

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

National Council for Agricultural Education

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PREFACE

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

Introduction

The vision of the National Council for Agricultural Education (The Council) is to be the premier leadership organization for shaping and strengthening school-based agricultural education (SBAE) at all levels in the United States. Its mission is to:

- Proactively identify current and emerging issues of national concern
- Provide innovative solutions in response to current and emerging issues
- Coordinate the efforts of appropriate entities in strengthening programs
- Serve as a national advocate for school-based agricultural education

In this spirit, The Council and the National AFNR Career Cluster Content Standards Committee took the lead in the development of the accompanying National AFNR Career Cluster Content Standards for the agricultural education profession. Members of the Committee are:

- Dr. David Hall, Chair—Montana
- Dr. Larry Case—United States Department of Education
- Dr. Karen Hutchison—Delaware
- Dr. Ike Kershaw—Ohio
- Joel Larsen—Minnesota
- Bradley Schloesser—Minnesota
- Don Sligar—Oregon
- Dr. Will Waidelich—National FFA Organization
- William (Buddy) Deimler—Utah
- Dale Gruis—Iowa

Purpose

Agriculture is a highly technical and ever-changing industry upon which everyone is dependent. We will maintain agriculture as our nation's number one industry only if we understand the importance of the different agrisciences, of marketing strategies, of safe food production and of the need for continuous research to improve agriculture. Strong, relevant agriscience programs are one way we can maintain our nation's agricultural edge.

The National AFNR Career Cluster Content Standards were developed as part of the National FFA 10 x 15 project to provide state agricultural education leaders and teachers with a forward-thinking guide for what students should know and be able to do through the study of agriculture in grades 9 through 14. The National AFNR Career Cluster Content Standards should be used as a guide to develop well-planned curriculum in agriscience education to be delivered to students throughout the country. Just as agriculture varies throughout our nation, so will our agricultural education programs. States should use these standards in conjunction with state and local advisory committees to determine what is most relevant and appropriate for their students in providing that all-important link between the school and the business community. The standards, performance elements, performance indicators and measurements should be used by educators to guide agricultural education curriculum development at the state and local levels.

Structure and Organization

The National AFNR Career Cluster Content Standards are organized into eight pathways. These pathways are:

- ***Agribusiness Systems (ABS)***—the study of business principles, including management, marketing and finance, and their application to enterprises engaged in Agriculture, Food and Natural Resources
- ***Animal Systems (AS)***—the study of animal systems, including life processes, health, nutrition, genetics, management and processing, through the study of small animals, aquaculture, livestock, dairy, horses and/or poultry
- ***Biotechnology Systems (BS)***—the study of data and techniques of applied science for the solution of problems concerning living organisms
- ***Environmental Service Systems (ESS)***—the study of systems, instruments and technology used in waste management and their influence on the environment
- ***Food Products and Processing Systems (FPP)***—the study of product development, quality assurance, food safety, production, sales and service, regulation and compliance, and food service within the food science industry

- **Natural Resource Systems (NRS)**—the study of the management of soil, water, wildlife, forests and air as natural resources
- **Plant Systems (PS)**—the study of plant life cycles, classifications, functions, structures, reproduction, media and nutrients, as well as growth and cultural practices, through the study of crops, turf grass, trees and shrubs and/or ornamental plants
- **Power, Structural and Technical Systems (PST)**—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

The Cluster Skills serve as the foundation for all pathways. They involve skills that apply to all pathways within the AFNR Career Cluster. Such concepts as leadership, communication, teamwork and general safety are included in the Cluster Skills.

Within each pathway, the standards are organized as follows:

- **Pathway Content Standard**—This is a general statement indicating the broad area of knowledge covered in each pathway.
- **Performance Elements**—These represent the major topical areas within each pathway. Generally, each pathway has 5 to 10 Performance Elements.
- **Performance Indicators**—These are more precise statements that serve as an indication of the knowledge/ability the student should possess.
- **Measurements**—These are sample measurable activities that students might carry out to indicate attainment of each Performance Indicator. The measurements are broken into three levels as follows:
 - *Level I*—These are fundamental activities/abilities students possess at roughly the 9th- and 10th-grade levels upon which all other activities are built.
 - *Level II*—These are activities/abilities that will build on the first-level knowledge and are skills that students possess at roughly the 11th- and 12th-grade levels.
 - *Level III*—These are activities/abilities that will build in complexity from the first two levels and are skills students possess at roughly the 13th- and 14th-grade levels. These skills may be obtained at the end of the high school level in more focused programs, in which case articulation agreements with postsecondary institutions are encouraged.

Methodologies and Processes

The development of the National AFNR Career Cluster Content Standards began with a review of the Knowledge & Skills Statements originally developed as part of the 2003 United States Department of Education (USDE) Clusters Project. The Committee began with these because the statements had been reviewed by hundreds of educators and industry representatives as they were developed. The comments of these reviewers guided the work in the development of the accompanying standards. Various iterations of the standards were reviewed by a total of 257 agricultural educators (averaging 32 per pathway). They included 178 secondary and 79 postsecondary/university agricultural educators, representing 39 states overall. Additionally, the standards were validated by a total of 155 representatives of the animal science, plant science, environmental science, natural resources, biotechnology, food processing, agribusiness and agricultural power & structures industries from 32 states (averaging 19 per pathway). Both of these totals exceeded the project's specifications. As development progressed through the review and validation processes, the succeeding versions became more fine-tuned.

Throughout the process, the National AFNR Career Cluster Content Standards Committee stressed rigor and relevance both in the agricultural content covered and in the alignment of the AFNR Career Cluster Content Standards to national academic standards. Thus, the accompanying document includes not only the AFNR Standards but also the alignment of the Performance Indicators to national academic standards. Further, these academic standards are fully stated in the Appendix that accompanies the AFNR Standards. The academic alignments were carried out using teams of both academic and agricultural educators. Core academic teachers are encouraged to review the National AFNR Career Cluster Content Standards as a way to raise agricultural awareness within the school and the community and provide related meaningful learning experiences for students.

Acknowledgments

The development of the National AFNR Career Cluster Content Standards was funded by the National FFA Foundation. The Center for Agricultural and Environmental Research & Training (CAERT), Inc., was selected as the contractor for the development of the standards. Ronald J. Biondo, Frank Flanders, and Jasper S. Lee should be acknowledged for their dedicated commitment as writers of the standards for the pathways.

Career Cluster: AGRICULTURE, FOOD AND NATURAL RESOURCES (AFNR)

Career Pathway: Agribusiness Systems (ABS)

Pathway Content Standard: The student will demonstrate competence in the application of principles and techniques for the development and management of agribusiness systems.

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
ABS.01. Performance Element: Utilize economic principles to establish and manage an AFNR enterprise.			
ABS.01.01. Performance Indicator: Apply principles of capitalism in the business environment.			Social Studies: 7b and 7g
ABS.01.01.01.a. Recognize principles of capitalism as related to AFNR businesses.	ABS.01.01.01.b. Differentiate types of ownership and outline the structure of AFNR businesses in a capitalistic economic system.	ABS.01.01.01.c. Execute supply-and-demand principles in AFNR businesses.	
ABS.01.02. Performance Indicator: Apply principles of entrepreneurship in businesses.			Social Studies: 7d
ABS.01.02.01.a. Describe the meaning, importance and economic impact of entrepreneurship.	ABS.01.02.01.b. Classify the characteristics of successful entrepreneurs in AFNR businesses.	ABS.01.02.01.c. Demonstrate entrepreneurship, including idea generation, opportunity analysis and risk assessment.	
ABS.02. Performance Element: Utilize appropriate management planning principles in AFNR business enterprises.			
ABS.02.01. Performance Indicator: Compose and analyze a business plan for an enterprise.			Language Arts: 3, 4, 5, 7 and 8 Social Studies: 7h
ABS.02.01.01.a. Recognize quality AFNR business plan components that have been developed using the SMART (specific, measurable, attainable, realistic and timely) format.	ABS.02.01.01.b. Identify components of business plans and demonstrate how to write such components using the SMART format.	ABS.02.01.01.c. Prepare and critique AFNR business plans.	
ABS.02.01.02.a. Identify and observe ethical standards in planning and operating AFNR businesses.	ABS.02.01.02.b. Observe appropriate laws and regulations in planning and operating AFNR businesses.	ABS.02.01.02.c. Utilize methods of AFNR business enterprise analysis, such as SWOT (strengths, weaknesses, opportunities and threats).	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
ABS.02.02. Performance Indicator: Read, interpret, evaluate and write a mission statement to guide business goals, objectives and resource allocation.			Language Arts: 3, 4, 5 and 6
ABS.02.02.01.a. Read and interpret mission statements.	ABS.02.02.01.b. Identify approaches in creating mission statements for AFNR businesses.	ABS.02.02.01.c. Create and disseminate a mission statement for business activities in AFNR.	
ABS.02.02.02.a. Identify the meaning and importance of goals and objectives in AFNR business enterprises.	ABS.02.02.02.b. Prepare short-term, intermediate and long-term goals and objectives that are consistent with the mission statement for an AFNR business.	ABS.02.02.02.c. Evaluate AFNR business goals and objectives and make revisions based on observations.	
ABS.02.03. Performance Indicator: Apply appropriate management skills to organize a business.			Language Arts: 12 Social Studies: 7f
ABS.02.03.01.a. Identify organizational structures and chains of command in AFNR businesses.	ABS.02.03.01.b. Identify management types in AFNR businesses.	ABS.02.03.01.c. Implement management approaches to assure efficiency and profitability.	
ABS.02.03.02.a. Identify appropriate local, state, federal, international and industry regulations for AFNR businesses.	ABS.02.03.02.b. Prepare and deliver AFNR business presentations that include customers served, sources of inputs and how a business produces goods and services.	ABS.02.03.02.c. Create an organizational chart for an AFNR business.	
ABS.02.04. Performance Indicator: Recruit, train and retain appropriate and productive human resources for businesses.			Language Arts: 4 and 9
ABS.02.04.01.a. Identify the meaning and functions of human resources in AFNR businesses.	ABS.02.04.01.b. Determine appropriate human resources for AFNR businesses.	ABS.02.04.01.c. Write job descriptions for specific positions in an AFNR business.	
ABS.02.04.02.a. Identify usual employee benefits in AFNR businesses.	ABS.02.04.02.b. Design a career development and training plan for employees of an AFNR business.	ABS.02.04.02.c. Create a recruitment and evaluation program for employees in an AFNR business.	
ABS.02.04.03.a. Explain the meaning and importance of employee relations, including communication.	ABS.02.04.03.b. Establish and maintain appropriate records and reports on human resources.	ABS.02.04.03.c. Determine and follow appropriate regulations in recruiting, hiring and promoting personnel.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
<p>ABS.02.04.04.a. Identify the meaning and nature of employee compensation.</p>	<p>ABS.02.04.04.b. Design a legally compliant and competitive compensation plan for AFNR business employees.</p>	<p>ABS.02.04.04.c. Devise a compensation plan to equitably compensate, motivate and recognize productivity of human resources.</p>	
<p>ABS.03. Performance Element: Utilize record keeping to accomplish AFNR business objectives while complying with laws and regulations.</p>			
<p>ABS.03.01. Performance Indicator: Prepare and maintain all files needed to accomplish effective record keeping.</p>			<p>Math: 5A and 6B Language Arts: 8</p>
<p>ABS.03.01.01.a. Maintain production and agribusiness records.</p>	<p>ABS.03.01.01.b. Analyze records to improve efficiency and profitability of an AFNR business.</p>	<p>ABS.03.01.01.c. Apply management information systems in AFNR business financial analysis.</p>	
<p>ABS.03.02. Performance Indicator: Implement appropriate inventory management practices.</p>			<p>Language Arts: 8</p>
<p>ABS.03.02.01.a. Monitor inventory to maintain optimal levels and calculate costs of carrying input and output inventory.</p>	<p>ABS.03.02.01.b. Use computer technology in inventory management and reporting, including spreadsheets, databases, word processing, networked systems and the Internet.</p>	<p>ABS.03.02.01.c. Apply logistics management strategies.</p>	
<p>ABS.04. Performance Element: Apply generally accepted accounting principles and skills to manage cash budgets, credit budgets and credit for AFNR businesses.</p>			
<p>ABS.04.01. Performance Indicator: Use accounting fundamentals to accomplish dependable bookkeeping and fiscal management.</p>			<p>Math: 1C, 5A and 5C Social Studies: 7h</p>
<p>ABS.04.01.01.a. Budget resources, as applied to the AFNR business, including capital, human, financial and time.</p>	<p>ABS.04.01.01.b. Manage assets, including credit, for agribusiness goal achievement.</p>	<p>ABS.04.01.01.c. Manage resources to minimize liabilities and maximize profit.</p>	
<p>ABS.04.01.02.a. Identify financial concepts associated with production and profit.</p>	<p>ABS.04.01.02.b. Use accounting information to estimate the cost of goods sold and margins on the goods.</p>	<p>ABS.04.01.02.c. Evaluate characteristics of lines of credit, loan terms and alternatives in sources of capital.</p>	
<p>ABS.04.01.03.a. Explain the importance of return on investment for an agribusiness enterprise.</p>	<p>ABS.04.01.03.b. Analyze reporting requirements for income, property and employment taxes associated with small AFNR businesses.</p>	<p>ABS.04.01.03.c. Utilize accountants in AFNR business management.</p>	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
ABS.05. Performance Element: Assess accomplishment of goals and objectives by an AFNR business.			
ABS.05.01. Performance Indicator: Maintain and interpret financial information (income statements, balance sheets, inventory, purchase orders, accounts receivable and cash-flow analyses) for businesses.			Math: 1C, 5A and 5C Language Arts: 8
ABS.05.01.01.a. Identify accounting information in AFNR business reporting and management.	ABS.05.01.01.b. Maintain accounting information needed to prepare an income statement, balance sheet and cash-flow analysis for an AFNR business.	ABS.05.01.01.c. Interpret financial information for an AFNR business to determine profitability, net worth position, financial ratios, performance measures and ability to meet cash-flow requirements.	
ABS.05.01.02.a. Name and explain the impact of external economic factors on an AFNR business.	ABS.05.01.02.b. Recognize how changes in prices of inputs and/or outputs influence the financial statements of an AFNR business.	ABS.05.01.02.c. Predict the consequences of delayed payment of expenses, prepayment of expenses and delayed receipts on a financial statement.	
ABS.05.01.03.a. Identify information needed for an AFNR business manager to monitor performance on a daily, weekly, monthly, quarterly and annual basis.	ABS.05.01.03.b. Interpret business performance data.	ABS.05.01.03.c. Conduct a breakeven analysis for an AFNR business.	
ABS.05.01.04.a. Calculate percentages, ratios and related business applications.	ABS.05.01.04.b. Summarize financial data for use in preparing various business financial statements.	ABS.05.01.04.c. Interpret and evaluate financial statements, including income statements, balance sheets and cash-flow analyses.	
ABS.06. Performance Element: Use industry-accepted marketing principles to accomplish AFNR business objectives.			
ABS.06.01. Performance Indicator: Conduct appropriate market and marketing research.			Social Studies: 7b and 7h
ABS.06.01.01.a. Investigate the meaning and methods of marketing in AFNR as related to agricultural commodities, products and services and to agricultural goods in domestic and international markets.	ABS.06.01.01.b. Apply benefit/cost analysis to marketing in AFNR businesses.	ABS.06.01.01.c. Implement and evaluate marketing strategies with agricultural commodities, products and services.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
ABS.06.01.02.a. Describe functions in agricultural marketing.	ABS.06.01.02.b. Assess the presence of marketing infrastructure for agricultural commodities.	ABS.06.01.02.c. Evaluate alternative marketing strategies, such as value-adding, branding and niche marketing, and propose and implement appropriate modifications to achieve AFNR business goals.	
ABS.06.02. Performance Indicator: Develop a marketing plan.			Language Arts: 3, 5, 7 and 8 Social Studies: 7b and 7d
ABS.06.02.01.a. Identify the purpose, components and developmental processes of marketing plans.	ABS.06.02.01.b. Perform a marketing analysis, including evaluation of the competitors, customers, international and domestic policy environment, regulations and rules, standards and AFNR business resources.	ABS.06.02.01.c. Establish marketing plan goals/objectives, including monitoring, measuring and analyzing goal achievement.	
ABS.06.03. Performance Indicator: Develop strategies for marketing plan implementation.			Social Studies: 7b and 7h
ABS.06.03.01.a. Identify and use strategies frequently employed in marketing programs, including those used in niche markets.	ABS.06.03.01.b. Determine marketing strategies that are most likely to be effective in an AFNR business.	ABS.06.03.01.c. Revise marketing strategies based on monitoring and measurement information for target customer base.	
ABS.06.04. Performance Indicator: Develop specific tactics to market AFNR products and services.			Social Studies: 7b, 7g and 7h
ABS.06.04.01.a. Explain the meaning and use of the four Ps (product, place, price and promotion) in marketing.	ABS.06.04.01.b. Develop advertising campaigns that promote products and services.	ABS.06.04.01.c. Implement sales goals and incentive programs, and identify pricing strategies used by competitors.	
ABS.06.05. Performance Indicator: Merchandise products and services to achieve specific marketing goals.			Language Arts: 4 Social Studies: 7b and 7d
ABS.06.05.01.a. Identify, explain and organize components of the sales process.	ABS.06.05.01.b. Develop effective customer relationships using approaches that are consistent and comprehensive.	ABS.06.05.01.c. Monitor marketing approaches to determine effectiveness in goal achievement, and make needed changes in such approaches.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
ABS.06.05.02.a. Develop strategies to gain new customers.	ABS.06.05.02.b. Devise sales practices to achieve goals effectively and efficiently.	ABS.06.05.02.c. Prepare and make sales presentations.	
ABS.06.05.03.a. Identify and maintain needed sales records.	ABS.06.05.03.b. Use strategies to follow up sales to provide post-sales service.	ABS.06.05.03.c. Intercept, interpret and process customer complaints, needs and problems with products and services.	
ABS.07. Performance Element: Create a production system plan.			
ABS.07.01. Performance Indicator: Prepare a step-by-step production plan that identifies needed resources.			Language Arts: 4, 5 and 8
ABS.07.01.01.a. Prepare a flowchart that shows production processes, including the resources needed for each step.	ABS.07.01.01.b. Identify and assess alternative production systems and ways products can be produced.	ABS.07.01.01.c. Adapt production processes based on changing product characteristics.	
ABS.07.02. Performance Indicator: Develop a production and operational plan.			Language Arts: 4, 5, 6 and 12
ABS.07.02.01.a. Identify the components of a production and operational plan.	ABS.07.02.01.b. Evaluate the components of a production and operational plan and then revise an existing plan.	ABS.07.02.01.c. Develop and implement a product supply and distribution plan that meets the goals and objectives of an AFNR business.	
ABS.07.02.02.a. Identify common resources needed to operate a production facility.	ABS.07.02.02.b. Examine legal and industry requirements for a production facility.	ABS.07.02.02.c. Develop a production facility plan that includes building, equipment, personnel, utilities and logistics components.	
ABS.07.03. Performance Indicator: Utilize appropriate techniques to determine the most likely strengths, weaknesses and inconsistencies in a business plan and relate these to risk management strategies.			Language Arts: 12
ABS.07.03.01.a. Examine a business plan to identify inconsistencies and actions to correct inconsistencies.	ABS.07.03.01.b. Describe approaches to use in revising a business plan for improved consistency and realism.	ABS.07.03.01.c. Revise business plans as needed to assure internal consistency.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
ABS.07.04. Performance Indicator: Manage risk and uncertainty.			Language Arts: 12
ABS.07.04.01.a. Determine the meaning and importance of risk and uncertainty with AFNR enterprises.	ABS.07.04.01.b. Describe alternative approaches to reducing risk, including the use of insurance for product liability, property, production or income loss and for personnel life and health.	ABS.07.04.01.c. Prepare a comprehensive risk management and contingency plan for an AFNR business.	

Career Cluster: AGRICULTURE, FOOD AND NATURAL RESOURCES (AFNR)

Career Pathway: Animal Systems (AS)

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and practices to the production and management of animals.

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
AS.01. Performance Element: Examine the components, historical development, global implications and future trends of the animal systems industry.			
AS.01.01. Performance Indicator: Evaluate the development and implications of animal origin, domestication and distribution.			Science: C3 Social Studies: 7h
AS.01.01.01.a. Identify the origin, significance, distribution and domestication of animal species.	AS.01.01.01.b. Evaluate and describe characteristics of animals that developed in response to the animals' environment and led to their domestication.	AS.01.01.01.c. Predict adaptations of animals to production practices and environments.	
AS.01.01.02.a. Define major components of the animal industry.	AS.01.01.02.b. Outline the development of the animal industry and the resulting products, services and careers.	AS.01.01.02.c. Predict trends and implications of future development of the animal systems industry.	
AS.02. Performance Element: Classify, evaluate, select and manage animals based on anatomical and physiological characteristics.			
AS.02.01. Performance Indicator: Classify animals according to hierarchical taxonomy and agricultural use.			Science: C3
AS.02.01.01.a. Explain the importance of the binomial system of nomenclature.	AS.02.01.01.b. Explain how animals are classified using Linnaeus's taxonomical classification system.	AS.02.01.01.c. Classify animals according to the taxonomical classification system.	
AS.02.01.02.a. Identify major animal species by common and scientific names.	AS.02.01.02.b. Compare and contrast the hierarchical classification of the major agricultural animal species.	AS.02.01.02.c. Appraise and evaluate the economic value of animals for various applications in the agriculture industry.	
AS.02.02. Performance Indicator: Apply principles of comparative anatomy and physiology to uses within various animal systems.			Science: C1, C5 and F2
AS.02.02.01.a. Identify basic characteristics of animal cells, tissues, organs and body systems.	AS.02.02.01.b. Compare and contrast animal cells, tissues, organs and body systems.	AS.02.02.01.c. Explain how the components and systems of animal anatomy and physiology relate to the production and use of animals.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
AS.02.02.02.a. Diagram a typical animal cell and identify the organelles.	AS.02.02.02.b. Describe the functions of animal cell structures.	AS.02.02.02.c. Describe the molecular makeup of animal cells and its importance in animal production and management.	
AS.02.02.03.a. Describe the basic functions of animal cells in growth and reproduction.	AS.02.02.03.b. Detail the processes of meiosis and mitosis in animal growth, development, health and reproduction.	AS.02.02.03.c. Explain the application of the processes of meiosis and mitosis to animal growth, development, health and reproduction.	
AS.02.02.04.a. Describe the properties, locations, functions and types of animal tissues.	AS.02.02.04.b. Explain the relationship of animal tissues to growth, performance and health.	AS.02.02.04.c. Explain the importance and uses made of animal tissues in the agriculture industry.	
AS.02.02.05.a. Describe the properties, locations, functions and types of animal organs.	AS.02.02.05.b. Compare and contrast organ types and functions among animal species.	AS.02.02.05.c. Relate the importance of animal organs to the health, growth and reproduction of animals.	
AS.02.02.06.a. Describe the functions of the animal body systems and system components.	AS.02.02.06.b. Compare and contrast body systems and system adaptations between animal species.	AS.02.02.06.c. Explain the impact of animal body systems on performance, health, growth and reproduction.	
AS.02.03. Performance Indicator: Select animals for specific purposes and maximum performance based on anatomy and physiology.			Science: C5
AS.02.03.01.a. Identify ways an animal's health can be affected by anatomical and physiological disorders.	AS.02.03.01.b. Compare and contrast desirable anatomical and physiological characteristics of animals within and between species.	AS.02.03.01.c. Evaluate and select animals to maximize performance based on anatomical and physiological characteristics that affect health, growth and reproduction.	
AS.02.03.02.a. Create a program to develop an animal to its highest potential performance.	AS.02.03.02.b. Assess an animal to determine if it has reached its optimal performance level based on anatomical and physiological characteristics.	AS.02.03.02.c. Develop efficient procedures to produce consistently high-quality animals, well suited for their intended purposes.	
AS.03. Performance Element: Provide for the proper health care of animals.			
AS.03.01. Performance Indicator: Prescribe and implement a prevention and treatment program for animal diseases, parasites and other disorders.			Science: C4, F1 and F5
AS.03.01.01.a. Explain methods of determining animal health and disorders.	AS.03.01.01.b. Perform simple health-check evaluations on animals.	AS.03.01.01.c. Perform diagnostic tests to detect health problems in animals.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
AS.03.01.02.a. Identify common diseases, parasites and physiological disorders that affect animals.	AS.03.01.02.b. Diagnose illnesses and disorders of animals based on symptoms and problems caused by diseases, parasites and physiological disorders.	AS.03.01.02.c. Treat common diseases, parasites and physiological disorders of animals.	
AS.03.01.03.a. Explain characteristics of causative agents and vectors of diseases and disorders in animals.	AS.03.01.03.b. Evaluate preventive measures for controlling and limiting the spread of diseases, parasites and disorders among animals.	AS.03.01.03.c. Design and implement a health maintenance and disease and disorder prevention plan for animals in their natural and/or confined environments.	
AS.03.01.04.a. Explain the clinical significance of common considerations in veterinary treatments, such as aseptic techniques.	AS.03.01.04.b. Prepare animals, facilities and equipment for surgical and nonsurgical veterinary treatments and procedures.	AS.03.01.04.c. Perform surgical and nonsurgical veterinary treatments and procedures in animal health care.	
AS.03.01.05.a. Identify and describe zoonotic diseases.	AS.03.01.05.b. Explain the health risk of zoonotic diseases to humans and their historical significance and future implications.	AS.03.01.05.c. Implement zoonotic disease prevention methods and procedures for the safe handling and treatment of animals.	
AS.03.02. Performance Indicator: Provide for the biosecurity of agricultural animals and production facilities.			Science: F5 and F6 Social Studies: 9d
AS.03.02.01.a. Explain the importance of biosecurity to the animal industry.	AS.03.02.01.b. Discuss procedures at the local, state and national levels to ensure biosecurity of the animal industry.	AS.03.02.01.c. Implement a biosecurity plan for an animal production operation.	
AS.04. Performance Element: Apply principles of animal nutrition to ensure the proper growth, development, reproduction and economic production of animals.			
AS.04.01. Performance Indicator: Formulate feed rations to provide for the nutritional needs of animals.			Math: 1C and 6B Science: A4 and C5
AS.04.01.01.a. Compare and contrast common types of feedstuffs and the roles they play in the diets of animals.	AS.04.01.01.b. Determine the relative nutritional value of feedstuffs by evaluating their general quality and condition.	AS.04.01.01.c. Select appropriate feedstuffs for animals based on factors such as economics, digestive system and nutritional needs.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
AS.04.01.02.a. Explain the importance of a balanced ration for animals.	AS.04.01.02.b. Appraise the adequacy of feed rations using data from the analysis of feedstuffs, animal requirements and performance.	AS.04.01.02.c. Formulate animal feeds based on nutritional requirements, using feed ingredients for maximum nutrition and optimal economic production.	
AS.04.02. Performance Indicator: Prescribe and administer animal feed additives and growth promotants in animal production.			Science: C5
AS.04.02.01.a. Explain the purpose and benefits of feed additives and growth promotants in animal production.	AS.04.02.01.b. Discuss how feed additives and growth promotants are administered and the precautions that should be taken.	AS.04.02.01.c. Prescribe and administer feed additives and growth promotants.	
AS.05. Performance Element: Evaluate and select animals based on scientific principles of animal production.			
AS.05.01. Performance Indicator: Evaluate the male and female reproductive systems in selecting animals.			Science: C1 and C3
AS.05.01.01.a. Explain the male and female reproductive organs of the major animal species.	AS.05.01.01.b. Describe the functions of major organs in the male and female reproductive systems.	AS.05.01.01.c. Select breeding animals based on characteristics of the reproductive organs.	
AS.05.02. Performance Indicator: Evaluate animals for breeding readiness and soundness.			Science: C6
AS.05.02.01.a. Explain how age, size, life cycle, maturity level and health status affect the reproductive efficiency of male and female animals.	AS.05.02.01.b. Summarize factors that lead to reproductive maturity.	AS.05.02.01.c. Evaluate and select animals for reproductive readiness.	
AS.05.02.02.a. Discuss the importance of efficient and economic reproduction in animals.	AS.05.02.02.b. Evaluate reproductive problems that occur in animals.	AS.05.02.02.c. Treat or cull animals with reproductive problems.	
AS.05.03. Performance Indicator: Apply scientific principles in the selection and breeding of animals.			Math: 6C Science: A4, C2 and E2
AS.05.03.01.a. Explain genetic inheritance in agricultural animals.	AS.05.03.01.b. Explain the advantages of using genetically superior animals in the production of animals and animal products.	AS.05.03.01.c. Select a breeding system based on the principles of genetics.	
AS.05.03.02.a. Define natural and artificial breeding methods.	AS.05.03.02.b. Explain the processes of natural and artificial breeding methods.	AS.05.03.02.c. Select animal breeding methods based on reproductive and economic efficiency.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
AS.05.03.03.a. Explain the use of quantitative breeding values (e.g., EPDs) in the selection of genetically superior breeding stock.	AS.05.03.03.b. Compare and contrast quantitative breeding value differences between genetically superior animals and animals of average genetic value.	AS.05.03.03.c. Select animals based on quantitative breeding values for specific characteristics.	
AS.05.03.04.a. Explain the advantages of major reproductive management practices, including estrous synchronization, superovulation, flushing and embryo transfer.	AS.05.03.04.b. Explain the processes of major reproductive management practices, including estrous synchronization, superovulation, flushing and embryo transfer.	AS.05.03.04.c. Perform procedures for estrous synchronization, superovulation, flushing, embryo transfer and other reproductive management practices.	
AS.05.03.05.a. Discuss the uses and advantages and disadvantages of natural breeding and artificial insemination.	AS.05.03.05.b. Explain the materials, methods and processes of artificial insemination.	AS.05.03.05.c. Demonstrate artificial insemination techniques.	
AS.06. Performance Element: Prepare and implement animal handling procedures for the safety of animals, producers and consumers of animal products.			
AS.06.01. Performance Indicator: Demonstrate safe animal handling and management techniques.			Science: C6
AS.06.01.01.a. Discuss the dangers involved in working with animals.	AS.06.01.01.b. Outline safety procedures for working with animals by species.	AS.06.01.01.c. Interpret animal behaviors and execute protocols for safe handling of animals.	
AS.06.01.02.a. Explain the implications of animal welfare and animal rights for animal agriculture.	AS.06.01.02.b. Design programs that assure the welfare of animals and prevent abuse or mistreatment.	AS.06.01.02.c. Implement quality-assurance programs and procedures for animal production.	
AS.06.02. Performance Indicator: Implement procedures to ensure that animal products are safe.			Science: F1 and F5
AS.06.02.01.a. Identify animal production practices that could pose health risks or are considered to pose risks by some.	AS.06.02.01.b. Discuss consumer concerns with animal production practices relative to human health.	AS.06.02.01.c. Implement a program to assure the safety of animal products.	
AS.06.02.02.a. Describe how animal identification systems can track an animal's location, nutrition requirements, production progress and changes in health.	AS.06.02.02.b. Explain why animal trace-back capability, using individual animal and farm identification systems, is important to producers and consumers.	AS.06.02.02.c. Implement an animal and/or premises identification program.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
AS.07. Performance Element: Select animal facilities and equipment that provide for the safe and efficient production, housing and handling of animals.			
AS.07.01. Performance Indicator: Design animal housing, equipment and handling facilities for the major systems of animal production.			Science: C6 and F6
AS.07.01.01.a. Identify facilities needed to house and produce each animal species safely and efficiently.	AS.07.01.01.b. Critique designs for an animal facility and prescribe alternative layouts and adjustments for the safe and efficient use of the facility.	AS.07.01.01.c. Design an animal facility, focusing on animal requirements, efficiency, safety and ease of handling.	
AS.07.01.02.a. Identify equipment and handling facilities used in modern animal production.	AS.07.01.02.b. Explain how modern equipment and handling facilities enhance the safe and economic production of animals.	AS.07.01.02.c. Select equipment and implement animal handling procedures and improvements to enhance production efficiency.	
AS.07.02. Performance Indicator: Comply with government regulations and safety standards for facilities used in animal production.			Science: F5
AS.07.02.01.a. List the general standards (e.g., environmental, zoning, construction) that must be met in facilities for animal production.	AS.07.02.01.b. Evaluate an animal facility to determine if standards have been met.	AS.07.02.01.c. Design a facility that meets standards for the legal, safe, ethical and efficient production of animals.	
AS.08. Performance Element: Analyze environmental factors associated with animal production.			
AS.08.01. Performance Indicator: Reduce the effects of animal production on the environment.			Science: C4 and F4
AS.08.01.01.a. Evaluate the effects of animal agriculture on the environment.	AS.08.01.01.b. Outline methods of reducing the effects of animal agriculture on the environment.	AS.08.01.01.c. Implement measures to reduce the impact of animal agriculture on the environment.	
AS.08.02. Performance Indicator: Evaluate the effects of environmental conditions on animals.			Science: C6 and F4
AS.08.02.01.a. Identify optimal environmental conditions for animals.	AS.08.02.01.b. Describe the effects of environmental conditions on animal populations and performance.	AS.08.02.01.c. Establish and maintain favorable environmental conditions for animal growth and performance.	

Career Cluster: AGRICULTURE, FOOD AND NATURAL RESOURCES (AFNR)

Career Pathway: Biotechnology Systems (BS)

Pathway Content Standard: Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to biotechnology in agriculture.

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
BS.01. Performance Element: Recognize the historical, social, cultural and potential applications of biotechnology.			
BS.01.01. Performance Indicator: Distinguish major innovators, historical developments and potential applications of biotechnology in agriculture.			Science: E2, F6 and G3 Language Arts: 8 Social Studies: 2b, 8a, 8c and 8e
BS.01.01.01.a. Define biotechnology and explore the historical impact it has had on agriculture.	BS.01.01.01.b. Create a timeline and use it to explain the developmental progression of biotechnology.	BS.01.01.01.c. Research and report on the major innovators and milestones in the development of biotechnology.	
BS.01.01.02.a. Investigate current applications of biotechnology in agriculture.	BS.01.01.02.b. Research and report on current work being done in agricultural biotechnology.	BS.01.01.02.c. Analyze the scope and impact of agricultural biotechnology in today's global society.	
BS.01.01.03.a. Examine potential future applications of biotechnology in agriculture and compare them with alternative approaches to improving agriculture.	BS.01.01.03.b. Research and report on emerging problems and issues associated with agricultural biotechnology.	BS.01.01.03.c. Assess the future impact agricultural biotechnology could have on world populations.	
BS.01.02. Performance Indicator: Determine regulatory issues and identify agencies associated with biotechnology.			Science: A1 Language Arts: 4 and 7 Social Studies: 10c
BS.01.02.01.a. Describe the role of agencies that regulate biotechnology.	BS.01.02.01.b. Interpret the major regulatory issues related to biotechnology.	BS.01.02.01.c. Research, evaluate and articulate a major regulatory issue pertaining to biotechnology.	
BS.01.03. Performance Indicator: Analyze the ethical, legal, social and cultural issues relating to biotechnology.			Science: A4 Language Arts: 4, 7 and 8 Social Studies: 10c and 10i
BS.01.03.01.a. Explore ethical, legal and social biotechnology issues.	BS.01.03.01.b. Evaluate the benefits and risks associated with biotechnology.	BS.01.03.01.c. Research, evaluate and articulate the implications of an ethical, legal, social or cultural biotechnology issue.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
BS.01.03.02.a. Explore the emergence, evolution and implications of bioethics.	BS.01.03.02.b. Examine an ethical dilemma associated with biotechnology by identifying its components.	BS.01.03.02.c. Research and debate an ethical issue associated with biotechnology.	
BS.01.03.03.a. Explain the meaning of intellectual properties as related to biotechnology.	BS.01.03.03.b. Examine intellectual properties associated with biotechnology by defining their components.	BS.01.03.03.c. Analyze an intellectual property issue associated with bioethics.	
BS.02. Performance Element: Demonstrate laboratory skills as applied to biotechnology.			
BS.02.01. Performance Indicator: Maintain and interpret biotechnology laboratory records.			Math: 2D, 3A and 5B Science: A2 and A6 Language Arts: 5 and 7
BS.02.01.01.a. Maintain a biotechnology laboratory notebook.	BS.02.01.01.b. Analyze strengths of the research based on data and procedures, and propose future investigation.	BS.02.01.01.c. Utilize external reviews and compare them to research conducted.	
BS.02.02. Performance Indicator: Operate biotechnology laboratory equipment according to standard procedures.			Math: 4A Science: A3
BS.02.02.01.a. Operate basic laboratory equipment and measurement devices.	BS.02.02.01.b. Operate advanced laboratory equipment and measurement devices.	BS.02.02.01.c. Calibrate laboratory equipment and conduct instrument qualification tests.	
BS.02.03. Performance Indicator: Demonstrate proper laboratory procedures using biological materials.			Science: A2, A3 and E1
BS.02.03.01.a. Demonstrate basic aseptic techniques in the biotechnology laboratory.	BS.02.03.01.b. Demonstrate advanced aseptic techniques in the biotechnology laboratory.	BS.02.03.01.c. Perform bioassays and experiments under aseptic conditions.	
BS.02.03.02.a. Perform procedures with biological materials according to directions.	BS.02.03.02.b. Select an appropriate standard operating procedure for working with biological materials.	BS.02.03.02.c. Develop a standard operating procedure for a biological process.	
BS.02.04. Performance Indicator: Safely manage biological materials, chemicals and wastes used in the laboratory.			Science: B2, B3, F4 and F5 Language Arts: 7
BS.02.04.01.a. Prepare simple chemical solutions using standard operating procedures.	BS.02.04.01.b. Prepare buffers, reagents, solutions and media.	BS.02.04.01.c. Verify the physical properties of buffers, reagents, solutions and media.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
BS.02.04.02.a. Identify and describe hazards associated with biological and chemical materials.	BS.02.04.02.b. Inventory biological and chemical materials, and maintain accurate records of supplies and expiration dates.	BS.02.04.02.c. Order, stock and maintain supplies of biological and chemical materials.	
BS.02.04.03.a. Maintain a safe environment by properly identifying and disposing of laboratory waste.	BS.02.04.03.b. Diagram the flow of waste after it leaves the laboratory.	BS.02.04.03.c. Devise a management plan to reduce laboratory waste.	
BS.02.05. Performance Indicator: Perform microbiology, molecular biology, enzymology and immunology procedures.			Math: 2C Science: A1, A2, A3, B2, C2, C6 and E2 Language Arts: 4
BS.02.05.01.a. Differentiate the types of organisms and demonstrate how to handle them safely.	BS.02.05.01.b. Isolate, maintain, quantify and store cell cultures.	BS.02.05.01.c. Characterize the physical, chemical and biological properties of microbes.	
BS.02.05.02.a. Explain the structures of DNA and RNA and how genotype influences phenotype.	BS.02.05.02.b. Explain the molecular basis for heredity and the tools and techniques used in DNA and RNA manipulations.	BS.02.05.02.c. Analyze factors that influence gene expression.	
BS.02.05.03.a. Extract and purify DNA and RNA.	BS.02.05.03.b. Perform electrophoretic techniques and interpret electrophoresis fragmentation patterns.	BS.02.05.03.c. Perform DNA and RNA manipulations, such as cloning/subcloning, blotting, sequencing and amplification.	
BS.02.05.04.a. Perform simple enzyme activity assays to detect proteins.	BS.02.05.04.b. Perform protein separation techniques and interpret the results.	BS.02.05.04.c. Characterize the biochemical properties of proteins.	
BS.02.05.05.a. Describe how antibodies are formed and how they can be used in biotechnology applications.	BS.02.05.05.b. Conduct an Enzyme-Linked Immunosorbent Assay (ELISA).	BS.02.05.05.c. Use antibodies to detect and quantify antigens.	
BS.02.05.06.a. Explain reasons for detecting microbes and identify sources of microbes.	BS.02.05.06.b. Research and describe the use of biotechnology to detect microbes.	BS.02.05.06.c. Design and perform an assay to detect a target microorganism in food, water or the environment.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
BS.03. Performance Element: Demonstrate the application of biotechnology to Agriculture, Food and Natural Resources (AFNR).			
BS.03.01. Performance Indicator: Evaluate the application of genetic engineering to improve products of AFNR systems.			Math: 2C Science: A2, C2, E2 and F4 Language Arts: 7 and 8
BS.03.01.01.a. Explain biological, social, agronomic and economic reasons for genetic modification of eukaryotes.	BS.03.01.01.b. Diagram the processes and describe the techniques used to produce transgenic eukaryotes.	BS.03.01.01.c. Design and conduct an experiment to evaluate an existing transgenic eukaryote.	
BS.03.01.02.a. Describe enzymes, the changes they cause in foods and the physical and chemical parameters that affect enzymatic reactions.	BS.03.01.02.b. Describe processes by which enzymes are produced through biotechnology.	BS.03.01.02.c. Use biotechnology tools or microbial strain selection to improve or discover enzymes for use in food processing.	
BS.03.01.03.a. Compare and contrast the use of natural organisms and genetically engineered organisms in the treatment of wastes.	BS.03.01.03.b. Diagram the process by which organisms are genetically engineered for waste treatment.	BS.03.01.03.c. Monitor and evaluate the treatment of a waste product using a genetically engineered organism.	
BS.03.01.04.a. Describe the benefits and risks associated with the use of biotechnology to increase productivity and improve quality of aquatic species.	BS.03.01.04.b. Investigate and report on genetic engineering procedures used in the production of aquatic species.	BS.03.01.04.c. Conduct field or clinical trials for genetically modified aquatic species.	
BS.03.02. Performance Indicator: Perform biotechnology processes used in AFNR systems.			Science: B3, C5, D1 and E2 Language Arts: 4
BS.03.02.01.a. Explain the functions of hormones in animals.	BS.03.02.01.b. Describe the processes used to produce animal hormones from transgenic organisms.	BS.03.02.01.c. Administer hormones to enhance animal health, growth or reproduction, and monitor and analyze the results.	
BS.03.02.02.a. Identify foods produced through fermentation.	BS.03.02.02.b. Compare and contrast bioengineering and conventional pathways used in food processing.	BS.03.02.02.c. Process food using biotechnology.	
BS.03.02.03.a. Explain the process of fermentation.	BS.03.02.03.b. Describe the process used in producing alcohol from biomass.	BS.03.02.03.c. Produce alcohol and co-products from biomass.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
BS.03.02.04.a. Explain the process of transesterification.	BS.03.02.04.b. Diagram the process used in producing biodiesel from biomass.	BS.03.02.04.c. Produce biodiesel and co-products from biomass.	
BS.03.02.05.a. Explain the process of methanogenesis.	BS.03.02.05.b. Illustrate the process used in producing methane from biomass.	BS.03.02.05.c. Produce methane and co-products from biomass.	
BS.03.03. Performance Indicator: Use biotechnology to monitor and evaluate procedures performed in AFNR systems.			Science: A2, A3, C4, C6 and F5 Language Arts: 7 and 8
BS.03.03.01.a. Describe the selective plant breeding process.	BS.03.03.01.b. Select biotechnology tools used to monitor and direct plant breeding.	BS.03.03.01.c. Design and conduct an experiment using biotechnology tools to evaluate selectively bred plants.	
BS.03.03.02.a. Describe biotechnology processes applicable to animal health.	BS.03.03.02.b. Assess the benefits, risks and opportunities associated with using biotechnology to promote animal health.	BS.03.03.02.c. Design animal-care protocols that use biotechnology tools to ethically monitor and promote animal systems.	
BS.03.03.03.a. Give examples of instances in which bioremediation can be applied to clean up environmental contaminants.	BS.03.03.03.b. Describe the use of biotechnology in bioremediation.	BS.03.03.03.c. Monitor and evaluate the effectiveness of bioremediation efforts by participating in a bioremediation project.	
BS.03.03.04.a. Explain the use of microorganisms in biological waste management.	BS.03.03.04.b. Describe the processes involved in biotreatment of biological wastes.	BS.03.03.04.c. Monitor and evaluate the treatment of biological wastes with microorganisms.	
BS.03.03.05.a. Explain the role of microorganisms in industrial chemical waste treatment.	BS.03.03.05.b. Interpret the processes involved in biotreatment of industrial chemical wastes.	BS.03.03.05.c. Monitor and evaluate the treatment of industrial chemical wastes with microorganisms.	
BS.03.03.06.a. Explain the global importance of biodiversity.	BS.03.03.06.b. Select biotechnology tools used to measure biodiversity.	BS.03.03.06.c. Use biotechnology tools to measure biodiversity in a population.	
BS.03.03.07.a. Explain the consequences of agricultural practices on wild populations.	BS.03.03.07.b. Explain how biotechnology tools can be used to monitor the effects of agricultural practices on wild populations.	BS.03.03.07.c. Analyze the implications of biotechnology on wild species.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
BS.03.03.08.a. Explain biomass and sources of biomass.	BS.03.03.08.b. Assess the characteristics of biomass that make it useful for biofuels production.	BS.03.03.08.c. Evaluate the technologies used to create biofuels from biomass.	
BS.03.03.09.a. Define industrial biotechnology, and describe the benefits and risks associated with its use in the manufacturing of fabrics, plastics and other products.	BS.03.03.09.b. Describe the processes used in the production of molecules for use in industrial applications.	BS.03.03.09.c. Monitor and evaluate biotechnology processes used in the synthesis of a molecule.	

Career Cluster: AGRICULTURE, FOOD AND NATURAL RESOURCES (AFNR)

Career Pathway: Environmental Service Systems (ESS)

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the management of environmental service systems.

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
ESS.01. Performance Element: Use analytical procedures to plan and evaluate environmental service systems.			
ESS.01.01. Performance Indicator: Analyze and interpret samples.			Math: 1A, 1B, 4A and 5B Science: A2
ESS.01.01.01.a. Identify sample types and sampling techniques, explain the importance of unbiased sampling and collect samples.	ESS.01.01.01.b. Determine the appropriate sampling techniques needed to generate statistical analysis data, and prepare valid chemical laboratory samples according to instructions.	ESS.01.01.01.c. Analyze and interpret results of sample measurements.	
ESS.01.01.02.a. Identify basic laboratory equipment and environmental monitoring instruments and explain their uses.	ESS.01.01.02.b. Demonstrate the proper use and maintenance of basic laboratory equipment and environmental monitoring instruments.	ESS.01.01.02.c. Calibrate and use laboratory and field equipment and instruments according to standard operating procedures.	
ESS.02. Performance Element: Assess the impact of policies and regulations on environmental service systems.			
ESS.02.01. Performance Indicator: Interpret laws affecting environmental service systems.			Science: F4 Language Arts: 1 and 8 Social Studies: 10c
ESS.02.01.01.a. Identify laws associated with environmental service systems.	ESS.02.01.01.b. Identify the purposes of laws associated with environmental service systems.	ESS.02.01.01.c. Abide by the specific laws pertaining to environmental service systems.	
ESS.03. Performance Element: Apply scientific principles to environmental service systems.			
ESS.03.01. Performance Indicator: Apply meteorology principles to environmental service systems.			Science: D2 and F4 Language Arts: 8 Social Studies: 3c
ESS.03.01.01.a. Identify components and structural layers of the earth's atmosphere.	ESS.03.01.01.b. Differentiate the types of weather systems and weather patterns.	ESS.03.01.01.c. Monitor meteorological conditions and accurately record and document the data.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
ESS.03.01.02.a. Explain how meteorological conditions influence air quality.	ESS.03.01.02.b. Illustrate the formation of acid precipitation and explain its impact on the environment.	ESS.03.01.02.c. Monitor air quality and accurately record and document the data.	
ESS.03.01.03.a. Explain climate change and recognize signs of climate change.	ESS.03.01.03.b. Prepare a report on the environmental consequences of climate change.	ESS.03.01.03.c. Evaluate the predicted impacts of global climate change on environmental service systems.	
ESS.03.01.04.a. Explain the earth's balance of energy.	ESS.03.01.04.b. Explain the basics of the greenhouse effect and describe how the greenhouse effect alters the earth's balance of energy.	ESS.03.01.04.c. Explain processes that contribute to the change in levels of greenhouse gases.	
ESS.03.02. Performance Indicator: Apply soil science principles to environmental service systems.			Science: B2 and D2 Social Studies: 3k
ESS.03.02.01.a. Explain the process of soil formation through weathering.	ESS.03.02.01.b. Differentiate rock types and relate the chemical composition of mineral matter in soils to the parent material.	ESS.03.02.01.c. Apply knowledge of soil orders to environmental service systems.	
ESS.03.02.02.a. Describe the biodiversity found in soil and the contribution of biodiversity to the physical and chemical characteristics of soil.	ESS.03.02.02.b. Relate the activities of microorganisms in soil to environmental service systems.	ESS.03.02.02.c. Evaluate the uses of soil microorganisms in environmental service systems.	
ESS.03.02.03.a. Explain how the physical qualities of the soil influence the infiltration and percolation of water.	ESS.03.02.03.b. Identify the physical qualities of the soil that determine its use for environmental service systems.	ESS.03.02.03.c. Conduct tests of soil to determine its use for environmental service systems.	
ESS.03.02.04.a. Identify land uses, capability factors and land capability classes.	ESS.03.02.04.b. Use a soil survey to determine the land capability classes for different parcels of land in an area.	ESS.03.02.04.c. Design a master land-use management plan for a given area.	
ESS.03.03. Performance Indicator: Apply hydrology principles to environmental service systems.			Science: D2
ESS.03.03.01.a. Describe the world's water supplies and discuss the many uses of water.	ESS.03.03.01.b. Describe characteristics of water that influence the biosphere and sustain life.	ESS.03.03.01.c. Research and debate one or more current environmental issues associated with the supplies of groundwater and surface water.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
ESS.03.03.02.a. Demonstrate knowledge of hydrogeology by differentiating between groundwater and surface water.	ESS.03.03.02.b. Describe interactions between groundwater and surface water.	ESS.03.03.02.c. Use groundwater-flow equations and Darcy's Law to explain how geology and meteorology affect groundwater and groundwater flow.	
ESS.03.03.03.a. Define groundwater potential.	ESS.03.03.03.b. Identify differences in groundwater potential.	ESS.03.03.03.c. Delineate groundwater potential zones.	
ESS.03.03.04.a. Identify environmental hazards associated with groundwater supplies.	ESS.03.03.04.b. Describe precautions taken to prevent/reduce contamination of groundwater supplies.	ESS.03.03.04.c. Test and document the quality of groundwater supplies.	
ESS.03.03.05.a. Discuss factors that influence the velocity of water through an open channel.	ESS.03.03.05.b. Explain how the velocity of water influences channel morphology and stream processes.	ESS.03.03.05.c. Measure and document water flow through an open channel and interpret channel-flow analysis.	
ESS.03.03.06.a. Identify the operational components of a pumping or fluid movement system.	ESS.03.03.06.b. Discuss design principles related to hydraulic systems and high-flow technologies related to fluid movement.	ESS.03.03.06.c. Install and maintain pumps and associated delivery systems.	
ESS.03.04. Performance Indicator: Apply best management techniques associated with the properties, classifications and functions of wetlands.			Science: C4 and F3 Social Studies: 3c
ESS.03.04.01.a. Describe the functions of wetlands and differentiate types of wetlands.	ESS.03.04.01.b. Explain the criteria for classifying wetlands.	ESS.03.04.01.c. Apply the Hydrogeomorphic (HGM) Approach and National Wetland Inventories (NWI) to determine the classifications for local wetlands.	
ESS.03.04.02.a. Identify the major types of living organisms that inhabit wetlands.	ESS.03.04.02.b. Identify the predominant species in a local wetland.	ESS.03.04.02.c. Conduct a survey of the predominant species in a local wetland.	
ESS.03.04.03.a. Explain the importance of wetland management, creation, enhancement and restoration programs.	ESS.03.04.03.b. Identify techniques used in wetland management, creation, enhancement and restoration programs.	ESS.03.04.03.c. Evaluate and document the condition of a local wetland and apply techniques to manage, create, enhance and/or restore local wetlands.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
ESS.03.05. Performance Indicator: Apply chemistry principles to environmental service systems.			Science: B2, B3 and F4
ESS.03.05.01.a. Explain basic chemistry principles.	ESS.03.05.01.b. Distinguish the characteristics of inorganic and organic compounds as they relate to environmental service systems.	ESS.03.05.01.c. Apply standard operating procedures for use of chemicals in environmental service systems.	
ESS.03.06. Performance Indicator: Apply microbiology principles to environmental service systems.			Science: A2, C1 and F1
ESS.03.06.01.a. Identify the basic structures of microorganisms and the major groups of microorganisms.	ESS.03.06.01.b. Describe microbial growth in the environment and analyze the influence of environmental factors on microbial growth.	ESS.03.06.01.c. Collect, culture and examine microorganisms, following safety procedures.	
ESS.03.06.02.a. Define the purposes of bioassay tests.	ESS.03.06.02.b. Outline procedures for a bioassay test.	ESS.03.06.02.c. Conduct bioassay tests related to environmental service systems and interpret results.	
ESS.04. Performance Element: Operate environmental service systems to manage a facility environment.			
ESS.04.01. Performance Indicator: Use pollution control measures to maintain a safe facility environment.			Science: F4 and F5
ESS.04.01.01.a. Identify types of pollution and distinguish between point source and nonpoint source pollution.	ESS.04.01.01.b. Give examples of how industrial and nonindustrial pollution has damaged the environment.	ESS.04.01.01.c. Survey the local area for evidence of industrial and nonindustrial pollution.	
ESS.04.01.02.a. Describe ways in which pollution can be managed and prevented.	ESS.04.01.02.b. Conduct tests to determine the presence and extent of pollution.	ESS.04.01.02.c. Plan and develop a pollution remediation, management or prevention program.	
ESS.04.02. Performance Indicator: Manage safe disposal of all categories of solid waste.			Science: F1, F4 and F5
ESS.04.02.01.a. Describe different types of solid waste.	ESS.04.02.01.b. Evaluate environmental hazards created by different types of solid waste, solid waste accumulation and solid waste disposal.	ESS.04.02.01.c. Analyze environmental hazards associated with the identification and acceptance of solid waste disposal sites.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
ESS.04.02.02.a. Discuss practical management options for treating solid waste.	ESS.04.02.02.b. Identify characteristics of solid waste treatment and recognize the byproducts of solid waste treatment.	ESS.04.02.02.c. Collect and treat solid waste materials.	
ESS.04.02.03.a. Define sanitary landfill.	ESS.04.02.03.b. Explain basic sanitary landfill operating procedures and design.	ESS.04.02.03.c. Evaluate sanitary landfill procedures.	
ESS.04.02.04.a. Define compost and composting.	ESS.04.02.04.b. Explain scientific principles related to composting.	ESS.04.02.04.c. Evaluate methods of operating a composting facility.	
ESS.04.02.05.a. Explain the basic concepts associated with solid waste incineration.	ESS.04.02.05.b. Describe the environmental impact of solid waste incineration.	ESS.04.02.05.c. Evaluate methods of incinerating solid waste, including those used in waste-to-energy plants.	
ESS.04.02.06.a. Explain the importance of recycling.	ESS.04.02.06.b. Describe recycling methods and identify materials that can be recycled.	ESS.04.02.06.c. Survey and evaluate local recycling programs and procedures.	
ESS.04.03. Performance Indicator: Apply the principles of public drinking water treatment operations to ensure safe water at a facility.			Science: F3 and F5
ESS.04.03.01.a. Identify chemical and physical properties of drinking water.	ESS.04.03.01.b. Illustrate the steps in the public drinking water treatment process.	ESS.04.03.01.c. Demonstrate the use of water-testing instruments and water-treatment equipment for processing public drinking water.	
ESS.04.03.02.a. Define source water quality.	ESS.04.03.02.b. Define source water assessment steps.	ESS.04.03.02.c. Conduct and interpret source water assessments.	
ESS.04.04. Performance Indicator: Apply principles of wastewater treatment to manage wastewater disposal in keeping with rules and regulations.			Science: F4 and F5
ESS.04.04.01.a. Define wastewater.	ESS.04.04.01.b. Diagram the steps in wastewater treatment.	ESS.04.04.01.c. Demonstrate the use of water-testing instruments and water-treatment equipment to treat wastewater.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
ESS.04.05. Performance Indicator: Manage hazardous materials to assure a safe facility and to comply with applicable regulations.			Science: F4 and F5
ESS.04.05.01.a. Identify types of hazardous materials.	ESS.04.05.01.b. Describe risks related to hazardous materials and describe health and safety practices to reduce risks from hazardous materials.	ESS.04.05.01.c. Describe the procedures for the treatment and disposal of hazardous materials and hazardous waste.	
ESS.05. Performance Element: Examine the relationships between energy sources and environmental service systems.			
ESS.05.01. Performance Indicator: Compare and contrast the impact of conventional and alternative energy sources on the environment.			Science: B6, D1 and F3
ESS.05.01.01.a. Identify conventional energy sources and list conservation measures to reduce energy consumption.	ESS.05.01.01.b. Identify advantages and disadvantages to conventional energy sources.	ESS.05.01.01.c. Evaluate the impact the burning of fossil fuels has on the environment.	
ESS.05.01.02.a. Identify alternative energy sources.	ESS.05.01.02.b. Identify advantages and disadvantages to alternative energy sources.	ESS.05.01.02.c. Evaluate the impact of alternative energy sources on the environment.	
ESS.06. Performance Element: Use tools, equipment, machinery and technology to accomplish tasks in environmental service systems.			
ESS.06.01. Performance Indicator: Use technological and mathematical tools to map land, facilities and infrastructure.			Science: A3 Social Studies: 3c and 3e
ESS.06.01.01.a. Explain the importance of surveying and mapping for environmental service systems.	ESS.06.01.01.b. Explain surveying and mapping principles and identify and explain the use of equipment for surveying and mapping.	ESS.06.01.01.c. Demonstrate surveying and cartographic skills to make site measurements and map facility accesses and infrastructure.	
ESS.06.02. Performance Indicator: Maintain tools, equipment and machinery in safe working order for tasks in environmental service systems.			
ESS.06.02.01.a. Demonstrate proper use and maintenance of hand tools.	ESS.06.02.01.b. Operate equipment and machinery in accordance with manufacturers' instructions and OSHA standards, specifically addressing personal protective equipment and proper machine guarding.	ESS.06.02.01.c. Demonstrate proper preventive maintenance techniques and set up a mock preventive maintenance schedule.	

Career Cluster: AGRICULTURE, FOOD AND NATURAL RESOURCES (AFNR)

Career Pathway: Food Products and Processing Systems (FPP)

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles, practices and techniques in the processing, storage and development of food products.

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
FPP.01. Performance Element: Examine components of the food industry and historical development of food products and processing.			
FPP.01.01. Performance Indicator: Evaluate the significance and implications of changes and trends in the food products and processing industry.			Science: F1 Language Arts: 7 and 8 Social Studies: 1g and 8c
FPP.01.01.01.a. Discuss the history and describe and explain the components (e.g., processing, distribution, byproducts) of the food products and processing industry.	FPP.01.01.01.b. Evaluate changes and trends in the food products and processing industry.	FPP.01.01.01.c. Predict trends and implications in the food products and processing industry.	
FPP.01.01.02.a. Identify and explain environmental and safety concerns about the food supply.	FPP.01.01.02.b. Discuss the issues of safety and environmental concerns about foods and food processing (e.g., Genetically Modified Organisms, microorganisms, contamination, irradiation).	FPP.01.01.02.c. Determine appropriate industry response to consumer concerns to assure a safe and wholesome food supply.	
FPP.01.02. Performance Indicator: Work effectively with industry organizations, groups and regulatory agencies affecting the food products and processing industry.			Language Arts: 12 Social Studies: 6c and 8f
FPP.01.02.01.a. Explain the purposes of organizations that are part of or regulate the food products and processing industry.	FPP.01.02.01.b. Evaluate the changes in the food products and processing industry brought about by industry organizations or regulatory agencies.	FPP.01.02.01.c. Interact effectively with organizations, groups and regulatory agencies that affect the food products and processing industry.	
FPP.01.02.02.a. Explain the importance and usage of industry standards in food products and processing.	FPP.01.02.02.b. Discuss the application of industry standards in the food products and processing industry.	FPP.01.02.02.c. Prepare a plan for implementation of industry standards in food products and processing programs.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
FPP.02. Performance Element: Apply safety principles, recommended equipment and facility management techniques to the food products and processing industry.			
FPP.02.01. Performance Indicator: Manage operational procedures and create equipment and facility maintenance plans.			Language Arts: 12
FPP.02.01.01.a. Explain the importance of developing and maintaining Sanitation Standard Operating Procedures (SSOP).	FPP.02.01.01.b. Evaluate the SSOP of a food products and processing company.	FPP.02.01.01.c. Develop SSOP for a food products and processing company.	
FPP.02.01.02.a. Explain the purpose of Good Manufacturing Practices (GMP).	FPP.02.01.02.b. Evaluate the GMP of a food products and processing company.	FPP.02.01.02.c. Implement GMP for a food products and processing company.	
FPP.02.01.03.a. Identify reasons for using a planned maintenance program to maintain equipment and facilities.	FPP.02.01.03.b. Develop a basic equipment and facility maintenance program.	FPP.02.01.03.c. Perform basic equipment and facility maintenance in a food products and processing operation.	
FPP.02.02. Performance Indicator: Implement Hazard Analysis and Critical Control Point (HACCP) procedures to establish operating parameters.			Science: F5 Language Arts: 8
FPP.02.02.01.a. Describe contamination hazards (physical, chemical and biological) associated with food products and processing.	FPP.02.02.01.b. Outline procedures to eliminate possible contamination hazards associated with food products and processing.	FPP.02.02.01.c. Analyze the effectiveness of a food products and processing company's Critical Control Point (CCP) procedures.	
FPP.02.02.02.a. Identify the seven principles of HACCP.	FPP.02.02.02.b. Explain the implementation of the seven principles of HACCP.	FPP.02.02.02.c. Implement an HACCP program for a food products and processing facility.	
FPP.02.03. Performance Indicator: Apply safety and sanitation procedures in the handling, processing and storing of food products.			Science: A2 and F5
FPP.02.03.01.a. Explain techniques and procedures for the safe handling of food products.	FPP.02.03.01.b. Evaluate food product handling procedures.	FPP.02.03.01.c. Demonstrate approved food product handling techniques.	
FPP.02.03.02.a. Describe the importance of performing quality-assurance tests on food products.	FPP.02.03.02.b. Perform quality-assurance tests on food products.	FPP.02.03.02.c. Interpret quality-assurance test results and apply corrective procedures.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
FPP.02.03.03.a. Describe the effects food-borne pathogens have on food products and humans.	FPP.02.03.03.b. Explain the importance of microbiological tests in food product preparation, listing common spoilage and pathogenic microorganisms.	FPP.02.03.03.c. Conduct and interpret microbiological tests for food-borne pathogens and implement corrective procedures.	
FPP.02.03.04.a. Explain the importance of record keeping in a food products and processing system.	FPP.02.03.04.b. Discuss documentation procedures in a food products and processing system.	FPP.02.03.04.c. Demonstrate proper record keeping in a food products and processing system.	
FPP.02.04. Performance Indicator: Demonstrate worker safety procedures with food product and processing equipment and facilities.			Science: F5 Language Arts: 8
FPP.02.04.01.a. Explain safety standards that must be observed in facility design and equipment use.	FPP.02.04.01.b. Outline guidelines for personnel safety in the food products and processing industry.	FPP.02.04.01.c. Evaluate a facility to determine the implementation of safety procedures.	
FPP.03. Performance Element: Apply principles of science to the food products and processing industry.			
FPP.03.01. Performance Indicator: Apply principles of science to food processing to provide a safe, wholesome and nutritious food supply.			Science: A2, B3 and F1
FPP.03.01.01.a. Discuss how research and industry developments lead to improvements in the food products and processing industry.	FPP.03.01.01.b. Design a research project in food science using the scientific method.	FPP.03.01.01.c. Conduct research in food science and interpret results to improve food products.	
FPP.03.01.02.a. Explain the application of chemistry and physics to food science.	FPP.03.01.02.b. Explain how the chemical and physical properties of foods influence nutritional value and eating quality.	FPP.03.01.02.c. Determine the chemical and physical properties of food products.	
FPP.03.01.03.a. Explain the Food Guide Pyramid in relation to essential nutrients for the human diet.	FPP.03.01.03.b. Compare and contrast the nutritive value of food and food groups.	FPP.03.01.03.c. Design a daily food guide for a healthful diet.	
FPP.03.01.04.a. Discuss common food constituents (e.g., proteins, carbohydrates, fats, vitamins, minerals).	FPP.03.01.04.b. Compare and contrast food constituents and their relative value to product taste, appearance, etc.	FPP.03.01.04.c. Analyze food products to identify food constituents.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
FPP.03.01.05.a. Identify common food additives (e.g., preservatives, antioxidants, buffers, stabilizers, colors, flavors).	FPP.03.01.05.b. Describe the purpose of common food additives.	FPP.03.01.05.c. Formulate and explain incorporation of additives into food products.	
FPP.03.01.06.a. Explain the importance of food labeling to the consumer.	FPP.03.01.06.b. Explain the required components of a food label.	FPP.03.01.06.c. Prepare and label foods according to the established standards of regulatory agencies.	
FPP.03.01.07.a. Describe factors in planning and developing a new food product (e.g., regulation, creativity, and economics).	FPP.03.01.07.b. Plan and create a new food product.	FPP.03.01.07.c. Perform sensory-testing and marketing functions to characterize and determine consumer preference and market potential.	
FPP.04. Performance Element: Select and process food products for storage, distribution and consumption.			
FPP.04.01. Performance Indicator: Utilize harvesting, selection and inspection techniques to obtain quality food products for processing.			Science: F1 Language Arts: 12
FPP.04.01.01.a. Identify quality and yield grades of food products.	FPP.04.01.01.b. Discuss factors that affect quality and yield grades of food products.	FPP.04.01.01.c. Assign quality and yield grades to food products according to industry standards.	
FPP.04.01.02.a. Select raw food products based on yield grades, quality grades and related selection criteria.	FPP.04.01.02.b. Perform quality-control inspections of raw food products for processing.	FPP.04.01.02.c. Implement procedures to maintain original food quality and yield.	
FPP.04.01.03.a. Identify and describe accepted animal treatment and harvesting techniques.	FPP.04.01.03.b. Compare and contrast accepted animal treatment and harvesting techniques.	FPP.04.01.03.c. Harvest animals using regulatory-agency-approved or industry-approved techniques.	
FPP.04.01.04.a. Describe the importance of pre-mortem and post-mortem inspections of animals for harvest.	FPP.04.01.04.b. Explain desirable and undesirable characteristics of both pre-mortem and post-mortem animals in relation to the production of food products.	FPP.04.01.04.c. Conduct pre-mortem and post-mortem inspections of animals.	
FPP.04.02. Performance Indicator: Evaluate, grade and classify processed food products.			Science: F1 Language Arts: 8
FPP.04.02.01.a. Identify and describe foods derived from meat, egg, poultry, fish and dairy products.	FPP.04.02.01.b. Discuss desirable qualities of processed meat, egg, poultry, fish and dairy products.	FPP.04.02.01.c. Evaluate, grade and classify processed meat, egg, poultry, fish and dairy products.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
FPP.04.02.02.a. Identify and describe products derived from fruits and vegetables.	FPP.04.02.02.b. Discuss desirable qualities of fruit and vegetable products.	FPP.04.02.02.c. Evaluate, grade and classify processed products from fruits and vegetables.	
FPP.04.02.03.a. Identify and describe products derived from grains, legumes and oilseeds.	FPP.04.02.03.b. Discuss desirable qualities of grain, legume and oilseed products.	FPP.04.02.03.c. Evaluate, grade and classify finished products derived from grains, legumes and oilseeds.	
FPP.04.03. Performance Indicator: Process, preserve, package and present food and food products for sale and distribution.			Math: 1C, 4A and 4B Science: F1
FPP.04.03.01.a. Identify and explain common weights and measures used in the food products and processing industry.	FPP.04.03.01.b. Weigh and measure food products and perform conversions between units of measure.	FPP.04.03.01.c. Use weights and measures to formulate and package food products.	
FPP.04.03.02.a. Explain methods and materials for processing foods for sale as fresh-food products.	FPP.04.03.02.b. Prepare foods for sale and distribution as fresh-food products.	FPP.04.03.02.c. Evaluate foods prepared for the fresh-food market based on factors such as shelf life, shrinkage, appearance and weight.	
FPP.04.03.03.a. Identify methods of food preservation and give examples of foods preserved by each method.	FPP.04.03.03.b. Explain the processes of food preservation methods.	FPP.04.03.03.c. Preserve foods using various methods and techniques.	
FPP.04.03.04.a. Explain techniques for preparing ready-to-eat food products.	FPP.04.03.04.b. Demonstrate techniques of preparing ready-to-eat food products.	FPP.04.03.04.c. Evaluate ready-to-eat food products.	
FPP.04.03.05.a. Explain materials and methods of food packaging and presentation.	FPP.04.03.05.b. Select and utilize packaging materials in storing processed foods and raw food products.	FPP.04.03.05.c. Analyze the foods stored in various packaging materials to determine which materials retain desirable food qualities.	
FPP.04.03.06.a. Identify and explain storage conditions to preserve product quality.	FPP.04.03.06.b. Select methods and conditions for storing raw and processed food products.	FPP.04.03.06.c. Compare and contrast foods stored under varying conditions for quality, shelf life and intended use.	

Career Cluster: AGRICULTURE, FOOD AND NATURAL RESOURCES (AFNR)

Career Pathway: Natural Resource Systems (NRS)

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the management of natural resources.

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
NRS.01. Performance Element: Explain interrelationships between natural resources and humans necessary to conduct management activities in natural environments.			
NRS.01.01. Performance Indicator: Apply knowledge of natural resource components to the management of natural resource systems.			Math: 5a Science: C4 and F3 Social Studies: 3h and 3k
NRS.01.01.01.a. Identify natural resources.	NRS.01.01.01.b. Differentiate between renewable and nonrenewable natural resources.	NRS.01.01.01.c. Research and debate one or more current issues related to the conservation or preservation of natural resources.	
NRS.01.01.02.a. Define ecosystem and related terms.	NRS.01.01.02.b. Describe the interdependence of organisms within an ecosystem.	NRS.01.01.02.c. Conduct a field study of an ecosystem, and record and document observations of species interactions.	
NRS.01.02. Performance Indicator: Classify natural resources.			Science: F3
NRS.01.02.01.a. Describe morphological characteristics used to identify trees and other woody plants.	NRS.01.02.01.b. Identify trees and other woody plants.	NRS.01.02.01.c. Conduct a field inventory of trees and other woody plants, and record and document findings.	
NRS.01.02.02.a. Describe morphological characteristics used to identify herbaceous plants.	NRS.01.02.02.b. Identify herbaceous plants.	NRS.01.02.02.c. Conduct a field inventory of herbaceous plants, and record and document findings.	
NRS.01.02.03.a. Describe morphological characteristics used to identify wildlife species.	NRS.01.02.03.b. Identify wildlife species.	NRS.01.02.03.c. Conduct a field inventory of wildlife species, and record and document findings.	
NRS.01.02.04.a. Describe morphological characteristics used to identify aquatic species.	NRS.01.02.04.b. Identify aquatic species.	NRS.01.02.04.c. Conduct a field inventory of aquatic species, and record and document findings.	
NRS.01.02.05.a. Demonstrate techniques used to identify rock, mineral and soil types.	NRS.01.02.05.b. Identify rock, mineral and soil types.	NRS.01.02.05.c. Conduct a field inventory of rock, mineral and soil types, and record and document findings.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
NRS.02. Performance Element: Apply scientific principles to natural resource management activities.			
NRS.02.01. Performance Indicator: Develop a safety plan for work with natural resources.			Science: F3 and F5 Language Arts: 8
NRS.02.01.01.a. Identify hazards associated with the outdoor environment.	NRS.02.01.01.b. Demonstrate safety practices when working in an outdoor environment.	NRS.02.01.01.c. Demonstrate appropriate responses to accidents and injuries that occur in an outdoor environment.	
NRS.02.01.02.a. Recognize biohazards associated with natural resources.	NRS.02.01.02.b. Use appropriate techniques and equipment when working with biohazards.	NRS.02.01.02.c. Demonstrate appropriate responses for disasters involving biohazardous materials.	
NRS.02.02. Performance Indicator: Demonstrate cartographic skills to aid in developing, implementing and evaluating natural resource management plans.			Math: 4B Science: A3 and F2 Social Studies: 3b and 3c
NRS.02.02.01.a. Demonstrate how to use maps to identify directions and features, calculate actual distance and determine the elevations of points.	NRS.02.02.01.b. Locate natural resources using a land survey and geographic coordinate system.	NRS.02.02.01.c. Employ Global Positioning System and Geographic Information Systems technologies to inventory features in natural resource management.	
NRS.02.03. Performance Indicator: Measure and survey natural resource status to obtain planning data.			Math: 5C Science: A3 and F2 Social Studies: 3h
NRS.02.03.01.a. Describe the value of resource inventories and population studies.	NRS.02.03.01.b. Discuss the procedures for conducting resource inventories and population studies.	NRS.02.03.01.c. Conduct resource inventories and population studies to assess resource status.	
NRS.02.04. Performance Indicator: Demonstrate natural resource enhancement techniques.			Science: F3 Social Studies: 3g and 3k
NRS.02.04.01.a. Identify the different kinds of streams.	NRS.02.04.01.b. Identify indicators of the biological health of a stream.	NRS.02.04.01.c. Create and implement a stream enhancement plan.	
NRS.02.04.02.a. Identify characteristics of a healthy forest.	NRS.02.04.02.b. Identify ways in which forest stands may be improved.	NRS.02.04.02.c. Formulate a timber stand improvement plan for a forest.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
NRS.02.04.03.a. Identify characteristics of a healthy wildlife habitat.	NRS.02.04.03.b. Identify methods of wildlife habitat improvement.	NRS.02.04.03.c. Conduct a survey of a habitat and devise a comprehensive improvement plan.	
NRS.02.04.04.a. Identify characteristics of healthy rangeland.	NRS.02.04.04.b. Identify methods of rangeland improvement.	NRS.02.04.04.c. Evaluate a rangeland and develop a management plan for improvement.	
NRS.02.04.05.a. Identify natural resource characteristics desirable for recreational purposes.	NRS.02.04.05.b. Identify natural resource management techniques for improving recreation opportunities.	NRS.02.04.05.c. Evaluate the impact of recreational activities on natural resources and create an improvement plan.	
NRS.02.04.06.a. Identify characteristics of healthy marine and coastal natural resources.	NRS.02.04.06.b. Identify methods to improve marine and coastal natural resources.	NRS.02.04.06.c. Assess marine and coastal natural resources and prepare an improvement plan.	
NRS.02.05. Performance Indicator: Interpret laws related to natural resource management and protection.			Science: F3 Language Arts: 7 Social Studies: 6c
NRS.02.05.01.a. Identify laws associated with natural resource systems.	NRS.02.05.01.b. Identify the purposes of laws associated with natural resource systems.	NRS.02.05.01.c. Abide by specific laws pertaining to natural resource systems.	
NRS.02.05.02.a. Define mitigation.	NRS.02.05.02.b. Identify issues involving mitigation of natural resources.	NRS.02.05.02.c. Demonstrate mitigation techniques for natural resources.	
NRS.02.06. Performance Indicator: Apply ecological concepts and principles to natural resource systems.			Science: D2 and F3 Social Studies: 3b, 3f and 3h
NRS.02.06.01.a. Identify biogeochemical cycles.	NRS.02.06.01.b. Diagram biogeochemical cycles and explain the processes.	NRS.02.06.01.c. Determine the human influence on biogeochemical cycles.	
NRS.02.06.02.a. Describe properties of watersheds and identify the boundaries of local watersheds.	NRS.02.06.02.b. Relate the function of watersheds to natural resources.	NRS.02.06.02.c. Analyze ecosystem functions of a watershed.	
NRS.02.06.03.a. Compare and contrast groundwater and surface-water flow.	NRS.02.06.03.b. Explain stream hydrology and structure, and determine the different classes of streams.	NRS.02.06.03.c. Classify and predict the behavior of local streams.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
NRS.02.06.04.a. Define riparian zones and riparian buffers, and explain their functions.	NRS.02.06.04.b. Identify techniques used in the creation, enhancement and management of riparian zones and riparian buffers.	NRS.02.06.04.c. Create, enhance and manage riparian zones and riparian buffers.	
NRS.02.06.05.a. Describe the processes associated with ecological succession.	NRS.02.06.05.b. Give examples of primary-succession and secondary-succession species in a community of organisms.	NRS.02.06.05.c. Conduct a field study to determine the stages of ecological succession in a community of organisms.	
NRS.02.06.06.a. Explain population ecology, population density and population dispersion.	NRS.02.06.06.b. Discuss factors that influence population density and population dispersion.	NRS.02.06.06.c. Create and implement a management plan based on a population study for a community of organisms.	
NRS.02.06.07.a. Define invasive species.	NRS.02.06.07.b. Discuss factors that influence the establishment and spread of invasive species.	NRS.02.06.07.c. Develop and implement a plan to reduce the impact of invasive species on natural resources.	
NRS.02.06.08.a. Describe sources of pollution and delineate between point and nonpoint source pollution.	NRS.02.06.08.b. Describe the impact of pollution on natural resources.	NRS.02.06.08.c. Create and implement a plan to prevent or limit the effects of pollution on natural resources.	
NRS.02.06.09.a. Describe climatic factors that influence natural resources.	NRS.02.06.09.b. Describe the impact climate has on natural resources.	NRS.02.06.09.c. Monitor the effects of climate on plants and wildlife.	
NRS.03. Performance Element: Apply knowledge of natural resources to production and processing industries.			
NRS.03.01. Performance Indicator: Produce, harvest, process and use natural resource products.			Science: F3
NRS.03.01.01.a. Describe forest harvesting methods.	NRS.03.01.01.b. Determine when to harvest forest products.	NRS.03.01.01.c. Harvest forest products according to principles of sustainable forest management.	
NRS.03.01.02.a. Describe uses of tree species.	NRS.03.01.02.b. Describe processing of forest products.	NRS.03.01.02.c. Process forest products.	
NRS.03.01.03.a. Identify wildlife species that can be sustainably harvested.	NRS.03.01.03.b. Describe techniques used in the harvesting of wildlife.	NRS.03.01.03.c. Formulate a management plan for protecting wildlife from overexploitation.	
NRS.03.01.04.a. Identify products obtained from wildlife species.	NRS.03.01.04.b. Describe techniques used in the processing of wildlife.	NRS.03.01.04.c. Process harvested wildlife.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
NRS.03.01.05.a. Describe the value of minerals and ores to the economy.	NRS.03.01.05.b. Describe economically important minerals and ores that are extracted and processed.	NRS.03.01.05.c. Give examples of methods used to extract and process minerals and ores.	
NRS.03.01.06.a. Describe the value of fossil fuels to the economy.	NRS.03.01.06.b. Describe sources of fossil fuels and products made from fossil fuels.	NRS.03.01.06.c. Give examples of methods used to extract and process fossil fuels.	
NRS.03.01.07.a. Describe the benefits of hydroelectric generation.	NRS.03.01.07.b. Describe characteristics of sites that lend themselves to hydroelectric generation.	NRS.03.01.07.c. Describe hydroelectric generation techniques and procedures, and prepare a report on the impacts of hydroelectric dams on aquatic systems.	
NRS.03.01.08.a. Identify recreational uses of natural resources.	NRS.03.01.08.b. Debate an issue related to the recreational use of natural resources.	NRS.03.01.08.c. Evaluate a natural resource site and recommend opportunities for recreational activities.	
NRS.03.01.09.a. Identify aquatic species harvested for commercial and recreational purposes.	NRS.03.01.09.b. Describe techniques used to harvest aquatic species.	NRS.03.01.09.c. Harvest aquatic species according to sustainable management principles.	
NRS.03.01.10.a. Identify uses of aquatic species.	NRS.03.01.10.b. Explain techniques used to process aquatic species.	NRS.03.01.10.c. Process harvested aquatic species.	
NRS.04. Performance Element: Demonstrate techniques used to protect natural resources.			
NRS.04.01. Performance Indicator: Manage fires in natural resource systems.			Science: F5
NRS.04.01.01.a. Differentiate between desirable and undesirable fires and prepare a report on the role fire plays in a healthy ecosystem.	NRS.04.01.01.b. Describe techniques used to suppress wildfires and manage prescribed fires.	NRS.04.01.01.c. Demonstrate the application of fire suppression and fire safety techniques.	
NRS.04.02. Performance Indicator: Diagnose plant and wildlife diseases and follow protocol to prevent their spread.			Science: F1 and F3 Social Studies: 9d
NRS.04.02.01.a. Identify causes of diseases in plants.	NRS.04.02.01.b. Report the observance of diseases affecting plants to the appropriate authorities.	NRS.04.02.01.c. Explain management techniques used to reduce infection and spread of plant diseases in natural resources.	
NRS.04.02.02.a. Identify causes of diseases in wildlife.	NRS.04.02.02.b. Report the observance of diseases affecting wildlife to the appropriate authorities.	NRS.04.02.02.c. Explain wildlife disease management techniques.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
NRS.04.03. Performance Indicator: Manage insect infestations of natural resources.			Science: C4 and F3
NRS.04.03.01.a. Identify harmful and beneficial insects and signs of insect damage to natural resources.	NRS.04.03.01.b. Report observance of insect pests to the appropriate authorities.	NRS.04.03.01.c. Describe techniques used to manage pests of natural resources.	
NRS.05. Performance Element: Use effective methods and venues to communicate natural resource processes to the public.			
NRS.05.01. Performance Indicator: Communicate natural resource information to the public.			Science: F3 and F6 Language Arts: 5 and 6
NRS.05.01.01.a. Identify ways in which a message regarding natural resources may be communicated to the public.	NRS.05.01.01.b. Design and construct a display that communicates a natural resource topic and discuss the topic in a public forum.	NRS.05.01.01.c. Communicate a natural resource message through the press, radio, television or public appearances.	

Career Cluster: AGRICULTURE, FOOD AND NATURAL RESOURCES (AFNR)

Career Pathway: Plant Systems (PS)

Pathway Content Standard: The student will demonstrate competence in the application of scientific principles and techniques to the production and management of plants.

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
PS.01. Performance Element: Apply knowledge of plant classification, plant anatomy and plant physiology to the production and management of plants.			
PS.01.01. Performance Indicator: Classify agricultural plants according to taxonomy systems.			Science: C3
PS.01.01.01.a. Explain systems used to classify plants.	PS.01.01.01.b. Compare and contrast the hierarchical classification of agricultural plants.	PS.01.01.01.c. Classify agricultural plants according to the hierarchical classification system, life cycles, plant use and as monocotyledons or dicotyledons.	
PS.01.01.02.a. Describe the morphological characteristics used to identify agricultural plants.	PS.01.01.02.b. Identify agriculturally important plants by common names.	PS.01.01.02.c. Identify agriculturally important plants by scientific names.	
PS.01.02. Performance Indicator: Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.			Science: B6, C3 and C5
PS.01.02.01.a. Diagram a typical plant cell and identify plant cell organelles and their functions.	PS.01.02.01.b. Compare and contrast mitosis and meiosis.	PS.01.02.01.c. Apply the knowledge of cell differentiation and the functions of the major types of cells to plant systems.	
PS.01.02.02.a. Identify the components, the types and the functions of plant roots.	PS.01.02.02.b. Identify root tissues and explain the pathway of water and nutrients into and through the root tissues.	PS.01.02.02.c. Relate the active and passive transport of minerals into and through the root system to plant nutrition.	
PS.01.02.03.a. Identify the components and the functions of plant stems.	PS.01.02.03.b. Describe the processes of translocation.	PS.01.02.03.c. Apply concepts associated with translocation to the management of plants.	
PS.01.02.04.a. Discuss leaf morphology and the functions of leaves.	PS.01.02.04.b. Explain how leaves capture light energy and allow for the exchange of gases.	PS.01.02.04.c. Explain the relationships between leaf structure and functions and plant management practices.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
PS.01.02.05.a. Identify the components of a flower, the functions of a flower and the functions of flower components.	PS.01.02.05.b. Identify the different types of flowers and flower forms.	PS.01.02.05.c. Apply the knowledge of flower structures to plant breeding, production and use.	
PS.01.02.06.a. Explain the functions and components of seeds and fruit.	PS.01.02.06.b. Identify the major types of fruit.	PS.01.02.06.c. Apply the knowledge of seed and fruit structures to plant culture and use.	
PS.01.03. Performance Indicator: Apply knowledge of plant physiology and energy conversion to plant systems.			Science: B6 and C5
PS.01.03.01.a. Explain the basic process of photosynthesis and its importance to life on Earth.	PS.01.03.01.b. Explain requirements necessary for photosynthesis to occur and identify the products and byproducts of photosynthesis.	PS.01.03.01.c. Explain the light-dependent and light-independent reactions that occur during photosynthesis and apply the knowledge to plant management.	
PS.01.03.02.a. Explain cellular respiration and its importance to plant life.	PS.01.03.02.b. Explain factors that affect cellular respiration and identify the products and byproducts of cellular respiration.	PS.01.03.02.c. Explain the four stages of aerobic respiration and relate cellular respiration to plant growth, crop management and post-harvest handling.	
PS.01.03.03.a. Define primary growth and the role of the apical meristem.	PS.01.03.03.b. Explain the process of secondary plant growth.	PS.01.03.03.c. Relate the principles of primary and secondary growth to plant systems.	
PS.01.03.04.a. Identify the five groups of naturally occurring plant hormones and synthetic plant growth regulators.	PS.01.03.04.b. Identify the plant responses to plant growth regulators and different forms of tropism.	PS.01.03.04.c. Select plant growth regulators to produce desired responses from plants.	
PS.02. Performance Element: Prepare and implement a plant management plan that addresses the influence of environmental factors, nutrients and soil on plant growth.			
PS.02.01. Performance Indicator: Determine the influence of environmental factors on plant growth.			Science: C6
PS.02.01.01.a. Describe the qualities of light that affect plant growth.	PS.02.01.01.b. Describe plant responses to light color, intensity and duration.	PS.02.01.01.c. Evaluate plant responses to varied light color, intensity and duration.	
PS.02.01.02.a. Describe the effects air, temperature and water have on plant metabolism and growth.	PS.02.01.02.b. Determine the optimal air, temperature and water conditions for plant growth.	PS.02.01.02.c. Design, implement and evaluate a plan to maintain optimal conditions for plant growth.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
PS.02.02. Performance Indicator: Prepare growing media for use in plant systems.			Science: B2
PS.02.02.01.a. Identify the major components of growing media and describe how growing media support plant growth.	PS.02.02.01.b. Describe the physical characteristics of growing media and explain the influence they have on plant growth.	PS.02.02.01.c. Formulate and prepare growing media for specific plants or crops.	
PS.02.02.02.a. Identify the categories of soil water.	PS.02.02.02.b. Discuss how soil drainage and water-holding capacity can be improved.	PS.02.02.02.c. Determine the hydraulic conductivity for soil and how the results influence irrigation practices.	
PS.02.03. Performance Indicator: Develop and implement a fertilization plan for specific plants or crops.			Math: 4B Science: A2
PS.02.03.01.a. Identify the essential nutrients for plant growth and development and their major functions.	PS.02.03.01.b. Describe nutrient deficiency symptoms and recognize environmental causes of nutrient deficiencies.	PS.02.03.01.c. Monitor plants for signs of nutrient deficiencies and prepare a scouting report.	
PS.02.03.02.a. Discuss the influence of pH and cation exchange capacity on the availability of nutrients.	PS.02.03.02.b. Contrast pH and cation exchange capacity between mineral soil and soilless growing media.	PS.02.03.02.c. Adjust the pH of growing media.	
PS.02.03.03.a. Collect soil and plant tissue samples for testing and interpret the test results.	PS.02.03.03.b. Determine the nutrient content of soil using appropriate laboratory procedures and prescribe fertilization based on results.	PS.02.03.03.c. Determine the nutrient content of plant tissue samples using appropriate laboratory procedures and prescribe fertilization based on results.	
PS.02.03.04.a. Identify fertilizer sources of essential plant nutrients, explain fertilizer formulations and describe different methods of fertilizer application.	PS.02.03.04.b. Calculate the amount of fertilizer to be applied and calibrate equipment to apply the prescribed amount of fertilizer.	PS.02.03.04.c. Use variable-rate technology to apply fertilizers to meet crop nutrient needs.	
PS.03. Performance Element: Propagate, culture and harvest plants.			
PS.03.01. Performance Indicator: Demonstrate plant propagation techniques.			Science: C2
PS.03.01.01.a. Explain pollination, cross-pollination and self-pollination of flowering plants.	PS.03.01.01.b. Diagram the process of plant fertilization.	PS.03.01.01.c. Design and implement a plan to control the pollination of plants.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
<p>PS.03.01.02.a. Demonstrate sowing techniques and provide favorable conditions for seed germination.</p>	<p>PS.03.01.02.b. Handle seed to overcome seed dormancy mechanisms and to maintain seed viability and vigor.</p>	<p>PS.03.01.02.c. Conduct tests associated with seed germination rates, viability and vigor.</p>	
<p>PS.03.01.03.a. Describe optimal conditions for asexual propagation and demonstrate techniques used to propagate plants by cuttings, division, separation and layering.</p>	<p>PS.03.01.03.b. Demonstrate proper procedures in budding or grafting selected materials.</p>	<p>PS.03.01.03.c. Evaluate asexual propagation practices based on productivity and efficiency.</p>	
<p>PS.03.01.04.a. Define micropropagation, discuss advantages associated with the practice and outline the four main stages of the process.</p>	<p>PS.03.01.04.b. Demonstrate aseptic micropropagation techniques.</p>	<p>PS.03.01.04.c. Propagate plants by micropropagation.</p>	
<p>PS.03.01.05.a. Explain the principles behind recombinant DNA technology and the basic steps in the process.</p>	<p>PS.03.01.05.b. Give examples of the risks and advantages associated with genetically modified plants.</p>	<p>PS.03.01.05.c. Evaluate the performance of genetically modified crops.</p>	
<p>PS.03.02. Performance Indicator: Develop and implement a plant management plan for crop production.</p>			<p>Science: C5 and C6 Language Arts: 7</p>
<p>PS.03.02.01.a. Explain the importance of starting with pest- and disease-free propagation material.</p>	<p>PS.03.02.01.b. Inspect propagation material for evidence of pests or disease.</p>	<p>PS.03.02.01.c. Produce pest- and disease-free propagation material.</p>	
<p>PS.03.02.02.a. Explain the reasons for preparing growing media before planting.</p>	<p>PS.03.02.02.b. Prepare soil for planting with the addition of amendments.</p>	<p>PS.03.02.02.c. Prepare growing media for planting.</p>	
<p>PS.03.02.03.a. Demonstrate proper planting procedures and post-planting care.</p>	<p>PS.03.02.03.b. Apply pre-plant treatments required of seeds and plants and evaluate the results.</p>	<p>PS.03.02.03.c. Operate mechanized planting equipment.</p>	
<p>PS.03.02.04.a. Observe and record environmental conditions during the germination, growth and development of a crop.</p>	<p>PS.03.02.04.b. Monitor the progress of plantings and determine the need to adjust environmental conditions.</p>	<p>PS.03.02.04.c. Prepare and implement a plant production schedule based on predicted environmental conditions.</p>	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
PS.03.02.05.a. Explain the reasons for controlling plant growth.	PS.03.02.05.b. Demonstrate proper techniques to control and manage plant growth through mechanical, cultural or chemical means.	PS.03.02.05.c. Create and implement a plan to control and manage plant growth.	
PS.03.03. Performance Indicator: Develop and implement a plan for integrated pest management.			Science: C4 and C6 Language Arts: 7
PS.03.03.01.a. Identify types of plant pests and disorders.	PS.03.03.01.b. Identify major local weeds, insect pests and infectious and noninfectious plant diseases.	PS.03.03.01.c. Design and implement a crop scouting program.	
PS.03.03.02.a. Describe damage caused by plant pests and diseases.	PS.03.03.02.b. Diagram the life cycles of major plant pests and diseases.	PS.03.03.02.c. Predict pest and disease problems based on environmental conditions and life cycles.	
PS.03.03.03.a. Describe pest control strategies associated with integrated pest management.	PS.03.03.03.b. Describe types of pesticide controls and formulations.	PS.03.03.03.c. Employ pest management strategies to manage pest populations, assess the effectiveness of the plan and adjust the plan as needed.	
PS.03.03.04.a. Explain risks and benefits associated with the materials and methods used in plant pest management.	PS.03.03.04.b. Explain procedures for the safe handling, use and storage of pesticides.	PS.03.03.04.c. Evaluate environmental and consumer concerns regarding pest management strategies.	
PS.03.04. Performance Indicator: Apply principles and practices of sustainable agriculture to plant production.			Science: F3, F4 and F6
PS.03.04.01.a. Explain sustainable agriculture and objectives associated with the strategy.	PS.03.04.01.b. Describe sustainable agriculture practices and compare the ecological effects of traditional agricultural practices with those of sustainable agriculture.	PS.03.04.01.c. Prepare and implement a plan for an agricultural enterprise that involves practices in support of sustainable agriculture.	
PS.03.05. Performance Indicator: Harvest, handle and store crops.			Science: F5
PS.03.05.01.a. Identify harvesting methods and harvesting equipment.	PS.03.05.01.b. Assess the stage of growth to determine crop maturity or salability and demonstrate proper harvesting techniques.	PS.03.05.01.c. Operate mechanized harvesting equipment.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
PS.03.05.02.a. Explain reasons for calculating crop yield and loss.	PS.03.05.02.b. Evaluate crop yield and loss data.	PS.03.05.02.c. Implement plans to reduce crop loss.	
PS.03.05.03.a. Identify storage methods for plants and plant products.	PS.03.05.03.b. Explain the proper conditions to maintain the quality of plants and plant products held in storage.	PS.03.05.03.c. Monitor environmental conditions in storage facilities for plants and plant products.	
PS.03.05.04.a. Explain the reasons for preparing plants and plant products for distribution.	PS.03.05.04.b. Demonstrate techniques for grading, handling and packaging plants and plant products for distribution.	PS.03.05.04.c. Evaluate techniques for grading, handling and packaging plants and plant products.	
PS.04. Performance Element: Employ elements of design to enhance an environment.			
PS.04.01. Performance Indicator: Create designs using plants.			Language Arts: 12
PS.04.01.01.a. Define design and identify design elements.	PS.04.01.01.b. Explain design elements of line, form, texture and color and express the visual effect each has on the viewer.	PS.04.01.01.c. Select plants, hard goods, supplies and other materials for use in a design based on a range of criteria.	
PS.04.01.02.a. Discuss the applications of art in agriculture/horticulture.	PS.04.01.02.b. Discuss principles of design that form the basis of artistic impression.	PS.04.01.02.c. Create and implement designs by following established principles of art.	

Career Cluster: AGRICULTURE, FOOD AND NATURAL RESOURCES (AFNR)

Career Pathway: Power, Structural and Technical Systems (PST)

Pathway Content Standard: The student will demonstrate competence in the application of principles and techniques for the development and management of power, structural and technical systems.

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
PST.01. Performance Element: Use physical science principles and engineering applications with power, structural and technical systems to solve problems and improve performance.			
PST.01.01. Performance Indicator: Select energy sources in power generation appropriate to the situation.			Science: B5, D1 and F3
PST.01.01.01.a. Identify renewable and nonrenewable energy sources and pathways of delivery.	PST.01.01.01.b. Examine environmental impacts and efficiencies of energy sources.	PST.01.01.01.c. Compare the efficiency of energy production from various sources.	
PST.01.02. Performance Indicator: Apply physical science laws and principles to identify, classify and use lubricants.			Science: B4
PST.01.02.01.a. Classify lubricants by source, sustainability and equipment compatibility.	PST.01.02.01.b. Classify lubricants by SAE viscosity and API service classifications.	PST.01.02.01.c. Select, use and dispose of lubricants.	
PST.01.03. Performance Indicator: Identify and use hand and power tools and equipment for service, construction and fabrication.			Science: E2
PST.01.03.01.a. Identify and demonstrate safe use and maintenance of measurement and layout tools.	PST.01.03.01.b. Select, maintain and use hand and power tools in service, construction and fabrication.	PST.01.03.01.c. Assess the performance of employees in use of hand and power tools to safely and efficiently service, construct and fabricate quality products.	
PST.02. Performance Element: Design, operate and maintain mechanical equipment, structures, biological systems, land treatment, power and technology.			
PST.02.01. Performance Indicator: Perform service routines to maintain power units and equipment.			Science: E2
PST.02.01.01.a. Identify and schedule power unit and equipment lubrication.	PST.02.01.01.b. Ensure the presence and function of safety systems and hardware on tools and equipment.	PST.02.01.01.c. Test and service electrical systems.	
PST.02.01.02.a. Service filtration systems and maintain fluid levels on power units and equipment.	PST.02.01.02.b. Adjust equipment, including belts and drives, chains and sprockets, and maintain fluid conveyance components, such as hoses, lines and nozzles.	PST.02.01.02.c. Troubleshoot malfunctions and failures in equipment using computer and on-board diagnostics.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
PST.02.01.03.a. Maintain the cleanliness and appearance of power units and equipment to assure functionality.	PST.02.01.03.b. Develop a preventive maintenance schedule for power units and equipment.	PST.02.01.03.c. Maintain and calibrate metering, monitoring and sensing devices on equipment.	
PST.02.02. Performance Indicator: Operate, service and diagnose the condition of power units and equipment.			Science: E2
PST.02.02.01.a. Identify power unit and equipment controls and instruments, along with their functions.	PST.02.02.01.b. Perform start-up and shut-down procedures on power units and equipment as specified in technical manuals.	PST.02.02.01.c. Select power units and equipment for operational efficiencies.	
PST.02.02.02.a. Perform pre-operation inspection according to manufacturers' specifications and/or prevailing industry standards.	PST.02.02.02.b. Demonstrate safe practices and regulations in the operation of power units and equipment.	PST.02.02.02.c. Adjust equipment for safe and efficient operation.	
PST.03. Performance Element: Service and repair mechanical equipment and power systems.			
PST.03.01. Performance Indicator: Troubleshoot and repair internal combustion engines.			Science: A1 and A4 Language Arts: 3
PST.03.01.01.a. Identify components and systems of internal combustion engines.	PST.03.01.01.b. Utilize technical manuals and computer-based diagnostics in engine analysis and repair.	PST.03.01.01.c. Performance test internal combustion engines to determine service and repair needs.	
PST.03.01.02.a. Describe the operation of internal combustion engines by types of fuel used.	PST.03.01.02.b. Analyze and troubleshoot internal combustion engines.	PST.03.01.02.c. Overhaul spark-and-compression internal combustion engines.	
PST.03.02. Performance Indicator: Utilize manufacturers' guidelines to service and repair the power transmission systems of equipment.			Math: 1C and 6B Science: B4 and E1
PST.03.02.01.a. Identify and describe applications of simple machines in power systems.	PST.03.02.01.b. Identify and compare operation principles and features, benefits and applications of various power transmission systems.	PST.03.02.01.c. Use speed, torque and power measurements to improve efficiency in power transmission systems.	
PST.03.02.02.a. Calculate mechanical advantage in mechanical systems.	PST.03.02.02.b. Describe features, benefits and applications of mechanical transmission components, including belts, chains, gears, bearings, seals, universals and drive shafts.	PST.03.02.02.c. Inspect, analyze and repair hydrostatic transmissions.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
PST.03.02.03.a. Identify power transfer principles, including those using friction, gears and fluids.	PST.03.02.03.b. Inspect, analyze and repair clutches and brakes.	PST.03.02.03.c. Inspect, analyze and repair differentials, final drives, transmissions (including gear-type and power-shift transmissions) and auxiliary drives.	
PST.03.03. Performance Indicator: Service and repair hydraulic and pneumatic systems.			Science: B4 and E1
PST.03.03.01.a. Describe features, benefits and applications of common types of hydraulic and pneumatic systems.	PST.03.03.01.b. Describe principles of hydraulic and pneumatic system operation.	PST.03.03.01.c. Utilize symbols and schematic drawings in the maintenance of hydraulic and pneumatic systems.	
PST.03.03.02.a. Apply hydrostatic and hydrodynamic principles in hydraulics and pneumatics, including Archimedes' principle and Pascal's law.	PST.03.03.02.b. Identify major components of hydraulic and pneumatic systems and describe their use.	PST.03.03.02.c. Inspect, analyze and repair hydraulic and pneumatic system components, including fluid and compressed-air conveyance components.	
PST.03.03.03.a. Evaluate hydraulic and pneumatic system functionality.	PST.03.03.03.b. Identify hydraulic and pneumatic system fittings and ports.	PST.03.03.03.c. Use a pressure-and-flow tester in diagnosing malfunctions and repairing hydraulic and pneumatic systems.	
PST.03.04. Performance Indicator: Troubleshoot and service electrical systems.			Math: 6B Science: E1
PST.03.04.01.a. Apply the meaning and measurement of electricity, including amperage, voltage and wattage.	PST.03.04.01.b. Assess and install electrical circuits, including conductors, insulators and controls.	PST.03.04.01.c. Evaluate power unit and equipment electrical systems, including ignition, lighting, auxiliary and electronic braking.	
PST.03.04.02.a. Identify the kinds and applications of electricity, including direct and alternating current.	PST.03.04.02.b. Interpret electrical system symbols and diagrams.	PST.03.04.02.c. Assess and repair malfunctioning electrical systems and components, such as battery, lighting, instrumentation and accessories.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
PST.03.05. Performance Indicator: Service vehicle heating and air-conditioning systems.			Math: 4A and 6C
PST.03.05.01.a. Identify principles of heat and temperature measurement.	PST.03.05.01.b. Describe physical principles of operation of vehicle heating and air-conditioning systems and interpret symbols and diagrams used with such systems.	PST.03.05.01.c. Troubleshoot, repair and evacuate and charge heating and air-conditioning components, including compressors, expansion valves, receiver dryers, pumps, hoses and recovery tools and systems.	
PST.03.06. Performance Indicator: Service and repair steering, suspension, traction and vehicle performance systems.			Math: 4A and 6C
PST.03.06.01.a. Identify and explain principles of motion, including speed, velocity and acceleration.	PST.03.06.01.b. Evaluate vehicle traction, ballasting and weight transfer and service as needed.	PST.03.06.01.c. Evaluate vehicle stability, power-hop, creep-crawl, wheel slip and tractive performance and service as needed.	
PST.03.06.02.a. Identify principles of force on acceleration, including friction and gravity.	PST.03.06.02.b. Evaluate vehicle performance and then service as needed, including horsepower management, ballasting, soil compaction and fuel efficiency.	PST.03.06.02.c. Evaluate vehicle suspension and steering systems and service as needed.	
PST.04. Performance Element: Plan, build and maintain agricultural structures.			
PST.04.01. Performance Indicator: Create sketches and plans of agricultural structures.			Math: 4A Science: A3 and E1
PST.04.01.01.a. Identify symbols and drawing techniques used to develop plans and sketches.	PST.04.01.01.b. Develop plans and sketches using drafting equipment and computer programs.	PST.04.01.01.c. Apply principles of design, fabrication and installation of agricultural structures.	
PST.04.01.02.a. Prepare bills of materials to accompany plans and sketches.	PST.04.01.02.b. Use scale measurement and dimension to develop plans and sketches.	PST.04.01.02.c. Design functional and efficient facilities for agricultural use.	
PST.04.02. Performance Indicator: Apply structural plans, specifications and building codes.			Language Arts: 12
PST.04.02.01.a. Identify major parts of a construction drawing.	PST.04.02.01.b. Identify and interpret different views of a construction drawing.	PST.04.02.01.c. Locate, explain and apply elements of a construction drawing.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
PST.04.02.02.a. Identify the sources and importance of industry construction and materials standards, including those of the American National Standards Institute (ANSI) and Underwriters' Laboratories (UL).	PST.04.02.02.b. Identify local code enforcement agencies and procedures.	PST.04.02.02.c. Follow local construction and safety codes and specifications in agricultural construction.	
PST.04.02.03.a. Identify design and construction recommendations and practices in agricultural structures.	PST.04.02.03.b. Read and interpret local structural code information.	PST.04.02.03.c. Complete appropriate local permit applications for a construction project.	
PST.04.03. Performance Indicator: Examine structural requirements for materials and procedures and estimate construction cost.			Math: 1C and 6B
PST.04.03.01.a. Identify criteria in selecting materials in agricultural construction/fabrication.	PST.04.03.01.b. Select types of materials, determine quantities and estimate their costs and other costs associated with a specified project plan.	PST.04.03.01.c. Prepare a project cost estimate, including materials, labor and management.	
PST.04.03.02.a. Explain the importance and use of requests for construction bids.	PST.04.03.02.b. Establish business relationships with vendors of materials and services used in agricultural construction.	PST.04.03.02.c. Prepare a bid package for a planned construction project, including construction timelines, site evaluation, construction plans and related management factors.	
PST.04.04. Performance Indicator: Follow architectural and mechanical plans to construct and/or repair equipment, buildings and facilities.			Math: 1C, 4A and 4B Science: E2
PST.04.04.01.a. Construct and/or repair with wood and metal.	PST.04.04.01.b. Install and/or repair pipes and plumbing equipment and fixtures.	PST.04.04.01.c. Evaluate work products or samples for quality and efficiency of workmanship following architectural and mechanical plans.	
PST.04.04.02.a. Identify electricity measurements and make measurement calculations.	PST.04.04.02.b. Distinguish electrical circuits and components of each.	PST.04.04.02.c. Install and/or repair electrical wiring components and fixtures following appropriate codes and standards.	
PST.04.04.03.a. Calculate areas and volumes for coatings.	PST.04.04.03.b. Paint or protect with coatings.	PST.04.04.03.c. Electroplate or otherwise coat materials.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
PST.04.04.04.a. Calculate efficiencies gained through insulation.	PST.04.04.04.b. Identify insulation materials and methods to achieve desired R-value.	PST.04.04.04.c. Insulate a structure.	
PST.04.04.05.a. Measure and calculate materials for concrete, brick, stone or masonry units in agricultural construction.	PST.04.04.05.b. Construct and/or repair with concrete, brick, stone or masonry units.	PST.04.04.05.c. Seal, pigment and otherwise prepare concrete, brick, stone or masonry unit surfaces.	
PST.04.04.06.a. Measure and calculate fencing materials.	PST.04.04.06.b. Construct and/or repair fencing, including wood, static wire, electrical wire and other fencing materials.	PST.04.04.06.c. Comply with government regulations and applicable fencing and installation codes.	
PST.04.04.07.a. Identify kinds and characteristics of metal materials.	PST.04.04.07.b. Distinguish welding processes, positions, and materials preparation.	PST.04.04.07.c. Construct and/or repair metal structures and equipment using welding fabrication procedures, including those associated with SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch methods.	
PST.04.04.08.a. Measure and calculate glass, rigid plastic panels and film plastics for job requirements.	PST.04.04.08.b. Install glass, ridged plastic panels and/or film plastics.	PST.04.04.08.c. Develop maintenance and service plans for glass, ridged plastic panel, and film plastics installations.	
PST.05. Performance Element: Apply technology principles in the use of agricultural technical systems.			
PST.05.01. Performance Indicator: Use instruments and meters to test and monitor electrical and electronic processes.			Math: 4B Science: A3
PST.05.01.01.a. Discuss various types and sources of electricity.	PST.05.01.01.b. Use volt and amp meters and continuity testers to demonstrate electricity principles.	PST.05.01.01.c. Locate and use electrical codes and regulations.	
PST.05.02. Performance Indicator: Prepare and/or use electrical drawings to design, install and troubleshoot control systems.			Science: E1
PST.05.02.01.a. Recognize common electrical symbols.	PST.05.02.01.b. Read and design schematic drawings for an electrical control system.	PST.05.02.01.c. Identify and use electrical control system components, including transistors, relays, HVAC and logic controllers.	

Level I	Level II	Level III	National Academic Standard Grade-Level Expectation
PST.05.02.02.a. Identify uses of electrical sensors and controls.	PST.05.02.02.b. Interpret maintenance schedules for electrical control systems.	PST.05.02.02.c. Troubleshoot electrical control system performance problems.	
PST.05.02.03.a. Identify hazards and safety practices in planning, installing and using electricity.	PST.05.02.03.b. Distinguish and select materials and tools used in electrical control circuit installation.	PST.05.02.03.c. Plan and install electrical control circuits to assure proper operation.	
PST.05.02.04.a. Identify the importance and uses of computer-based systems in agriculture, food and natural resources.	PST.05.02.04.b. Delineate the functions of programmable logic controllers (PLC) in agricultural production and manufacturing.	PST.05.02.04.c. Develop and implement control systems using programmable logic controllers (PLC) and/or other computer-based systems that operate as specified.	
PST.05.02.05.a. Use common computer-based programs to analyze agricultural data.	PST.05.02.05.b. Assess database summaries to draw conclusions and propose plans of action.	PST.05.02.05.c. Use computer-based data acquisition devices and sensors to statistically analyze and interpret data.	
PST.05.03. Performance Indicator: Use geospatial technologies in agricultural applications.			Science: A3, E2 and F6 Social Studies: 3c
PST.05.03.01.a. Identify geospatial technologies, including global positioning, geographical information and remote sensing.	PST.05.03.01.b. Explain and evaluate concepts and principles of geospatial technologies.	PST.05.03.01.c. Assess and install instrumentation and data acquisition systems, including Global Positioning System (GPS) receivers.	
PST.05.03.02.a. Explain site-specific agriculture as related to geospatial technologies.	PST.05.03.02.b. Describe equipment and processes used in geospatial technologies.	PST.05.03.02.c. Output and apply maps using GIS/GPS systems.	
PST.05.03.03.a. Identify uses, components and setup of precision technology in agriculture, food and natural resources.	PST.05.03.03.b. Describe principles of precision agriculture for map- and sensor-based systems.	PST.05.03.03.c. Demonstrate geospatial applications, including calibration, volumetric controlling and electrical design.	
PST.05.03.04.a. Describe the meaning and use of sensors, controllers and actuators.	PST.05.03.04.b. Identify sensor, control, and actuator system components on power units and equipment.	PST.05.03.04.c. Diagnose malfunctions and repair control systems and sensors, including those of engines, transmissions and implements.	

APPENDIX

National Academic Content Standards Aligned to AFNR Standards

National academic standards for mathematics, science, English language arts and social studies are reported below. The statements are based on information in reports of the respective associations/organizations in the academic areas. Some adjustment of numbering was done to facilitate the process of alignment with the standards that have been developed in the pathways of the Agriculture, Food and Natural Resources (AFNR) Career Cluster.

The approach was to determine the presence of alignment between the content standards, expectations or thematic strands of the four academic areas and the performance indicators of the AFNR Standards. Supporting statements have been included to clarify content of the respective content standards, expectations or thematic strands. The statements were initially developed independently by the respective organizations and, therefore, are not parallel in wording and presentation. Occasionally minor editing was done to adjust the background or stem of a statement but not the statement itself.

Mathematics

The mathematics standards presented here are for high schools and are reprinted with permission from *Principles and Standards for School Mathematics*, copyright 2000 by the National Council of Teachers of Mathematics. All rights reserved.

1. Standard and Expectations: Number and Operations

Instructional programs should enable all students to:

- 1A. Understand numbers, ways of representing numbers, relationships among numbers, and number systems.
- 1B. Understand meanings of operations and how they relate to one another.
- 1C. Compute fluently and make reasonable estimates.

Standards are listed with the permission of the National Council of Teachers of Mathematics (NCTM). NCTM does not endorse the content or validity of these alignments.

2. Standard and Expectations: Algebra

Instructional programs should enable all students to:

- 2A. Understand patterns, relations, and functions.
- 2B. Represent and analyze mathematical situations and structures using algebraic symbols.
- 2C. Use mathematical models to represent and understand quantitative relationships.
- 2D. Analyze change in various contexts.

3. Standard and Expectations: Geometry

Instructional programs should enable all students to:

- 3A. Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships.
- 3B. Specify locations and describe spatial relationships using coordinate geometry and other representational systems.
- 3C. Apply transformations and use symmetry to analyze mathematical situations.
- 3D. Use visualization, spatial reasoning, and geometric modeling to solve problems.

4. Standard and Expectations: Measurement

Instructional programs should enable all students to:

- 4A. Understand measurable attributes of objects and the units, systems, and processes of measurement.
- 4B. Apply appropriate techniques, tools, and formulas to determine measurements.

5. Standard and Expectations: Data Analysis and Probability

Instructional programs should enable all students to:

- 5A. Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.
- 5B. Select and use appropriate statistical methods to analyze data.
- 5C. Develop and evaluate inferences and predictions that are based on data.
- 5D. Understand and apply basic concepts of probability.

Standards are listed with the permission of the National Council of Teachers of Mathematics (NCTM). NCTM does not endorse the content or validity of these alignments.

6. Standard and Expectations: Problem Solving

Instructional programs should enable all students to:

- 6A. Build new mathematical knowledge through problem solving.
- 6B. Solve problems that arise in mathematics in other contexts.
- 6C. Apply and adapt a variety of appropriate strategies to solve problems.
- 6D. Monitor and reflect on the process of mathematical problem solving.

7. Standard and Expectations: Reasoning and Proof

Instructional programs should enable all students to:

- 7A. Recognize reasoning and proof as fundamental aspects of mathematics.
- 7B. Make and investigate mathematical conjectures.
- 7C. Develop and evaluate mathematical arguments and proofs.
- 7D. Select and use various types of reasoning and methods of proof.

8. Standard and Expectations: Communication

Instructional programs should enable all students to:

- 8A. Organize and consolidate their mathematical thinking through communication.
- 8B. Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.
- 8C. Analyze and evaluate the mathematical thinking and strategies of others.
- 8D. Use the language of mathematics to express mathematical ideas precisely.

9. Standard and Expectations: Connections

Instructional programs should enable all students to:

- 9A. Recognize and use connections among mathematical ideas.
- 9B. Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
- 9C. Recognize and apply mathematics in contexts outside of mathematics.

10. Standard and Expectations: Representation

Instructional programs should enable all students to:

- 10A. Create and use representations to organize, record, and communicate mathematical ideas.
- 10B. Select, apply, and translate among mathematical representations to solve problems.
- 10C. Use representations to model and interpret physical, social, and mathematical phenomena.

Standards are listed with the permission of the National Council of Teachers of Mathematics (NCTM). NCTM does not endorse the content or validity of these alignments.

Science

The science content standards and their underlying abilities and concepts presented here are for grades 9–12. These are reprinted with permission from the *National Science Education Standards*, © 1995 by the National Academy of Sciences; courtesy of the National Academies Press, Washington, D.C.

A. Content Standard: Science as Inquiry

As a result of their activities in grades 9–12, all students should develop the ability to:

- A1. Identify questions and concepts that guide scientific investigation.
- A2. Design and conduct scientific investigations.
- A3. Use technology and mathematics to improve investigations and communications.
- A4. Formulate and revise scientific explanations and models using logic and evidence.
- A5. Recognize and analyze alternative explanations and models.
- A6. Communicate and defend a scientific argument.

B. Content Standard: Physical Science

As a result of their activities in grades 9–12, all students should develop an understanding of:

- B1. Structure of atoms.
- B2. Structure and properties of matter.
- B3. Chemical reactions.

- B4. Motions and forces.
- B5. Conservation of energy and increase in disorder.
- B6. Interactions of energy and matter.

C. Content Standard: Life Science

As a result of their activities in grades 9–12, all students should develop an understanding of:

- C1. The cell.
- C2. Molecular basis of heredity.
- C3. Biological evolution.
- C4. Interdependence of organisms.
- C5. Matter, energy, and organization in living systems.
- C6. Behavior of organisms.

D. Content Standard: Earth and Space Science

As a result of their activities in grades 9–12, all students should develop an understanding of:

- D1. Energy in the earth system.
- D2. Geochemical cycles.
- D3. Origin and evolution of the earth system.
- D4. Origin and evolution of the universe.

E. Content Standard: Science and Technology

As a result of their activities in grades 9–12, all students should develop:

- E1. Abilities of technological design.
- E2. Understanding about science and technology.

F. Content Standard: Science in Personal and Social Perspectives

As a result of their activities in grades 9–12, all students should develop understanding of:

- F1. Personal and community health.
- F2. Population growth.
- F3. Natural resources.
- F4. Environmental quality.
- F5. Natural and human-induced hazards.
- F6. Science and technology in local, national, and global challenges.

G. Content Standard: History and Nature of Science

As a result of their activities in grades 9–12, all students should develop understanding of:

- G1. Science as human endeavor.
- G2. Nature of scientific knowledge.
- G3. Historical perspectives.

English Language Arts

The English language arts standards presented here are for high schools. They were taken from a document entitled *Standards for the English Language Arts*, by the International Reading Association and the National Council of Teachers of English (copyright 1996 by the International Reading Association and the National Council of Teachers of English; reprinted with permission).

1. Students read a wide range of print and non-print texts to build an understanding of texts, of themselves, and of the cultures of the United States and the world; to acquire new information; to respond to the needs and demands of society and the workplace; and for personal fulfillment. Among these texts are fiction and nonfiction, classic and contemporary works.
2. Students read a wide range of literature from many periods in many genres to build an understanding of the many dimensions (e.g., philosophical, ethical, aesthetic) of human experience.
3. Students apply a wide range of strategies to comprehend, interpret, evaluate, and appreciate texts. They draw on their prior experience, their interactions with other readers and writers, their knowledge of word meaning and of other texts, their word identification strategies, and their understanding of textual features (e.g., sound-letter correspondence, sentence structure, context, graphics).
4. Students adjust their use of spoken, written, and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.
5. Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes.
6. Students apply knowledge of language structure, language conventions (e.g., spelling and punctuation), media techniques, figurative language, and genre to create, critique, and discuss print and non-print texts.

7. Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience.
8. Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.
9. Students develop an understanding of and respect for diversity in language use, patterns, and dialects across cultures, ethnic groups, geographic regions, and social roles.
10. Students whose first language is not English make use of their first language to develop competency in the English language arts and to develop understanding of content across the curriculum.
11. Students participate as knowledgeable, reflective, creative, and critical members of a variety of literacy communities.
12. Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

Social Studies

The social studies standards and performance expectations presented here are for high schools. They are organized by thematic strands according to information in the document entitled ***Expectations of Excellence: Curriculum Standards for Social Studies***, published by the National Council for the Social Studies, 1994. (© National Council for the Social Studies. www.socialstudies.org. Reprinted by permission.)

1. Thematic Strand: Culture

Social studies programs should include experiences that provide for the study of culture and cultural diversity, so that the learner can:

- 1a. analyze and explain the ways groups, societies, and cultures address human needs and concerns;
- 1b. predict how data and experiences may be interpreted by people from diverse cultural perspectives and frames of reference;

- 1c. apply an understanding of culture and an integrated whole that explains the functions and interactions of language, literature, the arts, traditions, beliefs and values, and behavior patterns;
- 1d. compare and analyze societal patterns for preserving and transmitting culture while adapting to environmental or social change;
- 1e. demonstrate the value of cultural diversity, as well as cohesion, within and across groups;
- 1f. interpret patterns of behavior reflecting values and attitudes that contribute or pose obstacles to cross-cultural understanding;
- 1g. construct reasoned judgments about specific cultural responses to persistent human issues;
- 1h. explain and apply ideas, theories, and modes of inquiry drawn from anthropology and sociology in the examination of persistent issues and social problems.

2. Thematic Strand: Time, Continuity, and Change

Social studies programs should include experiences that provide for the study of the ways human beings view themselves in and over time, so that the learner can:

- 2a. demonstrate that historical knowledge and the concept of time are socially influenced constructions that lead historians to be selective in the questions they seek to answer and the evidence they use;
- 2b. apply key concepts such as time, chronology, causality, change, conflict, and complexity to explain, analyze, and show connections among patterns of historical change and continuity;
- 2c. identify and describe significant historical periods and patterns of change within and across cultures, such as the development of ancient cultures and civilizations, the rise of nation-states, and social, economic, and political revolutions;
- 2d. systematically employ processes of critical historical inquiry to reconstruct and reinterpret the past, such as using a variety of sources and checking their credibility, validating and weighing evidence for claims, and searching for causality;
- 2e. investigate, interpret, and analyze multiple historical and contemporary viewpoints within and across cultures related to important events, recurring dilemmas, and persistent issues, while employing empathy, skepticism, and critical judgment;
- 2f. apply ideas, theories, and modes of historical inquiry to analyze historical and contemporary developments, and to inform and evaluate actions concerning public policy issues.

3. Thematic Strand: People, Places, and Environments

Social studies programs should include experiences that provide for the study of people, places, and environments, so that the learner can:

- 3a. refine mental maps of locales, regions, and the world that demonstrate understanding of relative location, direction, size, and shape;
- 3b. create, interpret, use, and synthesize information from various representations of the earth, such as maps, globes, and photographs;
- 3c. use appropriate resources, data sources, and geographic tools such as aerial photographs, satellite images, geographic information systems (GIS), map projects, and cartography to generate, manipulate, and interpret information such as atlases, data bases, grid systems, charts, graphs, and maps.
- 3d. calculate distance, scale, area, and density and distinguish spatial distribution patterns;
- 3e. describe, differentiate, and explain the relationships among various regional and global patterns of geographic phenomena such as land forms, soils, climate, vegetation, natural resources, and population;
- 3f. use knowledge of physical system changes such as seasons, climate and weather, and the water cycle to explain geographic phenomena;
- 3g. describe and compare how people create places that reflect culture, human needs, government policy, and current values and ideals as they design and build specialized buildings, neighborhoods, shopping centers, urban centers, industrial parks, and the like;
- 3h. examine, interpret, and analyze physical and cultural patterns and their interactions, such as land use, settlement patterns, cultural transmission of customs and ideas, and ecosystem changes;
- 3i. describe and assess ways that historical events have been influenced by, and have influenced, physical and human geographic factors in local, regional, national, and global settings;
- 3j. analyze and evaluate social and economic effects of environmental changes and crises resulting from phenomena such as floods, storms, and drought;
- 3k. propose, compare, and evaluate alternative policies for the use of land and other resources in communities, regions, nations, and the world.

4. Thematic Strand: Individual Development and Identity

Social studies programs should include experiences that provide for the study of individual development and identity, so that the learner can:

- 4a. articulate personal connections to time, place, and social/cultural systems;
- 4b. identify, describe, and express appreciation for the influences of various historical and contemporary cultures on an individual's daily life;
- 4c. describe the ways family, religion, gender, ethnicity, nationality, socioeconomic status, and other group and cultural influences contribute to the development of a sense of self;
- 4d. apply concepts, methods, and theories about the study of human growth and development, such as physical endowment, learning, motivation, behavior, perception, and personality;
- 4e. examine the interactions of ethnic, national, or cultural influences in specific situations or events;
- 4f. analyze the role of perceptions, attitudes, values, and beliefs in the development of personal identity;
- 4g. compare and evaluate the impact of stereotyping, conformity, acts of altruism, and other behaviors on individuals and groups;
- 4h. work independently and cooperatively within groups and institutions to accomplish goals;
- 4i. examine factors that contribute to and damage one's mental health and analyze issues related to mental health and behavioral disorders in contemporary society.

5. Thematic Strand: Individuals, Groups, and Institutions

Social studies programs should include experiences that provide for the study of interactions among individuals, groups, and institutions, so that the learner can:

- 5a. apply concepts such as role, status, and social class in describing the connections and interactions of individuals, groups, and institutions in society;
- 5b. analyze group and institutional influences on people, events, and elements of culture in both historical and contemporary settings;
- 5c. describe the various forms institutions take, and explain how they develop and change over time;
- 5d. identify and analyze examples of tensions between expressions of individuality and efforts used to promote social conformity by groups and institutions;

- 5e. describe and examine belief systems basic to specific traditions and laws in contemporary and historical movements;
- 5f. evaluate the role of institutions in furthering both continuity and change;
- 5g. analyze the extent to which groups and institutions meet individual needs and promote the common good in contemporary and historical settings;
- 5h. explain and apply ideas and modes of inquiry drawn from behavioral science and social theory in the examination of persistent issues and social problems.

6. Thematic Strand: Power, Authority, and Governance

Social studies programs should include experiences that provide for the study of how people create and change structures of power, authority, and governance, so that the learner can:

- 6a. examine persistent issues involving the rights, roles, and status of the individual in relation to the general welfare;
- 6b. explain the purpose of government and analyze how its powers are acquired, used, and justified;
- 6c. analyze and explain ideas and mechanisms to meet needs and wants of citizens, regulate territory, manage conflict, establish order and security, and balance competing conceptions of a just society;
- 6d. compare and analyze the ways nations and organizations respond to conflicts between forces of unity and forces of diversity;
- 6e. compare different political systems (their ideologies, structures, institutions, processes, and political cultures) with that of the United States, and identify representative political leaders from selected historical and contemporary settings;
- 6f. analyze and evaluate conditions, actions, and motivations that contribute to conflict and cooperation within and among nations;
- 6g. evaluate the role of technology in communications, transportation, information-processing, weapons development, or other areas as it contributes to or helps resolve conflicts;
- 6h. explain and apply ideas, theories, and modes of inquiry drawn from political science to the examination of persistent issues and social problems;
- 6i. evaluate the extent to which governments achieve their stated ideals and policies at home and abroad;

- 6j. prepare a public policy paper and present and defend it before an appropriate forum in school or community.

7. Thematic Strand: Production, Distribution, and Consumption

Social studies programs should include experiences that provide for the study of how people organize for the production, distribution, and consumption of goods and services, so that the learner can:

- 7a. explain how the scarcity of productive resources (human, capital, technological, and natural) requires the development of economic systems to make decisions about how goods and services are to be produced and distributed;
- 7b. analyze the role that supply and demand, prices, incentives, and profits play in determining what is produced and distributed in a competitive market system;
- 7c. consider the costs and benefits to society of allocating goods and services through private and public sectors;
- 7d. describe relationships among the various economic institutions that comprise economic systems such as households, business firms, banks, government agencies, labor unions, and corporations;
- 7e. analyze the role of specialization and exchange in economic processes;
- 7f. compare how values and beliefs influence economic decisions in different societies;
- 7g. compare basic economic systems according to how rules and procedures deal with demand, supply, prices, the role of government, banks, labor and labor unions, savings and investments, and capital;
- 7h. apply economic concepts and reasoning when evaluating historical and contemporary social developments and issues;
- 7i. distinguish between the domestic and global economic systems, and explain how the two interact;
- 7j. apply knowledge of production, distribution, and consumption in the analysis of a public issue such as the allocation of health care or the consumption of energy, and devise an economic plan for accomplishing a socially desirable outcome related to that issue;
- 7k. distinguish between economics as a field of inquiry and the economy.

8. Thematic Strand: Science, Technology, and Society

Social studies programs should include experiences that provide for the study of relationships among science, technology, and society, so that the learner can:

- 8a. identify and describe both current and historical examples of the interaction and interdependence of science, technology, and society in a variety of cultural settings;
- 8b. make judgments about how science and technology have transformed the physical world and human society and our understanding of time, space, place, and human-environment interactions;
- 8c. analyze how science and technology influence the core values, beliefs, and attitudes of society, and how the core values, beliefs, and attitudes of society shape scientific and technological change;
- 8d. evaluate various policies that have been proposed as ways of dealing with social changes resulting from new technologies, such as genetically engineered plants and animals;
- 8e. recognize and interpret varied perspectives about human societies and the physical world using scientific knowledge, ethical standards, and technologies from diverse world cultures;
- 8f. formulate strategies and develop policies for influencing public discussions associated with technology-society issues, such as the greenhouse effect.

9. Thematic Strand: Global Connections

Social studies programs should include experiences that provide for the study of global connections and interdependence, so that the learner can:

- 9a. explain how language, art, music, belief systems, and other cultural elements can facilitate global understanding or cause misunderstanding;
- 9b. explain conditions and motivations that contribute to conflict, cooperation, and interdependence among groups, societies, and nations;
- 9c. analyze and evaluate the effects of changing technologies on the global community;
- 9d. analyze the causes, consequences, and possible solutions to persistent, contemporary, and emerging global issues, such as health, security, resource allocation, economic development, and environmental quality;
- 9e. analyze the relationships and tensions between national sovereignty and global interests in such matters as territory,

economic development, nuclear and other weapons, use of natural resources, and human rights;

- 9f. analyze and formulate policy statements demonstrating an understanding of concerns, standards, issues, and conflicts related to universal human rights;
- 9g. describe and evaluate the role of international and multinational organizations in the global arena;
- 9h. illustrate how individual behaviors and decisions connect with global systems.

10. Thematic Strand: Civic Ideals and Practices

Social studies programs should include experiences that provide for the study of the ideals, principles, and practices of citizenship in a democratic republic, so that the learner can:

- 10a. explain the origins and interpret the continuing influence of key ideals of the democratic republican form of government, such as individual human dignity, liberty, justice, equality, and the rule of law;
- 10b. identify, analyze, interpret, and evaluate sources and examples of citizens' rights and responsibilities;
- 10c. locate, access, analyze, organize, synthesize, evaluate, and apply information about selected public issues—identifying, describing, and evaluating multiple points of view;
- 10d. practice forms of civic discussion and participation consistent with the ideals of citizens in a democratic republic;
- 10e. analyze and evaluate the influence of various forms of citizen action on public policy;
- 10f. analyze a variety of public policies and issues from the perspective of formal and informal political factors;
- 10g. evaluate the effectiveness of public opinion in influencing and shaping public policy development and decision-making;
- 10h. evaluate the degree to which public policies and citizen behaviors reflect or foster the stated ideals of a democratic republican form of government;
- 10i. construct a policy statement and an action plan to achieve one or more goals related to an issue of public concern;
- 10j. participate in activities to strengthen the “common good,” based upon careful evaluation of possible options for citizen action.