientation, Safety, and Career Preparation	20
10	Advanced Cutting and Welding	60
11	Diesel Engines	60

12	Electrical Systems in Agricultural Mechanics	40
13	Agricultural Power Equipment Maintenance and Operation	50
14	Advanced Technology in Agricultural Mechanics	25
15	Immersion into FFA and Supervised Agriculture Experiences (SAE) for All	25
Total		**280**

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, during the five-year span (2020-2025) 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 in agriculture; 13% in sustainable food and biomaterials production; and 14% in education, communication, and government services. According to USDA, agriculture, food, and related industries contributed $1.109 trillion to the U.S. gross domestic product (GDP) in 2019. The Mississippi Department of Agriculture and Commerce reports that agriculture is Mississippi's number one industry at $7.35 billion and employing approximately 17.4% of the state's workforce.

Agriculture Power and Machinery 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 (2022). Employment opportunities for each of the occupations are listed below:

Table 1.1: Current and Projected Occupation Report

Description	Jobs, 2018	Projected Jobs, 2028	Change (Number)	Change (Percent)	Average Yearly Earnings, 2022
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
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

Source: Mississippi Department of Employment Security; mdes.ms.gov (2022).

Perkins V Requirements and Academic Infusion

The Agriculture Power and Machinery curriculum meets Perkins V requirements of introducing

students to and preparing them for high-skill, high-wage occupations to prepare them for the workforce. It also offers students a program of study, including secondary, postsecondary, and institutions of higher learning courses, that will further prepare them for Agriculture Power and Machinery 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 Agriculture Power and Machinery 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

As the third part of the school-based, agricultural-education model, the FFA component is the showcase of leadership, growth, and development for students. The FFA is the student organization for the APM curriculum. It offers many opportunities for student success, such as leadership development, career development events, degrees of attainment, awards and scholarships, and community service. The organization provides students with growth opportunities and competitive events. It also 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 Agriculture Power and Machinery 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 Agriculture Power and Machinery curriculum provides opportunities for students to work together and help each other complete complex tasks. Many field experiences within the Agriculture Power and Machinery curriculum will allow and encourage collaboration with professionals currently in the field.

Work-Based Learning

Work-based learning is an extension of understanding competencies taught in the Agriculture Power and Machinery classroom. The Agriculture Power and Machinery 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 Agriculture Power and Machinery 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

Agricultural Education Division of the Association for Career and Technical Education
acteonline.org

American Association for Agricultural Education
aaaeonline.org

Mississippi ACTE
mississippiacte.com

Mississippi Association of Vocational Agriculture Teachers (MAVAT)
mississippiffa.org

National Association of Agricultural Educators
naae.org
http://www.naae.org/
National Association of Supervisors of Agricultural Education
ffa.org/thecouncil/nasae

National FFA Alumni Association
ffa.org/getinvolved/alumni

National FFA Foundation, Inc.
ffa.org/support/foundation

National Farm and Ranch Business Management Education Association
nfrbmea.org

National Postsecondary Agricultural Student Organization
nationalpas.org

National Young Farmer Educational Association
nyfea.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 Agriculture Power and Machinery program is using a national certification, work-based learning, or another measure of accountability that aligns with Perkins V as a quality indicator, this material could very well be assessed on that quality indicator. It is the responsibility of the teacher to ensure all competencies for the selected quality indicator are covered throughout the year.

Unit 1: Introduction to Leadership and Career Preparation

Competencies and Suggested Objectives
1. Describe the Agriculture Power and Machinery (APM) industry. DOK1 a. Describe employment opportunities in the APM industry. b. Describe educational, training, and certification requirements for employment in the APM industry. c. Describe earning and working conditions in the APM industry. d. Practice filling out a job application
2. Explore the integral relationship between the National FFA organization and agricultural education. DOK2 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 (1935) • Public Law 740 (1950) • Merger of the FFA and the NFA (1965) • Female membership (1969) • Organizational name change (1988) b. Identify types of FFA membership. • Active • Honorary • FFA alumni and supporters 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
3. 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. 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
    - Stating a main motion
    - Voting on a motion
    - Understanding the use of the gavel
    - Distinguish between types of motions: main, subsidiary, incidental, and privileged.

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: Safety

Competencies and Suggested Objectives

1. Explain the general laboratory safety requirements for Agriculture Power and Machinery (APM). DOK1
   a. Describe personal safety rules for working in the laboratory and/or APM industry.
      - Eye safety law
      - Personal Protective Equipment (PPE)
      - Behavior in the shop/lab environment and liability
      - Maintaining shop/lab cleanliness and organization
   b. Describe general workplace safety rules per safety organizations standards.
      - Procedures for materials handling, including lifting heavy objects and storage
      - Procedures for shop equipment operation
      - Safe work requirements for elevated work, including fall-prevention guidelines
      - How to avoid struck-by hazards
      - How to identify common energy-related hazards and how to avoid these hazards.
      - Other specific job safety procedures (fires, environmental extremes, etc.)
   c. Identify standard industry safety color code scheme.
      - Red
      - Orange
      - Yellow
      - Green
      - Blue
      - White
      - Magenta and yellow or black and yellow
   d. Describe accident reporting procedures.
2. Investigate OSHA regulations and complete certification if applicable. DOK2
3. Identify hazardous materials that may be found in the laboratory or on a job site and describe procedures for handling/avoidance or removal of materials. DOK2
   a. Explain the purpose and use of Safety Data Sheets (SDS) sheets.
   b. Review an MSDS/SDS form to identify safe handling and disposal procedures for hazardous materials.
   c. Demonstrate procedures for posting and filing MSDS/SDS forms.
   d. Describe the approved storage procedures for flammable materials found in the APM laboratory.
   e. Describe approved procedures for disposal of hazardous materials.
   f. Demonstrate safe procedures for the use and storage of batteries.
4. Explain procedures for applying fire safety in the APM shop. DOK2
   a. Identify location of firefighting equipment.
   b. Identify classes of fires and associated equipment for each class.
   c. Identify exit locations in case of emergency.
5. Demonstrate the selection and use of hand tools in APM. DOK2

a. Identify basic hand tools, including metric and standard where applicable, used in APM.
    - Wrenches
    - Sockets and accessories
    - Screwdrivers
    - Pliers
    - Hammers
    - Punches
    - Chisels
b. Demonstrate the selection and use of hand tools in APM.

6. Demonstrate the proper use of portable power tools found in the APM laboratory. DOK3
    a. Identify types of portable power tools used in APM.
        - Grinders (portable angle or detail)
        - Drills or drivers (hammer, electric, etc.)
        - Saws (circular, reciprocating, portable band saw, and abrasive [miter/cutoff] saw)
        - Presses
        - Pneumatic tools (ratchets, nail gun, impact)
        - Pneumatic nail gun
        - Pavement breaker (pneumatic or air)
    b. Demonstrate safety procedures for use of portable power tools used in APM.
    c. Demonstrate the use of portable power tools used in the APM laboratory.

7. Demonstrate the proper use of stationary tools used in APM. DOK3
    a. Identify stationary tools used in the APM laboratory.
        - Band saws
        - Drill presses
        - Hydraulic shears
        - Pedestal or bench grinders
        - Abrasive cut-off saws
        - Hydraulic benders
    b. Describe the functions of stationary power tools used in APM.
    c. Describe safety rules of stationary power tools used in APM.
    d. Demonstrate use of each stationary power tool used in APM.
    e. Perform maintenance procedures on each stationary power tool used in APM.

8. Demonstrate the proper use of lifting, hoisting, and supporting equipment. DOK3
    a. Identify lifting, hoisting, and supporting equipment.
        - Jacks
        - Jack stands
        - Hoists
        - Floor cranes
        - Overhead cranes
        - Chains and slings
    b. Demonstrate safety rules for using lifting, hoisting, and supporting equipment.
    c. Demonstrate use of lifting, hoisting, and supporting equipment.

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: SAE For All

Competencies and Suggested Objectives

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:
      - Assist with career and personal choices.
      - Apply business practices, such as record keeping and money management.
      - Nurture individual talents and develop a cooperative attitude.
      - Build character and encourage citizenship and volunteerism.
      - Provide an environment for practical learning.
   c. Describe the types of programs under SAE For All:
      - Foundational SAE
        - Career exploration and planning
        - Employability skills for college and career readiness
        - Personal financial management and planning
        - Workplace safety
        - Agricultural literacy
      - Immersion SAE
        - Placement/Internship
        - Ownership/Entrepreneurship
        - Research
          - Experimental
          - Analytical
          - Invention
        - School-based Enterprise
        - Service Learning
   d. Explore the Mississippi Work-Based Learning (WBL) guide as a companion to Immersion SAE.
2. Launch a Foundational SAE plan. DOK3
   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 requirements of student, parents, supervisor, and/or employer.
3. Develop a record-keeping system for an individual student's SAE program. DOK3
   a. Determine types of records to keep:
      - Hours worked/spent on a project or experience

- Inventory of assets
- Expenses
- Income
- Skills attained during a project or experience
- Leadership record
- Community service record
- Journal of experiences
- Pictures

b. Maintain records using the state approved electronic/computer-based system of record keeping for the SAE program.

Refer to the updated and approved work-based learning requirements.

Unit 4: Measurement and Industry-Related STEM Skills

Competencies and Suggested Objectives
1. Identify types of measuring devices. DOK1 a. Identify types of measuring devices. • Tape measures • Rules and squares • Micrometers • Calipers • Dial indicators • Torque wrenches • Thickness gauges • Sliding T-bevel • Laser thermometer b. Demonstrate an ability to use the available measuring devices listed above.
2. Apply math skills related to the industry. DOK1 a. Describe standard and metric units for measuring distance, area, weight, temperature, and volume. b. Convert measurements from metric to standard units. • Decimals to fractions • Fractions to decimals c. Calculate the area of 2-D shapes. d. Calculate the volume of 3-D shapes.
3. Read and interpret technical plans for constructing a simple project (e.g., bird house, bench, toolbox, jewelry box, etc.). DOK3 a. Apply information from the plan to selecting project materials. • Construct the project based on the plan details.

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 5: Oxyfuel Cutting

Competencies and Suggested Objectives

1. Identify the major oxyfuel equipment and discuss the uses of each. DOK1
   a. Explore the major uses of oxyfuel equipment.
      - Cutting
      - Heating
      - Brazing/welding
2. Assemble and handle oxyfuel cutting equipment. DOK2
   a. Identify parts of the oxyfuel cutting equipment.
      - Regulators
      - Hoses
      - Fittings
      - Torch body
      - Tips
      - Accessories
      - Flashback arrestor
   b. Discuss safety procedures for set up of oxyfuel equipment.
   c. Assemble oxyfuel equipment, purge lines, and test for leaks.
   d. Demonstrate procedures for safe handling and storing of oxyfuel cylinders and equipment.
3. Operate oxyfuel equipment. DOK3
   a. Demonstrate safety procedures for operating oxyfuel equipment.
   b. Demonstrate procedures for lighting an oxyfuel torch and setting regulator pressures.
   c. Identify oxidizing, carburizing, and neutral flames.
   d. Demonstrate how to produce a neutral flame.
   e. Demonstrate procedures to make a cut in mild steel.
      - Straight cut
      - Bevel cut
      - Piercing cut
   f. Demonstrate how to adjust the cutting flame related to the appearance of drag lines on the metal.

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 6: Shielded Metal Arc Welding (SMAW)

Competencies and Suggested Objectives

1. Set up Shielded Metal Arc Welding (SMAW) equipment. DOK2
   a. Identify equipment and tools used in arc welding.
      - Safety glasses
      - Helmet
      - Leather gauntlet gloves
      - Skull caps
      - Wire brush
      - Chipping hammer
      - 100% cotton or wool long-sleeve shirts
      - Boots
      - Electrode
      - Electrode holder
      - Grounding clamp
   b. Describe safety procedures used in arc welding.
   c. Identify different electrodes and the meanings of the numbers in the electrode classification system.
   b. Identify the basic types of weld joints.
      - Butt
      - Fillet
   d. Identify the types of weld positions.
      - 1-4G
      - 1-4F
   e. Identify the parts of a weld, both groove, and fillet.
      - Toe
      - Face
      - Root
      - Throat
      - Leg

2. Demonstrate procedures for SMAW. DOK3
   a. Demonstrate safety procedures for arc welding.
   b. Demonstrate the process for initiating an arc weld (striking an arc).
   c. Demonstrate procedures to lay a stringer bead and develop a pad.
   d. Demonstrate procedures to construct a butt weld in the following positions.
      - Flat
      - Horizontal
      - Vertical
   e. Demonstrate procedures to construct a fillet weld in the following positions.
      - Flat
      - Horizontal
      - Vertical

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 7: Compact Engine Inspection, Service, Repair

Competencies and Suggested Objectives

1. Investigate the applications of small engines. DOK2
   a. Discuss the use of compact engines in the agriculture and outdoor recreation industry, including on all-terrain vehicle (ATVs) and utility terrain vehicle (UTVs).
   b. Discuss the use of compact engines in the marine industry.
   c. Discuss the use of compact engines in lawn, garden, and timber industry.
      - Mowers
      - String trimmer
      - Chainsaws
      - Tillers
      - Blowers
      - Limb saws
   d. Discuss the use of compact engines in the specialty recreation industry.
      - Go-karts
      - ATV/UTV
      - Pulling/competition tractors
      - Motorcycles
2. Describe the operation of the four-cycle engine. DOK2
   a. Identify the major components of a four-cycle engine.
   b. Describe the events occurring in each stroke of a four-cycle engine.
      - Intake
      - Compression
      - Power
      - Exhaust
3. Describe the operation of the two-cycle engine. DOK2
   a. Identify the components of a two-cycle engine.
   b. Describe the events occurring in each stroke of a two-cycle engine.
   c. Calculate ratios of oil and gasoline and mix fuel for a two-cycle engine.
4. Perform compact gasoline engine service. DOK4
   a. Describe the functions of engine oil.
   b. Describe the Society of Automotive Engineers viscosity rating system.
   c. Describe the American Petroleum Institute classifications.
   d. Select compact engine oil viscosity according to seasonal temperature.
   e. Identify the components of the lubrication system on a compact engine.
   f. Identify the cooling system components of an air-cooled and liquid-cooled engine.
   g. Identify the components of a gasoline fuel system on a compact engine.
   h. Identify the types of carburetors and fuel systems on a compact engine.
   i. Identify the types of air filters on compact engines.
   j. Identify the types of governor systems used on compact engines.
   k. Perform preventative maintenance on compact engines.
   l. Identify the model, serial, type, and code numbers found on compact engines.
   m. Describe the uses of the various codes and numbers found on compact engines.

5. Read and interpret an operator's manual to determine daily maintenance on compact gasoline engines. DOK2
   a. Select correct manuals to determine daily maintenance required on equipment.
   b. Obtain manufacturer's specifications for daily maintenance requirements on equipment.

6. Describe the basic operation and service of electrical systems. DOK3
   a. Understand the basic concept of Ohm's Law.
   b. Define common terms used in the electrical system.
      - DC
      - Volts
      - Amps
      - Ohms
   c. Identify the common sources of electricity.
      - Battery
      - Alternator
   d. Identify the parts of a basic circuit.
      - Power source
      - Fuse link/breaker
      - Toggle
      - Conductor
      - Lights/electric motor
   e. Identify the instruments used in checking electrical circuits.
   f. Measure voltage, amperage, and resistance of the electrical circuits.
   g. Service the ignition circuit on a compact gas engine.

7. Examine typical fasteners. DOK2
   a. Identify common fasteners.
      - Screws
      - Bolts
      - Nuts
      - Washers
      - Keys
      - Snap rings
      - Pins
      - Studs
   b. Identify bolt types.
      - Hex head bolt
      - Torx head bolt
      - Recessed Allen bolt
      - Inverted torx bolt
   c. Classify bolts according to metric or standard grades.
   d. Understand thread measuring terms.
      - Pitch
      - Thread
   e. Measure bolt and nut length, diameter, and thread type using a screw pitch gauge.

f. Discuss tools and procedures for extracting broken bolts and restoring internal and external threads. g. Identify tools and equipment used to create internal and external threads. h. Create internal and external threads using specified tools.
8. Disassemble, inspect, and reassemble a compact gasoline engine. DOK4 a. Disassemble, clean, and inspect the parts of a compact engine for wear or damage. b. Assemble a compact engine to manufacturer's specifications. c. Conduct a performance test and adjust a compact engine.

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 8: Equipment and Systems Maintenance

Competencies and Suggested Objectives
1. Read and interpret an operator's manual to determine daily maintenance on equipment. DOK2 a. Select correct manuals to determine daily maintenance required on equipment. b. Obtain manufacturer's specifications for daily maintenance requirements on equipment.
2. Perform daily maintenance on tractors and equipment. DOK4 a. Check tires for air pressure. b. Check fluid levels (engine oil, coolant, and hydraulic system). c. Lubricate the chassis and steering linkage. d. Inspect brakes for correct adjustment. e. Check safety equipment and gauges.
3. Identify the different types of equipment used in agricultural operations and describe their operation and key maintenance procedures. DOK1 a. Identify types of planting and tillage equipment and describe their operation and key maintenance procedures. b. Identify types of lawn turf equipment and describe their operation and key maintenance procedures. c. Identify types of harvesting equipment and describe their operation and key maintenance procedures. d. Identify types of forage equipment and describe their operation and key maintenance procedures. e. Identify types of irrigation equipment and describe their operation and key maintenance procedures. f. Identify types of poultry equipment and describe their operation and key maintenance procedures. g. Identify types of forestry equipment and describe their operation and key maintenance procedures.
4. Explore emerging technology related to diagnostic equipment (e.g., code reader, air conditioning gauges, hydraulic pressure, etc.). DOK2

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 9: Orientation, Safety, and Career Preparation

Competencies and Suggested Objectives
1. Review the general laboratory safety requirements for APM. DOK1 a. Review the personal safety rules for working in the laboratory and/or APM industry, including the eye safety law. b. Review general workplace safety rules and/or other safety organizations standards. c. Review accident reporting procedures. d. Review procedures for applying fire safety in the agricultural mechanic's shop. e. Review the location of firefighting equipment. f. Review the classes of fires and the associated equipment for each class. g. Review exit locations in case of emergency.
2. Investigate and develop the skills necessary for pursuing a career in the APM industry. DOK3 a. Compare the careers available in the APM industry. b. Build a personal resume and cover letter to apply for jobs. c. Perform a mock interview utilizing a personal resume.
3. Develop an understanding of personal financial management. DOK3 a. Explain how wages, salaries, and benefits (retirement, insurance, etc.) work when employed. b. Describe the differences in wages and salary payment options (monthly, weekly, bi-weekly, overtime, salary vs. hourly wage, flat rate, etc.). c. Describe how to open and maintain personal financial bank accounts. d. Describe employment benefits (insurance, vacation/personal/medical leave, retirement, etc.). e. Calculate the amount of income and other taxes that are to be deducted from your paycheck. f. Understand the cost of living associated with where you work and live. g. Develop an individual cost of living budget.
4. Develop and present a 3-to-5-minute multimedia presentation on an APM-related career. DOK3 a. Discuss the guidelines for preparing a successful presentation, including preparation, resource development, writing, and presentation skills.

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 10: Advanced Cutting and Welding

Competencies and Suggested Objectives

1. Demonstrate procedures for Shielded Metal Arc Welding (SMAW) with E7018 electrodes. DOK3
   a. Demonstrate safety procedures for arc welding.
   b. Demonstrate procedures to lay a stringer bead and develop a pad.
   c. Demonstrate procedures to construct a butt weld in the following positions.
      - Flat
      - Horizontal
      - Vertical
   d. Demonstrate procedures to construct a fillet weld in the following positions.
      - Flat
      - Horizontal
      - Vertical
2. Perform Gas Metal Arc Welding (GMAW). DOK2
   a. Demonstrate the safety procedures for GMAW.
   b. Identify and describe the use of different supplies and accessories associated with GMAW.
   c. Discuss the welding equipment setup associated with metal thicknesses and types.
   d. Set up GMAW welding equipment.
   e. Weld mild steel with GMAW welding equipment in the flat, vertical, and horizontal.
3. Explore Gas Tungsten Arc Welding (GTAW). DOK2
   a. Demonstrate the safety procedures for GTAW welding.
   b. Identify the accessories and supplies used in GTAW welding and describe their use.
   c. Discuss the welding equipment setup associated with metal thicknesses and types.
4. Perform Plasma Arc Cutting (PAC). DOK2
   a. Demonstrate the safety procedures for PAC.
   b. Discuss the plasma arc cutting process.
   c. Discuss the components of a plasma arc cutter.
   d. Set up PAC equipment.
   e. Cut mild steel with PAC equipment.
   f. Discuss the use of computer-controlled machinery in metal fabrication.
   g. Design and construct a metal project with computer
5. Fabricate metal components from a blueprint. DOK4
   a. Interpret the basic elements of a blueprint.
   b. Interpret welding symbol information.
   c. Apply the design of a blueprint to the construction of a metal project using a variety of fittings and welding skills that can be used in a local or regional industrial manufacturing facility.
6. Discuss alternative types of welding. DOK3
   a. Investigate the following welding processes:
      - Plastic
      - Resistance

- Robotics

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 11: Diesel Engines

Competencies and Suggested Objectives
1. Describe the basic operating principles of diesel engines. DOK1 a. Identify the differences between a diesel engine and a gasoline engine. b. Describe the sequence of events in each stroke of a four-cycle diesel engine.
2. Describe the components of the diesel engine. DOK1 a. Identify the components of the basic engine block assembly. • Engine block • Cylinder head • Pistons • Connecting rods • Crankshaft and bearings • Camshaft and bearings • Cylinder liners • Turbocharger b. Explain the functions of each component of the diesel engine.
3. Describe the components of the lubrication system. DOK1 a. Identify the components of the lubrication system. • Oil pump • Oil cooler • Filter • Relief valve b. Describe the functions of each component of the lubrication system.
4. Describe the components of the cooling system. DOK1 a. Identify the components of the cooling system. • Radiator • Thermostat • Water pump • Radiator cap • Radiator hoses • Belts and pulleys • Coolant and shroud • Mechanical fan clutch b. Describe the functions of each component of the cooling system.
5. Describe the components of the fuel system. DOK1 a. Identify the components of the fuel system. • Reservoir • Transfer pump • Injector pump • Injectors • Filter • Valves

- Lines and hoses
- Fuel

b. Describe the functions of each component of the fuel system.

6. Describe the components of the intake and exhaust system. DOK2
   a. Label the components of the intake and exhaust system.
      - DPF (diesel particulate filter)
      - DEF (diesel exhaust fluid)
      - EGR valve (exhaust gas recirculation)
   b. Describe the functions of the intake and exhaust system.
7. Perform basic maintenance and troubleshoot problems regarding the operation of a diesel engine. DOK2
   a. Set up a preventative maintenance plan for diesel engine-operated equipment or machinery.
   b. Perform primary engine checks on diesel equipment or machinery.
   c. Perform basic diesel engine preventative maintenance.
   d. Outline the general procedure for troubleshooting diesel engines.
   e. Use troubleshooting charts and engine service information to pinpoint the source of problems in a diesel engine.
   f. Use emerging tools and technology to troubleshoot problems regarding diesel engines according to the accessibility of electronic tools.
8. Discuss emerging tools and technology to troubleshoot problems regarding diesel engine systems. DOK3
   a. Explore and perform maintenance troubleshooting problems using emerging technology tools on diesel engine systems according to the accessibility of electronic tools.
      - Electronic diagnostic tools. (On Board Diagnostic tools)

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 12: Electrical Systems in Agricultural Mechanics

Competencies and Suggested Objectives

1. Explain the functions of the components of the cranking and charging systems. DOK1
   a. Describe the function of the cranking system.
      - Starter
      - Solenoid
      - Relay
      - Battery
   b. Describe the function of the charging system.

2. Demonstrate the troubleshooting and repair procedures for the Direct Current (DC) electrical system. DOK2
   a. Demonstrate the ability to use a digital multimeter to troubleshoot amps, ohms, and volts.
   b. Use service sources to check manufacturers' specifications on the electrical systems.
   c. Identify and interpret DC electrical components.
      - Open/close switch
      - Fuse
      - Fuse link
      - Conductor
      - Power source
      - Relay
      - Solenoid
      - Light bulb
      - Electric motor
   d. Make wire and terminal repairs using the soldering method and/or wire connectors.

3. Investigate the electronics systems used on tractors, implements, stationary systems, and recreational vehicles. DOK2
   a. Discuss the use of electronic sensors on tractors and implements.
   b. Research emerging technology for or in electronics and electrical systems in the Agriculture Power and Machinery industry.

4. Explore the basic principles of alternating current (AC) electrical systems. DOK3
   a. Discuss the following components and tools in an AC electrical system:
      - Breakers
      - Wire types
      - Receptacles
      - Connectors
      - Junction boxes
      - Electrical testers
      - Wire strippers
      - Lineman's pliers
      - Screwdriver

b. Perform AC wiring techniques.
    - Single- pole switch and light
    - Receptacle
    - Three-way switch and light
    - Single-pole switch, light, and receptacle

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 13: Agricultural Power Equipment Maintenance and Operation

Competencies and Suggested Objectives
1. Review the basic concepts of how power is generated and transferred using agricultural equipment. DOK2 a. Describe the terms of power, including work, force, and torque. b. Explain the differences in PTO, drawbar, and brake horsepower. c. Identify the diverse types and uses of clutches (centrifugal, mechanical, and hydraulic). d. Identify the parts associated with differential and axle systems.
2. Review manufacturers' manuals for periodic maintenance of agricultural power equipment. DOK3 a. Read and interpret manufacturers' manuals to obtain specifications for periodic maintenance. b. Perform periodic maintenance according to manufacturers' specifications.
3. Review manufacturers' manuals for seasonal maintenance of agricultural power equipment. DOK3 a. Read and interpret manufacturers' manuals to obtain specifications for seasonal maintenance. b. Perform seasonal maintenance according to manufacturers' specifications.
4. Review the operator's manuals to determine the procedures for the safe operation of agricultural power equipment. DOK3 a. Identify equipment controls and describe their functions. b. Identify instruments and indicators and describe their functions. c. Identify safety equipment, including safety switches, rollover protection, and seat belts. d. Apply safety rules when operating agricultural power equipment.
5. Operate agricultural power equipment safely. DOK3 a. Conduct an inspection before operation. b. Operate the tractor safely, including starting, warm-up, clutch engagement, and brake controls. c. Attach, set up, and adjust an implement on a tractor. d. Demonstrate operation under field conditions.
6. Apply troubleshooting methods for resolving mechanical issues with agricultural equipment. DOK3 a. Explain the meaning and importance of troubleshooting. b. Describe the processes and tools used in agricultural equipment troubleshooting. c. Use computer-aided diagnostic equipment to troubleshoot agricultural power equipment. d. Apply troubleshooting procedures to solve a problem on agricultural power equipment.
7. Identify the types of hydraulic pumps. DOK1 a. Identify a constant displacement pump. b. Identify a variable displacement pump.
8. Identify and describe the functions of hydraulic and pneumatic control valves. DOK2 a. Describe the types of hydraulic and pneumatic valves.

- Spool valve
- Check valve
- Relief valve

b. Explain the functions of hydraulic and pneumatic valves.

9. Explain the functions of hydraulic and pneumatic systems. DOK2
   a. Describe the function of an open-center hydraulic and pneumatic system.
   b. Describe the function of a closed-center hydraulic and pneumatic system.
   c. Read and interpret basic hydraulic and pneumatic schematics symbols.
      - Pump
      - Valve (relief and spool)
      - Reservoir
      - Motor
      - Filter
      - Actuator (cylinder)
10. Demonstrate the maintenance of hydraulic and pneumatic systems per the manufacturer's specifications. DOK3
    a. Check the fluid levels and condition.
    b. Service the filter system.
    c. Change hydraulic fluids.
    d. Inspect the system for external leaks and correct where necessary.

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 14: Advanced Technology in Agriculture

Competencies and Suggested Objectives

1. Research how advanced technology is being utilized in agriculture. DOK3
   a. Discuss areas of modern technology applications in APM.
   b. Observe applications of modern technology in the APM industry.
   c. Conduct investigations to observe and record applications of advanced technology in agriculture.
      - Remanufacturing equipment
      - 3-D metal fabrication
      - Development of electrical sensors and applications for APM
   d. The use of robotics in manufacturing APM
2. Discuss the concepts and operating principles of precision agriculture technology. DOK2
   a. Identify and describe the components of a precision agriculture technology system.
   b. Describe global positioning systems (GPS) in precision agriculture.
   c. Describe the use of spatial imagery in precision agriculture.
   d. Describe the use of geographic information system (GIS) software in precision agriculture.
   e. Describe the use of artificial intelligence (AI) in precision agriculture.
   f. Describe the use of variable-rate application in precision agriculture.
   g. Describe the use of yield monitoring in precision agriculture.
3. Investigate the transition from diesel/gas-powered equipment to electrically powered equipment. DOK2
   a. Compare the pros and cons between diesel/gas-powered equipment and alternatively powered equipment.
      - Electric
      - Propane
      - Natural Gas

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 15: 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)
        - Tractor operation
        - Agricultural Mechanics
        - Welding
      - Leadership retreats or conferences
      - Industry-related seminars, workshops, or conferences
      - Other related FFA activities
2. Apply concepts learned from the school-based agricultural education 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 records utilizing an electronic/computer-based 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
   c. Complete degree and proficiency award applications as they apply to the SAE.

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.

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 Leadership and Career Preparation		
	1.	Describe the Agriculture Power and Machinery (APM) industry.
	2.	Explore the integral relationship between the National FFA organization and agricultural education.
	3.	Explore the role of the FFA in promoting leadership, personal growth, and career success through 21st Century Skills Standards.
Unit 2: Safety		
	1.	Explain the general laboratory safety requirements for Agriculture Power and Machinery (APM).
	2.	Investigate OSHA regulations and complete certification if applicable.
	3.	Identify hazardous materials that may be found in the laboratory or on a job site and describe procedures for handling/avoidance or removal of materials.
	4.	Explain procedures for applying fire safety in the APM shop.
	5.	Demonstrate the selection and use of hand tools in APM.
	6.	Demonstrate the proper use of portable power tools found in the APM laboratory.
	7.	Demonstrate the proper use of stationary tools used in APM.
	8.	Demonstrate the proper use of lifting, hoisting, and supporting equipment.
Unit 3: 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 4: Measurement and Industry-Related STEM Skills		
	1.	Identify types of measuring devices.
	2.	Apply math skills related to the industry.
	3.	Read and interpret technical plans for constructing a simple project (e.g., bird house, bench, toolbox, jewelry box, etc.).
Unit 5: Oxyfuel Cutting		

	1.	Identify the major oxyfuel equipment and discuss the uses of each.
	2.	Assemble and handle oxyfuel cutting equipment.
	3.	Operate oxyfuel equipment.
Unit 6: Shielded Metal Arc Welding (SMAW)		
	1.	Set up Shielded Metal Arc Welding (SMAW) equipment.
	2.	Demonstrate procedures for SMAW.
Unit 7: Compact Engine Inspection, Service, Repair		
	1.	Investigate the applications of small engines.
	2.	Describe the operation of the four-cycle engine.
	3.	Describe the operation of the two-cycle engine.
	4.	Perform compact gasoline engine service.
	5.	Read and interpret an operator's manual to determine daily maintenance on compact gasoline engines.
	6.	Describe the basic operation and service of electrical systems.
	7.	Examine typical fasteners.
	8.	Disassemble, inspect, and reassemble a compact gasoline engine.
Unit 8: Equipment and Systems Maintenance		
	1.	Read and interpret an operator's manual to determine daily maintenance on equipment.
	2.	Perform daily maintenance on tractors and equipment.
	3.	Identify the different types of equipment used in agricultural operations and describe their operation and key maintenance procedures.
	4.	Explore emerging technology related to diagnostic equipment (e.g., code reader, air conditioning gauges, hydraulic pressure, etc.).
Unit 9: Orientation, Safety, and Career Preparation		
	1.	Review the general laboratory safety requirements for APM.
	2.	Investigate and develop the skills necessary for pursuing a career in the APM industry.
	3.	Develop an understanding of personal financial management.
	4.	Develop and present a 3-to-5-minute multimedia presentation on an APM related career.
Unit 10: Advanced Cutting and Welding		
	1.	Demonstrate procedures for Shielded Metal Arc Welding (SMAW) with E7018 electrodes.
	2.	Perform Gas Metal Arc Welding (GMAW).
	3.	Explore Gas Tungsten Arc Welding (GTAW).
	4.	Perform Plasma Arc Cutting (PAC).
	5.	Fabricate metal components from a blueprint.

	6.	Discuss alternative types of welding.
Unit 11: Diesel Engines		
	1.	Describe the basic operating principles of diesel engines.
	2.	Describe the components of the diesel engine.
	3.	Describe the components of the lubrication system.
	4.	Describe the components of the cooling system.
	5.	Describe the components of the fuel system.
	6.	Describe the components of the intake and exhaust system.
	7.	Perform basic maintenance and troubleshoot problems regarding the operation of a diesel engine.
	8.	Discuss emerging tools and technology to troubleshoot problems regarding diesel engine systems. according to accessibility of electronic tools.
Unit 12: Electrical Systems in Agricultural Mechanics		
	1.	Explain the functions of the components of the cranking and charging systems.
	2.	Demonstrate the troubleshooting and repair procedures for the Direct Current (DC) electrical system.
	3.	Investigate the electronics systems used on tractors, implements, stationary systems, and recreational vehicles.
	4.	Explore the basic principles of alternating current (AC) electrical systems.
Unit 13: Agricultural Power Equipment Maintenance and Operation		
	1.	Review the basic concepts of how power is generated and transferred using agricultural equipment.
	2.	Review manufacturers' manuals for periodic maintenance of agricultural power equipment.
	3.	Review manufacturers' manuals for seasonal maintenance of agricultural power equipment.
	4.	Review the operator's manuals to determine the procedures for the safe operation of agricultural power equipment.
	5.	Operate agricultural power equipment safely.
	6.	Apply troubleshooting methods for resolving mechanical issues with agricultural equipment.
	7.	Identify the types of hydraulic pumps.
	8.	Identify and describe the functions of hydraulic and pneumatic control valves.
	9.	Explain the functions of hydraulic and pneumatic systems.
	10.	Demonstrate the maintenance of hydraulic and pneumatic systems per the manufacturer's specifications.
Unit 14: Advanced Technology in Agricultural Mechanics		
	1.	Research how advanced technology is being utilized in agriculture.
	2.	Discuss the concepts and operating principles of precision agriculture technology.

	3.	Investigate the transition from diesel/gas-powered equipment to electrically powered equipment.
Unit 15: 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 school-based agricultural education program to continue the progression of immersion SAEs.

Appendix A: Industry Standards

	Units	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
AFNR Standards																
ABS- Agribusiness Systems		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AS- Animal Systems				X									X			X
BS- Biotechnology		X	X	X	X		X	X	X	X	X	X	X		X	X
CRP- Career Ready Practices		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CS- AFNR Cluster Skill		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ES- Environmental Service Systems		X	X	X		X	X	X	X	X		X	X	X	X	X
FPP- Food Products and Processing Systems			X	X				X			X				X	X
NRS- Natural Resource Systems				X		X		X			X	X				X
PS- Plant Systems				X	X	X	X					X	X			
PST- Power, Structural, and Technical Systems		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

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

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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.