2022 Diversified Agriculture Food Science

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The Research and Curriculum Unit (RCU), located in Starkville, as part of Mississippi State University (MSU), was established to foster educational enhancements and innovations. In keeping with the land-grant mission of MSU, the RCU is dedicated to improving the quality of life for Mississippians. The RCU enhances intellectual and professional development of Mississippi students and educators while applying knowledge and educational research to the lives of the people of the state. The RCU works within the contexts of curriculum development and revision, research, assessment, professional development, and industrial training.

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Acknowledgments

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Standards

Standards and alignment crosswalks are referenced in the appendices. Depending on the curriculum, these crosswalks should identify alignment to the standards mentioned below, as well as possible related academic topics as required in the Subject Area Testing Program in Algebra I, Biology I, English II, and U.S. History from 1877, which could be integrated into the content of the units. Mississippi's CTE food science curriculum is aligned to the following standards:

National Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards
The National AFNR Career Cluster Content Standards were developed by the National Council on Agricultural Education to serve as a guide for what students should know or be able to do through a study of agriculture in Grades 9-12 and two-year postsecondary programs. The standards were extensively researched and reviewed by leaders in the agricultural industry, secondary and postsecondary instructors, and university specialists. The standards consist of a pathway content standard for each of the eight career pathways. For each content standard, performance elements representing major topic areas with accompanying performance indicators were developed. Measurements of assessment of the performance elements and performance indicators were developed at the basic, intermediate, and advanced levels. 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 National Council for Agricultural Education 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. 21 *Framework Definitions* (2019).
battelleforkids.org/networks/p21/frameworks-resources

Preface

Secondary CTE programs in Mississippi face many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing applied learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments. This document provides information, tools, and solutions that will aid students, teachers, and schools in creating and implementing applied, interactive, and innovative lessons. Through best practices, alignment with national standards and certifications, community partnerships, and a hands-on, student-centered concept, educators will be able to truly engage students in meaningful and collaborative learning opportunities.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, *Mississippi Code of 1972*, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, Ch. 487, §14; Laws, 1991, Ch. 423, §1; Laws, 1992, Ch. 519, §4 eff. from and after July 1, 1992; Strengthening Career and Technical Education for the 21st Century Act, 2019 [Perkins V]; and Every Student Succeeds Act, 2015).

Mississippi Teacher Professional Resources

The following are resources for Mississippi teachers:

Curriculum, Assessment, Professional Learning
: Program resources can be found at the RCU's website, rcu.msstate.edu.

Learning Management System: An Online Resource
: Learning management system information can be found at the RCU's website, under Professional Learning.

Should you need additional instructions, call the RCU at 662.325.2510.

Executive Summary

Pathway Description
Food science is a one-credit course within the diversified agriculture pathway. All students must complete principles of agriscience before being allowed to enroll in food science. Content in the course includes competencies in food chemistry, composition and analysis, the science of food processing, sensory evaluation, and product development. Upon completion of this course, students will have learned the basic roles and functions of a career in food science and will have gained basic skills required of an entry-level worker in food processing facility.

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

Grade Level and Class Size Recommendations
It is recommended that students enter this program as 10th-12th graders. Exceptions to this are a district-level decision based on class size, enrollment numbers, student maturity, and CTE delivery method. This is a hands-on, lab- or shop-based course. Therefore, a maximum of 15 students is recommended per class with only one class with the teacher at a time.

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

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

or

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

or

1. Instructor approval

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

Applied Academic Credit
The latest academic credit information can be found at mdek12.org/ese/approved-course-for-the-secondary-schools.

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

Professional Learning
If you have specific questions about the content of any of the training sessions provided, please contact the RCU at 662.325.2510.

Course Outlines

One 1-Carnegie Unit Course

This curriculum consists of one 1-credit course.

Food Science—Course Code: Insert number here

Unit	Title	Hours
1	Introduction to Food Science	10
2	Safety and Sanitation in Food Science	10
3	Food Chemistry	20
4	Food Composition and Analysis	10
5	Food Microbiology	10
6	The Science of Food Processing	25
7	Sensory Evaluation of Food Products	10
8	Product Development	20
9	Careers and Professionalism in Food Science	5
10	Current Issues and Trends in Food Science	10
11	Immersion Into FFA and Supervised Agricultural Experience (SAE) for All	10
Total		140

Career Pathway Outlook

Overview

The agricultural sciences career cluster covers the broad field of occupations related to the production and use of plants and animals for food, fiber, aesthetic, and environmental purposes. According to the U.S. Department of Agriculture, during the next five years (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.

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

Needs of the Future Workforce

Data for this synopsis were compiled from the Mississippi Department of Employment Security (2018). Employment opportunities for each of the occupations are listed below:

Table 1.1: Current and Projected Occupation Report

Description	Jobs, 2016	Projected Jobs, 2026	Change (Number)	Change (Percent)	Average Yearly Earnings, 2021
Agricultural and Food Science Technicians	240	260	20	8.3%	$41,110
Food Service Managers	3,040	3,420	380	12.5%	$53,050
Food Scientists and Technologists	30	30	0	0%	$66,860
Food Preparation, Serving Occupations	103,790	114,450	10,660	10.3%	$21,780
Agricultural Inspectors	350	360	10	2.9%	$42,470
Butchers and Meat Cutters	1,220	1,250	30	2.5%	$27,920
Meat, Poultry, and Fish Cutters and Trimmers	6,650	6,730	80	1.2%	$29,880
Slaughterers and Meat Packers	2,560	2,610	50	2.0%	$28,150
Food Processing Workers	950	960	10	1.1%	$28,620

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

Perkins V Requirements and Academic Infusion
The food science curriculum meets Perkins V requirements of introducing students to and preparing them for high-skill, high-wage occupations in agricultural fields. It also offers students a program of study, including secondary, postsecondary, and institutions of higher learning courses, that will further prepare them for careers in the agriculture industry. 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 food science educator's goal should be to include teaching strategies that incorporate current technology. To make use of the latest online communication tools—wikis, blogs, podcasts, and social media platforms, for example—the classroom teacher is encouraged to use a learning management system that introduces students to education in an online environment and places more of the responsibility of learning on the student.

Differentiated Instruction

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

CTE Student Organizations

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

Cooperative Learning

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

Work-Based Learning

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

Professional Organizations

American Association for Agricultural Education (AAAE)
aaaeonline.org

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

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

Mississippi ACTE (MS ACTE)
mississippiacte.com

National Association of Agricultural Educators (NAAE)
naae.org

National FFA Organization
ffa.org

Using This Document

Competencies and Suggested Objectives
A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students are 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. Teachers are welcome to teach the competencies in other ways than the listed objectives if it allows for mastery of the competencies. Teachers are also allowed to teach the units and competencies in the order that they prefer, as long as they teach necessary material allotted for that specific course or credit they are teaching at the time.

Teacher Resources
Teacher resources for this curriculum may be found in multiple places. Many program areas have teacher resource documents that accompany the curriculum and can be downloaded from the same site as the curriculum. The teacher resource document contains references, lesson ideas, websites, teaching and assessment strategies, scenarios, skills to master, and other resources divided by unit. This document could be updated periodically by RCU staff. Please check the entire document, including the entries for each unit, regularly for new information. If you have something you would like to add or have a question about the document, call or email the RCU's instructional design specialist for your program. The teacher resource document can be downloaded at rcu.msstate.edu/curriculum/curriculumdownload.aspx. All teachers should request to be added to the Canvas Resource Guide for their course. This is where all resources will be housed in the future, if they are not already. To be added to the guide, send a Help Desk ticket to the RCU by emailing helpdesk@rcu.msstate.edu.

Perkins V Quality Indicators and Enrichment Material
Some of the units may include an enrichment section at the end. If the diversified agriculture food science program is currently using the Mississippi Career Planning and Assessment System (MS-CPAS) as a measure of accountability, the enrichment section of material will not be tested. If this is the case, it is suggested to use the enrichment material when needed or desired by the teacher and if time allows in the class. This material will greatly enhance the learning experiences for students. If, however, the diversified agriculture food science program is using a national certification, work-based learning, or other measure of accountability that aligns with Perkins V as a quality indicator, this material could very well be tested on that quality indicator. It is the responsibility of the teacher to ensure all competencies for the selected quality indicator are covered throughout the year.

Unit 1: Introduction to Food Science

Competencies and Suggested Objectives

1. Identify terms associated with food science. DOK 1
   a. Define terms associated with food science.
      - Food science
      - Food processing
      - Nutrition

2. Investigate the various dimensions of the food science industry. DOK 2
   a. Compare the various disciplines associated with food science.
      - Food microbiology
      - Food chemistry
      - Food preservation and processing
      - Food packaging
      - Product development
      - Sensory evaluation
      - Food and nutrition
   b. Describe the different categories of the food industry.
      - Cereals
      - Baked goods and confections
      - Meats, fish, and poultry
      - Snack products
      - Dairy products
      - Fruits and vegetables
      - Fats and oils
      - Beverages (i.e., alcoholic and non-alcoholic)
   c. Describe the different platforms associated with the food industry (i.e., product development).
      - Frozen
      - Refrigerated
      - Shelf stable
      - Convenience
      - Ready-to-eat (RTE)
      - Heat and serve
   d. Describe the four major areas of the food industry.
      - Production
      - Processing
      - Distribution
      - Market
        - Wholesale
        - Retail
        - Food service
        - Convenience store

3. Explain the history of food science, food products, and food processing. DOK 2
    a. Describe the development of the food industry.
    b. Examine the technological developments that made the current food science industry possible.
        - Refrigeration
        - Pasteurization
        - Canning
        - Fermentation
        - Freezing

4. Identify governmental regulatory agencies involved in food science. DOK 1
    a. List governmental agencies that oversee food production.
        - United States Department of Agriculture (USDA)
        - USDA Food Safety and Inspection Service (USDA-FSIS)
        - Food and Drug Administration (FDA)
        - National Oceanic and Atmospheric Administration (NOAA)
        - Occupational Safety and Health Administration (OSHA)
        - Environmental Protection Agency (EPA)
        - Food and Agriculture Organization (FAO)
        - World Health Organization (WHO)
        - National Center for Food Protection and Defense (NCFPD)
        - Local and state government agencies
            - Mississippi State Department of Health (MSDH)
            - Mississippi Department of Agriculture and Commerce (MDAC)

5. Demonstrate proper laboratory methods and techniques. DOK 2
    a. Review the scientific method.
    b. Demonstrate the aseptic technique in the handling of microorganisms.
    c. Identify the parts of a laboratory report.
        - Name/lab title/date
        - Introduction
        - Materials and methods
        - Results and discussion
        - Summary and application
    d. Write a formal laboratory report as it applies to a scientific experiment.

6. Demonstrate the correct way to use a microscope in the food science lab. DOK 2
    a. Review proper care, use, and handling of a microscope.
    b. Prepare slides for examination with a microscope.

Unit 2: Safety and Sanitation in Food Science

Competencies and Suggested Objectives

1. Explain the importance of safety and sanitation in food production. DOK 2
   a. Differentiate why some microorganisms are beneficial while others contribute to foodborne illness.
      - Spoilage microorganisms
      - Pathogenic microorganisms
      - Beneficial microorganisms (e.g., yogurt, cheese, wine, etc.)
   b. Discuss methods of preventing cross-contamination.
   c. Examine the importance of controlling time and temperature.
   d. Discuss preparation processes.
      - Handling
      - Thawing
      - Preparing
      - Cooking
      - Cooling
      - Reheating food
2. Investigate legislation that impacted food science development. DOK 2
   a. Trace the development of federal legislation regarding food law.
      - 1883—Dr. Harvey Wiley, the father of the FDA
      - 1906—The Meat Inspection Act influenced by *The Jungle*
      - 1906—Food Drug and Cosmetics Act
      - 1958—Food Additives Amendment
      - 1966—Fair Packaging and Labeling Act
      - 1982—Anti-Tampering Act
      - 1990—Nutritional Labeling and Education Act
      - 2004—Food Allergy Labeling and Consumer Protection Act
      - 2011—Food Safety Modernization Act
3. Discuss federal regulations regarding the safe management of the food supply. DOK 2
   a. Describe the purpose of the Code of Federal Regulations as it applies to food production.
   b. Identify the titles within the Code of Federal Regulations that are specific to agriculture food production.
      - Title 7—Agriculture
      - Title 9—Animals and Animal Products
      - Title 21—Food and Drugs
      - Title 27—Alcohol, Tobacco Products, and Firearms
   c. Describe programs that address food safety.
      - Hazard Analysis and Critical Control Point (HACCP)
      - Good Manufacturing Practices (GMP)
      - Standard Operating Procedures (SOP)
      - Sanitation Standard Operating Procedures (SSOP)
      - Food Safety Modernization Act (FSMA)

- Hazard Analysis and Risk-based Preventive Controls (HARPC)

4. Investigate issues related to food safety. DOK 2
   a. Describe the difference between food safety and food quality.
   b. Identify the types of food hazards and list examples of each.
      - Physical—metal, wood, plastic pieces, hair, insects
      - Chemical—pesticides, soaps, cleaning solutions, allergens
      - Biological—feces, microorganisms
   c. Describe the dangers of foodborne illness and methods for prevention.
   d. Explain the food safety responsibilities of food workers from farm to table.
   e. Discuss the personal hygiene requirements of food handlers.
      - Personal protective equipment (PPE)
      - Handwashing
   f. Examine methods for maintaining sanitary facilities and equipment and managing pests.
      - Remove material
      - Clean
      - Sanitize
   g. Calculate appropriate concentrations for using bleach in sanitizing solutions.

5. Examine food safety systems. DOK 3
   a. List and describe the seven steps of HACCP as a method to prevent foodborne illness.
   b. Explain the role of the USDA-FSIS.
   c. Discuss food product recall and traceability.

Enrichment

1. Reference the USDA-FSIS (fsis.usda.gov) to see a list of recalls.
2. Utilize ecfr.gov, Parker, R., *Introduction to Food Science,* Delmar, Inc. as a resource for this unit.

Unit 3: Food Chemistry

Competencies and Suggested Objectives
1. Identify various nutrients that are found in different foods. DOK 1 a. Identify the six categories of nutrients found in food. • Water • Proteins • Lipids • Carbohydrates • Vitamins • Minerals
2. Discover common ingredients, units of measurement, safe temperatures, and cook times associated with food science as listed in Appendix B. DOK 1 a. Identify the weights of common ingredients in grams. b. Recognize the internal temperature and rest times for common food products. c. Use scenarios to calculate common unit measurements and conversions.
3. Examine the chemical makeup and role of water found in food. DOK 1 a. Describe the chemical properties of water. b. Describe the concept of water activity. c. Describe the types of water in foods. d. Explain how freezing affects the chemical characteristics of food. e. Calculate the moisture content of various foods. f. Compare the relationship between water, food, and product shelf life.
4. Examine the chemical makeup and role of proteins found in food. DOK 1 a. Discuss amino acids as building blocks for proteins. b. Identify the sources and applications of proteins from food. c. Describe the function of proteins in foods. d. Explain the role of proteins in health and nutrition. • Essential amino acids e. Identify examples of enzymes in food and food applications. • Papain tenderization of meat • Enzymatic browning of apples • Blanching of green beans in food preservation
5. Examine the chemical makeup and role of lipids found in food. DOK 1 a. Identify the sources and applications of lipids from food. • Omega-3 • Omega-6 • Fatty acids • Triglycerides • Phospholipids • Cholesterol

b. Describe the function of lipids in foods.
c. Explain the role of lipids in health and nutrition.

6. Examine the chemical makeup and role of carbohydrates found in food. DOK 1
   a. Identify the sources and applications of carbohydrates from food.
      - Monosaccharides (sugar)
        - Nonenzymatic browning (Maillard reaction)
      - Disaccharides (sugar, lactose)
      - Polysaccharides (starches and gums)
   b. Describe the function of carbohydrates in foods.
   c. Explain the role of carbohydrates in health and nutrition.

7. Identify the sources of vitamins from food. DOK 1
   a. Discuss fat-soluble vitamins.
   b. Discuss water-soluble vitamins.
   c. Discuss the impact of processing on vitamin bioavailability.
   d. Explain the role of vitamins in health and nutrition.
   e. Investigate bioengineered fortification of crops for malnourished populations.

8. Identify the sources and applications of minerals from food. DOK 1
   a. Discuss the seven macro-minerals.
      - Calcium
      - Phosphorus
      - Potassium
      - Sodium
      - Chloride
      - Magnesium
      - Sulfur
   b. Discuss micro-minerals.
   c. Describe the function of minerals in foods.
   d. Discuss the impact of processing on mineral bioavailability.
   e. Discuss the impact of minerals on lipid oxidation and off-flavors.

Unit 4: Food Composition and Analysis

Competencies and Suggested Objectives
1. Define common terms used in food composition and nutritional values and labels. DOK 1 a. Discuss food composition. b. Define energy, calorie, nutrition, nutritional values, and nutritional labels.
2. Examine the methods used to identify food composition. DOK 1 a. Discuss the proximate analysis method. b. Discuss spectrophotometry. c. Discuss liquid chromatography. d. Discuss gas chromatography.
3. Discuss the methods used to determine the caloric content of foods. DOK 1 a. Explore the use of calorimeters. b. Calculate the caloric content of foods. • Proteins (e.g., 4 calories/g) • Carbohydrates (e.g., 4 calories/g) • Fats (e.g., 9 calories/g)
4. Describe instrumental quality measurements. DOK 1 a. Describe pH, color, texture, and cooking loss.
5. Identify food additives. DOK 1 a. Define a food additive. b. Define generally recognized as safe (GRAS) food additives. c. Describe the functions of food additives. • Preservatives • Antimicrobial agents • Antioxidants • Flavoring agents (natural vs. synthetic) and flavor enhancers • Sweeteners (nutritive vs. nonnutritive) • Enrichment and fortification
6. Examine the major factors that affect the nutrient content of foods. DOK 1 a. Discuss the impact of genetics on food nutrient content. b. Discuss the impact of environment on food nutrient content. c. Discuss the impact of storage on food nutrient content. d. Discuss the impact of preparation on food nutrient content.

Unit 5: Food Microbiology

Competencies and Suggested Objectives
1. Explain the role of microbiology in food science. DOK 1 a. Define terms associated with food microbiology. • Microbiology • Microorganism • Bacteria (i.e., aerobic vs. anaerobic) • Yeast • Mold (i.e., fungus) • Spores • Pasteurization • Fermentation • Starter
2. Describe how microbes impact the food supply. DOK 1 a. List the types of single-cell organisms. • Bacteria • Mold (i.e., fungus) • Yeast b. Discuss the factors that influence microbial growth (i.e., FAT TOM). • Food components • Acidity • Temperature • Time • Oxygen • Moisture c. Differentiate between yeast, mold, and bacterial fermentation. d. Compare and contrast microbes using a microscope. e. Identify food products that are made because of fermentation. f. Create a food product using a fermentation method.
3. Discuss the foodborne pathogens that affect the food supply. DOK 2 a. Differentiate among the types of food borne illnesses. • Food intoxication—Staphylococcus aureus, Clostridium botulinum (Botulism), Clostridium perfringens, Bacillus cereus • Food infection—Listeria monocytogenes, Salmonella spp., Escherichia coli (E. coli) • Parasitic infection—Trichinosis • Viral infections—Rotavirus, Hepatitis, Norovirus (Norwalk) • Prions—Creutzfeldt-Jakob Disease (CJD), Bovine Spongiform Encephalopathy (BSE), also known as Mad Cow Disease b. Describe the main ways pathogens enter the food supply. • Transmission by animals • Improper handling procedures (e.g., time and temperature abuse, poor personal hygiene, cross contamination, and uninformed or careless consumers)

- Water contamination

c. Demonstrate food handling procedures that will reduce the growth of foodborne illness microorganisms.
d. Develop a HACCP plan for a selected food industry.

Unit 6: The Science of Food Processing

Competencies and Suggested Objectives

1. Describe food processing. DOK 1
    a. Define terms associated with food processing.
        - Food processing
        - Shelf life
        - Aseptic processing and packaging
        - Preservation
        - Refrigeration
        - Packaging
        - Drying/dehydration
        - Food irradiation
        - Freezing
        - Blast freezing
        - Canning
        - Product code dating

2. Examine the various methods and techniques used in the heat preservation of food. DOK 1
    a. Describe heat preservation.
    b. Identify the four degrees of heat preservation.
        - Blanching
        - Pasteurization
        - Commercial sterilization
        - Sterilization
    c. Explain the factors in choosing a heat preservation method.
        - Heat transfer
        - Time vs. temperature
        - Food components
        - pH of food
    d. Determine the pH of selected foods.
    e. List and describe the guidelines for the home canning process according to USDA's *Complete Guide for Home Canning* or the National Center for Home Food Preservation's website.
    f. Use concepts in the canning process to demonstrate the home canning process.

3. Examine the different methods of cold processing foods. DOK 1
    a. Describe and give examples of the methods of cold processing foods.
        - Blast freezing
        - Individual quick freeze (IQF)
        - Home freezing
    b. Analyze the effects of freezing select foods on appearance, texture, quality, and flavor.

4. Explain the factors that affect water activity. DOK 1
    a. List the factors that affect water activity.
        - Temperature
        - Moisture content
        - Solutes (i.e., salt and sugar)
    b. Demonstrate the dehydration process using selected foods.

5. Explain the irradiation method of food preservation. DOK 2
    a. Analyze the advantages and disadvantages of irradiation as a food preservation method.

Unit 7: Sensory Evaluation of Food Products

Competencies and Suggested Objectives

1. Explain the sensory evaluation of food products. DOK 1
    a. Define terms associated with sensory evaluation.
        - Sensory
        - Sensory panel
        - Taste bias
        - Appearance
        - Flavor
        - Aroma
        - Astringency
        - Texture
        - Consistency
        - Mouthfeel
        - Triangle test
        - Palatability
        - Palate
    b. Describe the techniques used to identify the sensory characteristics of food products.
        - Appearance
        - Flavor
        - Aroma
        - Texture
    c. Conduct a triangle test on food samples to identify flavor, aroma, visual cues, and/or textural differences.
    d. Identify the aroma of selected samples from the National FFA Food Science Career Development Event (CDE) Handbook.

Unit 8: Product Development

Competencies and Suggested Objectives

1. Describe the process of product development in food science. DOK 1
    a. Identify methods of research in the food industry.
        - Descriptive
        - Analytical
    b. Describe the steps involved in product development.
    c. Identify the product need or opportunity.
        - Platforms
            - Frozen
            - Refrigerated
            - Shelf stable
            - Convenience
            - Ready-to-eat (RTE)
            - Heat and serve
        - Categories
            - Cereals
            - Snacks
            - Meals
            - Side dishes
            - Beverages
            - Supplements
            - Condiments
            - Desserts
    d. Identify the target audience.
    e. Conduct research.
    f. Develop the product.
    g. Pilot manufacture the product.
    h. Mass produce the product.
        - Identify the market.
            - Wholesale
            - Retail
            - Food service
            - Convenience store
    i. Explain how to calculate the cost of producing a food product.

2. Describe food product labeling. DOK 1
    a. Discuss the general food label requirements.
        - Principal display panel (PDP)
            - Name of food or statement of identity
            - Form of food
            - Net weight, volume, or quantity
        - Information panel
            - Company name and address
            - Ingredients in descending order of predominance by weight (FDA Labeling Guide)
            - Identify the food allergens in a food product and develop a "Contains" statement, if applicable.
                - "Big 8 Allergens": soy, peanuts, tree nuts, shellfish, fish, milk, wheat, eggs
                - Understand that by **Jan. 1, 2023**, food companies must declare the presence of **sesame** as an allergen on food packaging labels.
            - Nutrition facts label
    b. Identify the parts of a nutrition facts label.
        - Serving size
        - Servings per container
        - Calories
        - Total fat
            - Saturated fat
            - Trans fat
        - Cholesterol
        - Sodium
        - Total carbohydrates
            - Dietary fiber
            - Total sugars
                - Added sugars
        - Protein
        - Vitamin D
        - Calcium
        - Iron
        - Potassium
        - Percent daily value
        - Footnotes
    c. Use a provided list of ingredients to calculate the nutritional content for a food product nutrition facts label.

d. Discuss the nutrient content claims that can be included on a nutrition label.
    - Health claims
    - Qualified health claims
    - Structure/function claims
    - Nutrient content claims (e.g., low fat, low sodium, etc.)

e. Create a label for a food product derived from a specified list of ingredients.

3. Apply concepts of product development to a scenario that describes a need for a new or redesigned product that appeals to a potential market. DOK 4

a. Create a presentation to promote the product.
    - Cost of goods sold
    - Nutrition
    - Target audience
    - Quality control
    - Marketing, sales, and advertising
    - Product description
    - Processing
    - Packaging
    - Food safety

Unit 9: Careers and Professionalism in Food Science

Competencies and Suggested Objectives

1. Investigate the various careers in the food science industry. DOK 1
   a. Identify careers in the food science industry.
      - Food product development (FPD) or research and development (R&D)
      - Food microbiologist or fermentation scientist
      - Flavor technologist or sensory scientist
      - Food safety or food quality assurance manager
      - Food stylist or research chef
      - Food inspector or government agency scientist
      - Nutritionist or registered dietician (RD)
      - Produce inspector
      - Academic professor/teacher/extension specialist
      - Lobbyist/trade organization
      - Packaging engineer
      - Production engineer
      - Technical ingredient sales
      - Regulatory and compliance specialists

2. Explain the requirements and working conditions for employment in the food science industry. DOK 2
   a. Describe the education and experience requirements for employment in the food science industry using online information sources. (i.e., Institute of Food Technologists [IFT] ift.org, FFA agexplorer.ffa.org).
   b. Describe the earning and working conditions in the food science industry.
   c. Describe the employability skills necessary for employment in the food science industry.
      - Customer service and communication
      - Professional appearance and hygiene
      - Interpersonal skills
      - Technical writing skills
      - Problem-solving skills
      - Teamwork skills
      - Character and integrity
   d. Research and present information regarding a career in the food science industry.
      - Complete a job application
      - Complete a personal résumé.
      - Participate in a job interview.

Unit 10: Current Issues and Trends in Food Science

Competencies and Suggested Objectives
1. Identify environmental issues associated with food production. DOK 1 a. Describe the properties and requirements of water used in food processing. b. Examine the methods food processing industries use to dispose of solid wastes. c. List contaminants that could be in wastewater. d. Explain the ways food processors reduce the amount of solid wastes and water discharge. e. Explain the methods of conserving water during food processing. f. Explain the opportunities of water reuse in the food industry.
2. Examine the use of human manipulation of crops and food products. DOK 2 a. Examine the use of chemicals, medicines, and growth regulators in animals raised for food and food products. b. Analyze the role of biotechnology in the food industry. c. Debate the use of genetically modified organisms (GMOs) in food.
3. Discuss food consumption trends. DOK 1 a. Discuss how food consumption trends impact public health, obesity, and diseases. b. Discuss marketing techniques used to influence food consumption. c. Identify healthy lifestyles and activities people should follow to maintain a healthy body and mind. d. Discuss statement standards, requirements, and labeling for organic, natural, grass fed, locally grown, genetically engineered, gluten free, and other foods. e. Investigate how a pandemic affects the food supply and food industry.
4. Explore the future of food production, food packaging, and other food-related topics. DOK 2 a. Investigate the use of automated technology in food processing facilities. b. Research culinary trends in retail and food service establishments. c. Explore sustainability and conservation trends in food science (e.g., farm to table, etc.). d. Discuss issues related to the importing and exporting of food.
5. Conduct a project that requires identifying a social issue that affects food insecurity and/or world hunger, researching the issue, and developing a potential solution to the problem.DOK3
6. Investigate the movement of food from farm to table. DOK 2 a. Discuss the principles of purchasing, receiving, and inspecting food. b. Examine general storage guidelines and the types of storage.

Unit 11: Immersion Into FFA and Supervised Agricultural Experience (SAE) for All

Competencies and Suggested Scenarios
1. Participate in local, state, and/or national FFA activities that provide opportunities for leadership development and career exploration. DOK 3 a. Actively participate in FFA activities. • Leadership Development Events (LDEs) • Career Development Events (CDEs) o Food Science and Technology • 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. DOK 4 a. Redefine and adjust requirements of agreements between the student, parents, supervisor, and/or employer. b. Update SAE records using an electronic/computer-based system of record keeping. • 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.

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 Food Science		
	1.	Identify terms associated with food science.
	2.	Investigate the various dimensions of the food science industry.
	3.	Explain the history of food science, food products, and food processing.
	4.	Identify governmental regulatory agencies involved in food science.
	5.	Demonstrate proper laboratory methods and techniques.
	6.	Demonstrate the correct way to use a microscope in the food science lab.
Unit 2: Safety and Sanitation in Food Science		
	1.	Explain the importance of safety and sanitation in food production.
	2.	Investigate legislation that impacted food science development.
	3.	Discuss federal regulations regarding the safe management of the food supply.
	4.	Investigate issues related to food safety.
	5.	Examine food safety systems.
Unit 3: Food Chemistry		
	1.	Identify various nutrients that are found in different foods.
	2.	Discover common ingredients, units of measurement, safe temperatures, and cook times associated with food science as listed in Appendix B.
	3.	Examine the chemical makeup and role of water found in food.
	4.	Examine the chemical makeup and role of proteins found in food.
	5.	Examine the chemical makeup and role of lipids found in food.
	6.	Examine the chemical makeup and role of carbohydrates found in food.
	7.	Identify the sources of vitamins from food.
	8.	Identify the sources and applications of minerals from food.
Unit 4: Food Composition and Analysis		
	1.	Define common terms used in food composition and nutritional values and labels.
	2.	Examine the methods used to identify food composition.

	3.	Discuss the methods used to determine the caloric content of foods.
	4.	Describe instrumental quality measurements.
	5.	Identify food additives.
	6.	Examine the major factors that affect the nutrient content of foods.
Unit 5: Food Microbiology		
	1.	Explain the role of microbiology in food science.
	2.	Describe how microbes impact the food supply.
	3.	Discuss the foodborne pathogens that affect the food supply.
Unit 6: The Science of Food Processing		
	1.	Describe food processing.
	2.	Examine the various methods and techniques used in the heat preservation of food.
	3.	Examine the different methods of cold processing foods.
	4.	Explain the factors that affect water activity.
	5.	Explain the irradiation method of food preservation.
Unit 7: Sensory Evaluation of Food Products		
	1.	Explain the sensory evaluation of food products.
Unit 8: Product Development		
	1.	Describe the process of product development in food science.
	2.	Describe food product labeling.
	3.	Apply concepts of product development to a scenario that describes a need for a new or redesigned product that appeals to a potential market.
Unit 9: Careers and Professionalism in Food Science		
	1.	Investigate the various careers in the food science industry.
	2.	Explain the requirements and working conditions for employment in the food science industry.
Unit 10: Current Issues and Trends in Food Science		
	1.	Identify environmental issues associated with food production.
	2.	Examine the use of human manipulation of crops and food products.
	3.	Discuss food consumption trends.
	4.	Explore the future of food production, food packaging, and other food-related topics.
	5.	Conduct a project that requires identifying a social issue that affects food insecurity and/or world hunger, researching the issue, and developing a potential solution to the problem.
	6.	Investigate the movement of food from farm to table.

Unit 11: Immersion Into FFA and Supervised Agricultural 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

Framework for AFNR Content Standards and Performance Elements Crosswalk for Diversified Agriculture Food Science												
	Unit	1	2	3	4	5	6	7	8	9	10	11
AFNR												
ABS- Agribusiness Systems									X	X	X	X
AS- Animal Systems												
BS- Biotechnology			X	X		X					X	
CRP- Career Ready Practices		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
ES- Environmental Service Systems												
FPP- Food Products and Processing Systems		X	X	X	X	X	X	X	X	X	X	X
NRS- Natural Resource Systems												
PS- Plant Systems												
PST- Power, Structural, and Technical Systems												

AFNR Pathway
Content Standards and Performance Elements

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

Agribusiness Systems Career Pathway Content Standards

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

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Agribusiness Systems (AG-ABS) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

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

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

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

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

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

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

ABS.02.01. Performance Indicator: Apply fundamental accounting principles, systems, tools and applicable laws and regulations to record, track and audit AFNR business transactions (e.g., accounts, debits, credits, assets, liabilities, equity, etc.).

ABS.02.02. Performance Indicator: Assemble, interpret and analyze financial information and reports to monitor AFNR business performance and support decision-making (e.g., income statements, balance sheets, cash-flow analysis, inventory reports, break-even analysis, return on investment, taxes, etc.).

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

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

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

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

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

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

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

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

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

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

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

Animal Systems Career Pathway Content Standards

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

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Animal Systems (AG-AS) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Common Career Technical Core Career Ready Practices Content Standards

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

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

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for CRPs from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** –These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a CTE program of study.

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

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

CRP.01.02 Performance Indicator: Evaluate and consider the near-term and long-term impacts of personal and professional decisions on employers and community before taking action.

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

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

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

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

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

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

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

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

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

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

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

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

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

CRP.05.02. Performance Indicator: Make, defend and evaluate decisions at work and in the community using information about the potential environmental, social and economic impacts.

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

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

CRP.06.02. Performance Indicator: Assess a variety of workplace and community situations to identify ways to add value and improve the efficiency of processes and procedures.

CRP.06.03. Performance Indicator: Create and execute a plan of action to act upon new ideas and introduce innovations to workplace and community organizations.

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

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

CRP.07.02. Performance Indicator: Evaluate the validity of sources and data used when considering the adoption of new technologies, practices and ideas in the workplace and community.

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

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

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

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

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

CRP.09.01. Performance Indicator: Model characteristics of ethical and effective leaders in the workplace and community (e.g. integrity, self-awareness, self-regulation, etc.).

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

CRP.09.03. Performance Indicator: Demonstrate behaviors that contribute to a positive morale and culture in the workplace and community (e.g., positively influencing others, effectively communicating, etc.).

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

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

CRP.10.02. Performance Indicator: Examine career advancement requirements (e.g., education, certification, training, etc.) and create goals for continuous growth in a chosen career.

CRP.10.03. Performance Indicator: Develop relationships with and assimilate input and/or advice from experts (e.g., counselors, mentors, etc.) to plan career and personal goals in a chosen career area.

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

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

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

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

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

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

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

Agriculture, Food, and Natural Resources Cluster Skill Content Standards

The AFNR Cluster Skills (CS) encompasses the study of fundamental knowledge and skills related to all AFNR professions. Students completing a program of study in any AFNR career

pathway will demonstrate fundamental knowledge of the nature, scope and relationships of AFNR systems and the skills necessary for analysis of current and historical issues and trends; application of technologies; safety, health and environmental practices; stewardship of natural resources; and exploration of career opportunities.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Agriculture, Food and Natural Resources Career Cluster® (AG) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** –These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

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

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

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

- **CS.02.01. Performance Indicator:** Research and use geographic and economic data to solve problems in AFNR systems.
- **CS.02.02. Performance Indicator:** Examine the components of the AFNR systems and assess their impact on the local, state, national and global society and economy.

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

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

CS.04. CCTC Standard: Demonstrate stewardship of natural resources in AFNR activities.
- **CS.04.01. Performance Indicator:** Identify and implement practices to steward natural resources in different AFNR systems.
- **CS.04.02. Performance Indicator:** Assess and explain the natural resource related trends, technologies and policies that impact AFNR systems.

CS.05. CCTC Standard: Describe career opportunities and means to achieve those opportunities in each of the Agriculture, Food & Natural Resources career pathways.
- **CS.05.01. Performance Indicator:** Evaluate and implement the steps and requirements to pursue a career opportunity in each of the AFNR career pathways (e.g., goals, degrees, certifications, resumes, cover letter, portfolios, interviews, etc.).

CS.06. CCTC Standard: Analyze the interaction among AFNR systems in the production, processing and management of food, fiber and fuel and the sustainable use of natural resources.
- **CS.06.01. Performance Indicator:** Examine and explain foundational cycles and systems of AFNR.
- **CS.06.02. Performance Indicator:** Analyze and explain the connection and relationships between different AFNR systems on a national and global level.

Biotechnology Systems Career Pathway Content Standards

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

Within each pathway, the standards are organized as follows:

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

BS.01. NCAE Standard: Assess factors that have influenced the evolution of biotechnology in agriculture (e.g., historical events, societal trends, ethical and legal implications, etc.).
- **BS.01.01**. **Performance Indicator**: Investigate and explain the relationship between past, current and emerging applications of biotechnology in agriculture (e.g., major innovators, historical developments, potential applications of biotechnology, etc.).

BS.01.02. Performance Indicator: Evaluate the scope and implications of regulatory agencies on applications of biotechnology in agriculture and protection of public interests (e.g., health, safety, environmental issues, etc.).

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Environmental Service Systems Career Pathway Content Standards

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

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Environmental Service Systems (AG-ESS) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

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

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

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

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

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

ESS.02.02. Performance Indicator: Compare and contrast the impact of current trends on regulation of environmental service systems (e.g., climate change, population growth, international trade, etc.).

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

ESS.03. CCTC Standard: Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.

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

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

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

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

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

ESS.04. CCTC Standard: Demonstrate the operation of environmental service systems (e.g., pollution control, water treatment, wastewater treatment, solid waste management and energy conservation).

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

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

ESS.04.03. Performance Indicator: Apply techniques to ensure a safe supply of drinking water and adequate treatment of wastewater according to applicable rules and regulations.

ESS.04.04. Performance Indicator: Compare and contrast the impact of conventional and alternative energy sources on the environment and operation of environmental service systems.

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

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

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

Food Products and Processing Systems Career Pathway Content Standards

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

Within each pathway, the standards are organized as follows:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Natural Resource Systems Career Pathway Content Standards

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

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Natural Resource Systems (AG-NRS) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

NRS.01. CCTC Standard: Plan and conduct natural resource management activities that apply logical, reasoned and scientifically based solutions to natural resource issues and goals.

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

NRS.01.02. Performance Indicator: Classify different types of natural resources in order to enable protection, conservation, enhancement and management in a particular geographical region.

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

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

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

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

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

NRS.02.01. Performance Indicator: Examine and interpret the purpose, enforcement, impact and effectiveness of laws and agencies related to natural resource management, protection, enhancement and improvement (e.g., water regulations, game laws, historic preservation laws, environmental policy, etc.).

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

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

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

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

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

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

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

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

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

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

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

NRS.04.04. Performance Indicator: Manage fires in natural resource systems.

Plant Science Systems Career Pathway Content Standards

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

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

- **PS.01.01. Performance Indicator:** Determine the influence of environmental factors on plant growth.
- **PS.01.02. Performance Indicator:** Prepare and manage growing media for use in plant systems.
- **PS.01.03. Performance Indicator:** Develop and implement a fertilization plan for specific plants or crops.

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

- **PS.02.01. Performance Indicator:** Classify plants according to taxonomic systems.
- **PS.02.02. Performance Indicator:** Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.
- **PS.02.03. Performance Indicator:** Apply knowledge of plant physiology and energy conversion to plant systems.

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

- **PS.03.01. Performance Indicator:** Demonstrate plant propagation techniques in plant system activities.
- **PS.03.02. Performance Indicator:** Develop and implement a management plan for plant production.
- **PS.03.03. Performance Indicator:** Develop and implement a plan for integrated pest management for plant production.
- **PS.03.04. Performance Indicator:** Apply principles and practices of sustainable agriculture to plant production.
- **PS.03.05. Performance Indicator:** Harvest, handle and store crops according to current industry standards.

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

- **PS.04.01. Performance Indicator:** Evaluating, identifying and preparing plants to enhance an environment.
- **PS.04.02. Performance Indicator:** Create designs using plants.

Power, Structural and Technical Systems Career Pathway Content Standards

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

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Power, Structural and Technical Systems (AG-PST) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

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

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

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

PST.01.03. Performance Indicator: Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

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

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

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

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

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

PST.03.02. Performance Indicator: Service electrical systems and components of mechanical equipment and power systems using a variety of troubleshooting and/or diagnostic methods.

PST.03.03. Performance Indicator: Utilize manufacturers' guidelines to diagnose and troubleshoot malfunctions in machinery, equipment and power source systems (e.g., hydraulic, pneumatic, transmission, steering, suspension, etc.).

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

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

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

PST.04.03. Performance Indicator: Follow architectural and mechanical plans to construct, maintain and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

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

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

PST.05.01. Performance Indicator: Apply computer and other technologies (e.g., robotics, CNC, UAS, etc.) to solve problems and increase the efficiency of AFNR systems.

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

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

Appendix B: Conversion Charts

Weights of Common Ingredients in Grams

Ingredient	1 cup	3/4 cup	2/3 cup	1/2 cup	1/3 cup	1/4 cup	2 Tbsp
Flour, all purpose (wheat)	120 g	90 g	80 g	60 g	40 g	30 g	15 g
Flour, well sifted all purpose (wheat)	110 g	80 g	70 g	55 g	35 g	27 g	13 g
Sugar, granulated cane	200 g	150 g	130 g	100 g	65 g	50 g	25 g
Confectioner's sugar (cane)	100 g	75 g	70 g	50 g	35 g	25 g	13 g
Brown sugar, packed firmly (but not too firmly)	180 g	135 g	120 g	90 g	60 g	45 g	23 g
Corn meal	160 g	120 g	100 g	80 g	50 g	40 g	20 g
Corn starch	120 g	90 g	80 g	60 g	40 g	30 g	15 g
Rice, uncooked	190 g	140 g	125 g	95 g	65 g	48 g	24 g
Macaroni, uncooked	140 g	100 g	90 g	70 g	45 g	35 g	17 g
Couscous, uncooked	180 g	135 g	120 g	90 g	60 g	45 g	22 g
Oats, uncooked quick	90 g	65 g	60 g	45 g	30 g	22 g	11 g
Table salt	300 g	230 g	200 g	150 g	100 g	75 g	40 g
Butter	240 g	180 g	160 g	120 g	80 g	60 g	30 g
Vegetable shortening	190 g	140 g	125 g	95 g	65 g	48 g	24 g
Chopped fruits and vegetables	150 g	110 g	100 g	75 g	50 g	40 g	20 g
Nuts, chopped	150 g	110 g	100 g	75 g	50 g	40 g	20 g
Nuts, ground	120 g	90 g	80 g	60 g	40 g	30 g	15 g
Breadcrumbs, fresh, loosely packed	60 g	45 g	40 g	30 g	20 g	15 g	8 g

Internal Temperature and Rest Times for Common Food Products

Product	Minimum Internal Temperature and Rest Time
Beef, pork, veal and lamb steaks, chops, roasts	145°F (62.8°C) and allow to rest for at least 3 minutes
Ground meats	160°F (71.1°C)
Ground poultry	165°F (73.9°C)
Ham, fresh or smoked (uncooked)	145°F (62.8°C) and allow to rest for at least 3 minutes
Fully cooked ham (to reheat)	Reheat cooked hams packaged in USDA-inspected plants to 140°F (60°C) and all others to 165°F (73.9°C)
All poultry (breasts, whole bird, legs, thighs, wings, ground poultry, giblets, and stuffing	165°F (73.9°C)
Eggs	160°F (71.1°C)
Fish and shellfish	145°F (62.8°C)
Leftovers	165°F (73.9°C)
Casseroles	165°F (73.9°C)

Units of Measurement and Conversions

Mass	Abbreviations
1000 g= 1 kg	g=gram
1000 mg = 1 g	kg=kilogram
1000 ug = 1 mg	mg=milligram
1000 ng = 1 ug	ug=microgram
454 g= 1 lb	ng= nanogram
16 ounces= 1 lb	ounce=oz
28.375 g= 1 ounce	pounds=lb
Tbsp and Tsp vary based on density	
Volume	
1 L=1000 ml	L= liter
1 ml=1000 uL	ml=milliliter
1 uL=1000 nL	ul=microliter
1 Gallon=3.786 liters	Tbsp=Tablespoon
1 Gallon=4 quarts	Tsp=Teaspoon
1 quart=1.057 quarts	
1 quart = 2 pints	
1 pint= 2 cups	
Tbsp=14.8 ml, most round up to 15 ml	
Tsp=4.94 ml, most round up to 5 ml	
Tbsp= 3 tablespoons	

Length	
1 m=100 cm	m= meter
1 m=1000 mm	cm=centimeter
1 m = 3.28 feet	mm= millimeter
1 ft= 12 inches	ft=foot
1 ft= 30.48 cm	
1 inch=2.54 cm	
Temperature	
Fahrenheit= 1.8xCelsius+32	
Calories	
1 g fat = 9 Calories	Kcal=Kilocalorie
1 g carbohydrate = 4 Calories	
1 g protein = 4 Calories	
1 Calorie= 1 Kcal	
1 Calorie= 1000 calories	
Moisture	
Most foods have more water than other components	
Meat= 75 % water	
Fruits and vegetables= 80-95% water	