Agriculture, Food & Natural Resources Career Cluster

1. Analyze how issues, trends, technologies and public policies impact systems in the Agriculture, Food & Natural Resources Career Cluster.

AG 1.1: Explain how regulations and major laws impact management of AFNR activities.

Sample Indicators:

- *Describe the major impacts of AFNR legislation.*
- *Describe the major regulations impacting the management of an individual resource.*
- *Identify situations that violate regulations.*

AG 1.2: Describe current issues impacting AFNR activities.

Sample Indicators:

- *Identify significant issues that impact work assignment.*

AG 1.3: Identify, organize alternatives, and evaluate public policy issues related to AFNR.

Sample Indicators:

- *Identify alternatives to an issue's potential solution.*
- *Evaluate alternatives for strengths and weaknesses.*
- *Recommend a solution based on research and analysis.*

AG 1.4: Consider public input in decision-making for AFNR activities.

Sample Indicators:

- *Identify impacts on the environment of a given animal management or production situation.*
- *List strategies to reduce or mitigate environmental impacts.*
- *Apply techniques to prevent potentially negative environmental impacts in an animal management or production situation.*

AG 1.5: Explain the impact of sustainability on ARNR activities and practices.

Sample Indicators:

- *Identify significant environmental and economic issues facing AFNR.*
- *List the potential economic, environmental, and social costs and benefits of enacting sustainability initiatives in AFNR.*

AG 1.6: Recognize the historical, social, cultural and potential applications of biotechnology on AFNR activities.

Sample Indicators:

- *Discuss the current applications of biotechnology in AFNR.*

AG.1.7: Demonstrate the application of biotechnology to AFNR activities.

Sample Indicators:

- *Explain how biotechnology is used in specific AFNR activities*

2. Evaluate the nature and scope of the Agriculture, Food & Natural Resources Career Cluster and the role agriculture, food and natural resources (AFNR) play in society and the economy.

AG 2.1: Examine company performance and goals within AFNR organizations and the AFNR industry.

Sample Indicators:

- *Examine the role and major functions of AFNR organizations to better utilize AFNR guidelines.*
- *Explain the major guidelines used by AFNR organizations to manage and improve performance while maintaining ecosystem health.*
- *Examine economic, social, and technological changes to spotlight their impact on AFNR organizations and the industry.*
- *Explain technological changes to reveal their impact on information technology and transportation.*

AG 2.2: Examine the role of AFNR in global, national, and regional economies.

Sample Indicators:

- *State the economic output of AFNR-related industries in the United States.*
- *Describe the role of global supply and demand on AFNR.*
- *Evaluate the impact of AFNR activities in your local community.*

AG 2.3: Explain the types of industries, organizations, and activities part of AFNR.

Sample Indicators:

- *Provide examples of AFNR organizations in each of the AFNR pathways.*
- *Explain the relationship between agriculture, food, and natural resources.*
- *Describe the role of government, multinational companies, regional companies, small businesses, entrepreneurs, and consumers in AFNR activities.*

AG 2.4: Explain the influence of AFNR on society.

Sample Indicators:

- *Identify ways in which the average person interacts with AFNR on a daily basis.*
- *Find examples of tradition, custom, or policy that result from practices in AFNR.*
- *Communicate the importance of AFNR to general public.*

3. Examine and summarize importance of health, safety and environmental management systems in AFNR organizations.

AG 3.1: Examine health risks associated with a particular skill to better form personnel safety guidelines.

Sample Indicators:

- *Define what level of possible contamination or injury is considered a risk in order to set safety priorities.*
- *Assess mental and physical stresses to determine all aspects necessary to perform well and what health risks are associated with both the mental and physical aspects.*

AG 3.2: Develop response plans to handle emergencies.

Sample Indicators:

- *Identify various emergency response plan requirements for a facility.*
- *Develop an emergency response plan for natural disasters.*

AG 3.3: Identify hazards and acquire first aid skills to promote environmental safety.

Sample Indicators:

- *Identify general workplace safety hazards.*
- *Apply general workplace safety precautions/procedures.*
- *Acquire and maintain first aid certification.*
- *Acquire and maintain cardiopulmonary resuscitation (CPR) certification.*
- *Respond to medical emergencies.*
- *Explain purpose of pollution control systems.*
- *Describe procedures to comply with environmental regulations.*
- *Maintain environmental health and safety facilities.*
- *Handle chemicals and safety equipment appropriately.*
- *Explain ergonomic procedures.*
- *Assess workplace safety.*
- *Assess a safety-training plan.*
- *Observe all regulatory and safety standards.*

AG 3.4: Examine required regulations to maintain/improve safety, health and environmental management systems and sustainable business practices.

Sample Indicators:

- *Study appropriate resources to identify the major regulatory areas (e.g., personal protective equipment) and government laws and regulations.*
- *Examine the major system components to realize benefits of health, safety, and environmental management systems in AFNR organizations.*
- *Measure or estimate benefits to explain how government agencies promote compliance and improved health, safety, and environmental performance to AFNR organizations.*
- *Examine logistics, distribution, and transportation organizations to explain how AFNR organizations promote improved health, safety, and environmental performance.*

AG 3.5: Enact procedures that demonstrate the importance of safety, health, and environmental responsibilities in the workplace.

Sample Indicators:

- *Establish a set of safety, health, and environmental principles to ensure a high level of performance.*
- *Develop a pollution/waste prevention plan to reduce or eliminate waste.*

AG 3.6: Demonstrate methods to correct common hazards.

Sample Indicators:

- *Identify and describe common hazards in the workplace.*
- *Identify and describe major sources of information about hazards in the workplace (e.g., MSDS, work procedures, exposure control plans, training materials, labels, and signage).*
- *Identify sources of combustible/flammable materials, fire, and emergencies to establish a fire-safe environment.*
- *Interpret safety signs and symbols.*

AG.3.7: Demonstrate application of personal and group health and safety practices.

Sample Indicators:

- *Identify procedures necessary for maintaining a safe work area.*
- *Identify methods to correct common hazards.*
- *Identify methods for disposing of hazardous materials.*
- *Demonstrate principals of safe physical movement to avoid slips, trips, and spills.*
- *Inspect and use protective equipment (PPE).*

4. Demonstrate stewardship of natural resources in AFNR activities.

AG.4.1: Demonstrate evidence of interest and concern for natural resource stewardship.

Sample Indicators:

- *Explain how personal choices are related to natural resource sustainability.*
- *Describe strategies to help an organization create a culture of natural resource stewardship.*

AG.4.2: Explain the environmental considerations of decision making in AFNR management.

Sample Indicators:

- *Predict the positive and negative impacts of given AFNR activities.*

5. Describe career opportunities and means to achieve those opportunities in each of the Agriculture, Food & Natural Resources Career Pathways.

AG.5.1: Locate and identify career opportunities that appeal to personal career goals.

Sample Indicators:

- *Locate and interpret career information for at least one career cluster.*
- *Identify job requirements for career pathways.*
- *Identify educational and credentialing requirements for career cluster and pathways.*

AG.5.2: Match personal interest and aptitudes to selected careers.

Sample Indicators:

- *Identify personal interests and aptitudes.*
- *Identify job requirements and characteristics of selected careers.*
- *Compare personal interests and aptitudes with job requirements and characteristics of career selected.*
- *Modify career goals based on results of personal interests and aptitudes with career requirements and characteristics.*

AG.5.3: Provide examples and descriptions of various careers in each of the AFNR pathways.

Sample Indicators:

- *List examples of careers that require various levels of postsecondary education in each AFNR pathway.*
- *Explain the primary benefit of having a career in each of the AFNR pathways.*

6. Analyze the interaction among ANFR systems in the production, processing and management of food, fiber and fuel and sustainable use of natural resources.

AG.6.1: Explain foundational cycles and systems of AFNR.

Sample Indicators:

- *Explain the typical plant and animal life cycle.*
- *Explain nutrient and water cycles.*
- *Describe basic plant and animal production cycles.*

AG.6.2: Explain the interconnectedness of systems within AFNR.

Sample Indicators:

- *Describe how various systems (e.g., soil, water, economic, plant, insect, livestock production) are impacted by the production practices of a give crop such as corn or alfalfa.*
- *Explain how changes in one system in AFNR can benefit and cost components of other systems. (e.g., using less irrigation water and the impact on soli systems, economic systems, watersheds)*

Agribusiness Systems Career Pathway (AG-BIZ)

1. Apply management planning principles in AFNR business enterprises.

AG-BIZ 1.1: Develop a mission statement and related goals and objectives to guide business activities.

Sample Indicators:

- *Identify planning approaches for preparing mission statement.*
- *Write a mission statement.*

- *Establish short- and long-term goals.*
- *Ask for feedback from stakeholders to test the impact of the mission statement.*
- *Disseminate mission statement to inform fellow employees and gain in-house support.*

AG-BIZ 1.2: Apply management skills to organize an AFNR enterprise or business unit.

Sample Indicators:

- *Identify management types.*
- *Identify organizational structures.*
- *Identify time management techniques.*
- *Make business agreements.*
- *Follow local, state, and federal regulations and appreciate the consequences of not following them.*
- *Recruit, train, and evaluate human resources.*
- *Make business presentations.*

2. Use record keeping to accomplish AFNR business objectives, manage budgets, and comply with laws and regulations.

AG-BIZ 2.1: Employ fundamental accounting principles in business bookkeeping and associated financial files.

Sample Indicators:

- *Budget resources (e.g., capital, human, financial, time).*
- *Manage assets for optimum utilization.*
- *Manage risk of liabilities.*
- *Evaluate credit uses and options.*
- *Prepare and interpret financial statements (e.g., balance sheet, profit/loss statement, cash flow statement).*
- *Prepare tax forms (e.g., W-4, I9, Depreciation, 1099, Workers Compensation).*
- *Determine cost of doing business.*
- *Compare and examine advantages and disadvantages of banking procedures (e.g., bank reconciliation).*
- *Analyze investment options (e.g., buy, lease, finance, risk).*

AG-BIZ 2.2: Prepare and maintain all files as needed for effective record keeping practices.

Sample Indicators:

- *Identify information management systems.*
- *Develop record keeping techniques and practices.*
- *Keep production and agribusiness records.*
- *Make records analysis.*

3. Manage cash budgets, credit budgets and credit for an AFNR business using generally accepted accounting principles.

AG-BIZ 3.1: Employ fundamental accounting principles in business bookkeeping and associated financial files.

Sample Indicators:

- *Budget resources (e.g., capital, human, financial, time).*
- *Manage assets for optimum utilization.*
- *Manage risk of liabilities.*
- *Evaluate credit uses and options.*
- *Prepare and interpret financial statements (e.g., balance sheet, profit/loss statement, cash flow statement).*
- *Prepare tax forms (e.g., W-4, I9, Depreciation, 1099, Workers Compensation).*
- *Determine cost of doing business.*
- *Compare and examine advantages and disadvantages of banking procedures (e.g., bank reconciliation).*
- *Analyze investment options (e.g., buy, lease, finance, risk).*

4. Develop a business plan for an AFNR enterprise or business unit.

AG-BIZ 4.1: Identify strategies to manage or mitigate risk.

Sample Indicators:

- *Identify sources of risk for an AFNR operation.*
- *Explain risk management strategies common across all industries and strategies specific to AFNR operations.*
- *Match appropriate risk management strategies to risk situations in an AFNR operation.*

AG-BIZ 4.2: Develop business goals and strategies that capitalize on opportunities in an AFNR market.

Sample Indicators:

- *Evaluate market opportunities.*
- *Establish mission and vision for AFNR enterprise or business unit.*
- *Write business goals that are clear, specific, realistic, and aligned to the mission and vision of the organization.*
- *Define the purpose, customers, and goals of the business.*
- *Prepare a one-year and multiple-year projected budget for the business.*

AG-BIZ 4.3: Develop an operation and/or production plan to provide required levels of product or service.

Sample Indicators:

- *Identify the resources required for operation or production of an AFNR enterprise or business unit.*

- *Calculate costs of carrying inventory.*
- *List the components of a supply chain in an AFNR enterprise or business unit.*

AG-BIZ 4.4: Analyze the strengths, weaknesses, opportunities, and threats to an AFNR enterprise or business unit.

Sample Indicators:

- *Collect feedback from shareholders, stakeholders, and outside sources.*
- *Describe the opportunities and threats unique to AFNR operations.*
- *Analyze strengths and weakness of an AFNR enterprise or business unit compared to peer organizations.*

5. Use sales and marketing principles common to agribusiness systems to accomplish AFNR business objectives.

AG-BIZ 5.1: Develop a mission statement and related goals and objectives to guide business activities.

Sample Indicators:

- *Identify planning approaches for preparing mission statement.*
- *Write a mission statement.*
- *Establish short- and long-term goals.*
- *Ask for feedback from stakeholders to test the impact of the mission statement.*
- *Disseminate mission statement to inform fellow employees and gain in-house support.*

Environmental Service Systems Pathway (AG-ENV)

1. Use analytic procedures and instruments to manage environmental systems activities.

AG-ENV 1.1: Monitor samples using a variety of instrumentation.

Sample Indicators:

- *Operate basic laboratory equipment and environment-monitoring instruments (e.g., pH meter/ISE meter, compound microscope/dissecting microscope, sound level measuring devices, turbidimeter, conductivity meter, chlorine meter OVA, HNMU).*
- *Perform chemical laboratory sample preparation.*
- *Perform analytical separation techniques.*
- *Perform spectroscopic analysis using instruments such as: spectrophotometer/auto spectrophotometer, AA/graphite furnace, ICP, GC/MS, oxygen meter, IC, IR, FTIR X-ray diffraction nitrogen analyzer, mercury analyzer, FID/PID analyzer, and RAD meter.*
- *Operate advanced laboratory and field equipment and instruments (e.g., HPLC, GC, bomb calorimeters, Geiger Mueller counters, explosimeters, specific gas meters, carbon analyzers, microwaves).*

- *Use computers to interface with chemical analytical instruments.*
- *Perform instrumental analysis (e.g., mass spectrometers, chromatographs, electron microscopes).*

AG-ENV 1.2: Analyze and interpret results of sample measurements.

Sample Indicators:

- Apply basic statistics concepts.
- *Interpret scattergrams.*
- *Analyze probability theories.*
- *Determine control limits.*
- *Determine process capability.*
- *Prepare and evaluate charts.*
- *Conduct process improvement studies.*
- *Interpret quantitative and graphic output from chemical analysis instruments.*

AG-ENV 1.3: Calibrate and service field equipment and instruments according to manufacturer's specifications.

Sample Indicators:

- *Maintain instruments using gas systems.*
- *Calibrate chemical analytical instruments.*
- *Operate and maintain flow instrument systems.*
- *Operate and maintain pressure test instruments (e.g., manometers, vacuum pumps, pressure and vacuum gages).*
- *Service thermal measuring instruments.*
- *Service physical property (e.g., sample control) measuring instruments.*
- *Service chemical property measuring instruments (e.g., O2 meter, spectrophotometer, atomic absorption spectrophotometer, inductively coupled plasma, ion chromatography, infrared).*

2. Evaluate the impact of public policies and regulations on environmental services facility operations.

AG-ENV 2.1: Identify the major laws impacting environmental services by consulting reliable resources or participating in trainings.

Sample Indicators:

- *Identify key components of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).*
- *Identify requirements of the Superfund Amendment Reauthorization Act (SARA).*
- *Identify requirements of waste and material transportation.*
- *Describe job-related activities subject to the Occupational Safety and Health Administration (OSHA).*

- *Describe requirements of the Resource Conservation and Recovery Act (RCRA).*
- *Explain requirements of the Clean Water Act.*
- *Explain requirements of the Safe Drinking Water Act (SDWA).*
- *Explain requirements of the Clean Air Act.*
- *Identify requirements of the Nuclear Waste Policy Act.*
- *Identify key components of ISO 14000.*

3. Develop proposed solutions to environmental issues, problems, and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry, and ecology.

AG-ENV 3.1: Recognize weather systems and weather patterns using meteorological principles and knowledge.

Sample Indicators:

- *Identify the components of the earth's atmosphere.*
- *Explain basic meteorology principles.*

AG-ENV 3.2: Describe soil compositions and properties to demonstrate knowledge of soil science.

Sample Indicators:

- *Describe soil geology.*
- *Describe composition of soil.*
- *Describe the biological properties of soil.*
- *Identify the physical properties of soil.*
- *Describe the chemical properties of soil.*
- *Test soil samples to determine characteristics.*
- *Explain classification of soil water.*
- *Explain the relationship between soil classifications and land use.*

AG-ENV 3.3: Explain well design and groundwater supplies using knowledge of hydrology.

Sample Indicators:

- *Explain hydrology.*
- *Explain geological and meteorological principles affecting groundwater supply.*
- *Conduct channel flow analysis.*
- *Identify basic criteria for water well design.*
- *Identify differences in groundwater potential.*
- *Identify environmental hazards associated with groundwater supplies.*

AG-ENV 3.4: Use chemical analysis to conduct tests.

Sample Indicators:

- *Explain basic chemistry principles (e.g., elements, compounds).*
- *Apply chemical laboratory skills.*

AG-ENV 3.5: Perform common microbiology procedures to examine cell types and conduct tests.
Sample Indicators:

- *Conduct bioassay tests.*
- *Identify groups of microorganisms.*
- *Analyze factors affecting microbial growth.*

AG-ENV 3.6: Apply sampling techniques and other assessments using procedures and principles from the study of microbiology.
Sample Indicators:

- *Apply microbiological principles and procedures.*
- *Explain immunological procedures.*
- *Describe roles of microorganisms in the environment.*
- *Explain microbial growth.*
- *Describe influence of environmental factors on microbes.*
- *Demonstrate the use of fundamental statistics in sampling practices.*

AG-ENV 3.7: Apply chemistry principles to environmental service systems.
Sample Indicators:

- *Distinguish the characteristics of inorganic and organic compounds related to environmental service systems.*
- *Apply standard operating procedures for use and management of chemicals in environmental service systems.*

AG-ENV 3.8: Discuss properties, classifications, functions, and principles for managing wetlands.
Sample Indicators:

- *Explain wetlands classification.*
- *Explain the function of wetlands.*
- *Describe the living components of wetland habitats.*
- *Delineate wetlands.*
- *Identify techniques used in wetland management, enhancement, and restoration programs.*
- *Identify principles used in wetland mitigation and restoration.*

AG-ENV 3.9: Discuss properties, classifications, functions, and principles for managing watersheds.
Sample Indicators:

- *Identify properties of watersheds.*
- *Explain watershed management.*
- *Delineate watersheds.*
- *Assess source water.*

Food Products & Processing Systems (AG-FD)

1. Develop and implement procedures to ensure safety, sanitation, and quality in food product and processing facilities.

AG-FD 1.1: Implement Hazard Analysis and Critical Control Point (HACCP) procedures.
Sample Indicators:

- *Describe the principles of HACCP.*
- *Outline procedures to eliminate possible contamination hazards associated with food products and processing.*

AG-FD 1.2: Develop operational procedures and maintenance plans for food processing equipment and facilities.
Sample Indicators:

- *Develop and maintain a Standard Sanitation Operating Procedure (SSOP).*
- *Explain and demonstrate Good Manufacturing Practices (GMP).*
- *Perform equipment and facility maintenance in a food product and processing operation.*
- *Practice worker safety procedures.*

AG-FD 1.3: Employ safety and sanitation procedures for the handling, processing, and storage of food products.
Sample Indicators:

- *Explain techniques and procedures for safe handling of food products.*
- *Perform quality-assurance tests on food products.*
- *Demonstrate approved food product handling techniques.*
- *Explain the importance of microbiological tests in food product preparation.*

2. Apply principles of nutrition, biology, microbiology, chemistry, and human behavior to development of food products.

AG-FD 2.1: Execute key processes related to food product development and enhancement.
Sample Indicators:

- *Conduct research.*
- *Apply the use of chemistry.*
- *Comply with and apply USDA/FDA standards.*
- *Use product development (e.g., consumer opinion, taste testing).*
- *Conduct nutritional analysis (e.g., biochemistry).*
- *Compare and contrast the nutritive value of food groups.*
- *Identify and compare various food constituents.*

AG-FD 2.2: Field-test a food product for consumer acceptance.

Sample Indicators:

- *Describe human behaviors related to food.*
- *Plan a field test for a new food product.*
- *Perform sensory testing of a new food product with consumers.*

AG-FD 2.3: Analyze a food product to identify food constituents.

Sample Indicators:

- *Compare the nutritive value of food.*
- *Describe common food constituents (e.g., fats, vitamins, proteins)*
- *Explain how food constituents (proteins, minerals, etc.) contribute to product taste and appearance.*

AG-FD 2.4: Determine the physical and chemical properties of a food product.

Sample Indicators:

- *Identify the required information for a food label.*
- *Explain the function of common food additives.*
- *Predict the effects of altering a food product's formulation.*

3. Select and process food products for storage, distribution, and consumption.

AG-FD 3.1: Evaluate and grade food products.

Sample Indicators:

- *Evaluate, grade, and classify meat, egg, fish, poultry, and dairy products.*
- *Evaluate, grade, and classify processed fruit and vegetable products.*
- *Evaluate, grade, and classify grain, legume, and oilseed products.*

AG-FD 3.2: Process food products for sale and distribution.

Sample Indicators:

- *Formulate food packages based on standard weights and measures.*
- *Prepare fresh food products for distribution and sale.*
- *Preserve foods through a variety of techniques.*
- *Select packaging for storage of processed foods.*
- *Evaluate storage conditions for food quality, shelf life, and indented use.*

AG-FD 3.3: Use harvesting, selection, and selection techniques to obtain quality food products for processing and distribution.

Sample Indicators:

- *Assign quality grades and yield grades to food products according to industry standards.*
- *Perform quality-assurance inspections of raw food products.*
- *Describe acceptable animal treatment and harvesting techniques.*

4. Explain the scope of the food industry and the historical and current developments of food products and processing.

AG-FD 4.1: Explain the participants and their relationships in the food industry.
Sample Indicators:

- *Describe the role of producers, wholesale buyers, ingredient manufacturers, merchandisers, processors, distributors, and retailers in the food industry.*
- *Explain the relationships among participants in the food industry for a given food product.*

AG-FD 4.2: Describe historical developments in food products and processing.
Sample Indicators:

- *Describe technological advancements that impacted food processing, storage, and distribution.*
- *Explain how environmental and GMO concerns about food products have impacted the food industry.*
- *Discuss food safety issues raised by consumers over time and the resulting impact on the food industry.*
- *Predict trends and their impact on the future of food production and processing.*

AG-FD 4.3: Explain the role of industry associations, governmental agencies, and other organizations in the food industry.
Sample Indicators:

- *Discuss the application of industry standards in food products and processing.*
- *Explain the importance of industry standard grading systems for food products and processing.*
- *Identify examples of collaboration between industry associations, governmental agencies, and other organizations related to a food industry issue.*

AG-FD 4.4: Recognize the historical, social, cultural and potential applications of biotechnology on food products and processing.
Sample Indicators:

- *Explain the costs and benefits of biotechnology applications in food products and processing.*

Natural Resources Systems (AG-NR)

1. Plan and conduct natural resource management activities that apply logical, reasoned, and scientifically based solutions to natural resource issues and goals.

AG-NR 1.1: Recognize weather and other natural hazards related to working in an outdoor environment.
Sample Indicators:

- *Recognize weather-related dangers.*

- *Recognize hazards as they relate to terrain.*
- *Recognize poisonous plants and animals.*
- *Recognize hazardous situations at the work location.*

AG-NR 1.2: Apply cartographic skills to the planning, implementing, and evaluating natural resource activities.

Sample Indicators:

- *Describe different types of maps.*
- *Interpret map features and legend.*
- *Determine map scale and actual distance.*
- *Determine direction from map.*
- *Determine elevation and terrain features from topographic maps.*
- *Use directional tools with map to locate position.*
- *Use land survey and coordinate system.*
- *Use a Geographic Information System (GIS) to interface geospatial data.*
- *Interpret photos and images.*

AG-NR 1.3: Obtain and analyze data by monitoring natural resource status.

Sample Indicators:

- *Conduct resource inventory and population studies.*
- *Establish sample plots and points.*
- *Locate and identify resources.*
- *Collect data concerning resource availability and health.*
- *Maintain databases of resource data.*
- *Use a Geographic Information System (GIS) to analyze resource data.*
- *Prepare a technical report.*
- *Describe the relationship of harvest levels to long-term availability of resources.*

AG-NR 1.4: Explain the application of laws and regulations related to natural resource systems.

Sample Indicators:

- *Identify applicable laws and regulations.*
- *List federal, state, and local agencies that carry out laws and regulations related to natural resource systems.*

AG-NR 1.5: Execute natural resource strategies and activities applying scientific knowledge from the study of ecology and wildlife.

Sample Indicators:

- *Demonstrate stream enhancement techniques.*
- *Demonstrate forest stand improvement techniques.*
- *Demonstrate wildlife habitat enhancement techniques.*
- *Demonstrate range enhancement techniques.*

- *Demonstrate recreation area enhancement techniques.*

2. Plan and Analyze interrelationships between natural resources and humans needed to manage natural resource systems.

AG-NR 2.1: Examine natural resource topics using science concepts, processes, and research techniques.

Sample Indicators:

- *Develop a research/monitoring plan to inquire about a natural resource topic.*
- *Conduct a research/monitoring activity for a natural resource topic.*
- *Evaluate the results of a natural resource-related inquiry.*
- *Produce a technical report of results/findings*

AG-NR 2.2: Examine biological and physical characteristics to identify and classify natural resources.

Sample Indicators:

- *Identify tree species and other woody vegetation.*
- *Identify grass and forage species.*
- *Identify wildlife species.*
- *Identify fish species.*
- *Identify rocks, minerals, and soil types.*

AG-NR 2.3: Examine natural cycles and related phenomena to describe ecologic concepts and principles.

Sample Indicators:

- *Describe the hydrologic cycle.*
- *Describe the nitrogen cycle.*
- *Describe the carbon cycle.*
- *Describe nutrient cycles.*
- *Describe succession.*
- *Describe population dynamics.*
- *Describe primary and secondary producers.*
- *Describe predator-prey relationships.*
- *Identify potential pollution sources.*
- *Define watershed boundaries.*
- *Use stream classification system.*
- *Describe the influence of weather and climatic factors.*

AG-NR 2.4: Examine natural cycles and related phenomena to describe ecologic concepts and principles.

Sample Indicators:

- *Describe the hydrologic cycle.*

- *Describe the nitrogen cycle.*
- *Describe the carbon cycle.*
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- *Describe primary and secondary producers.*
- *Describe predator-prey relationships.*
- *Identify potential pollution sources.*
- *Define watershed boundaries.*
- *Use stream classification system.*
- *Describe the influence of weather and climatic factors.*

3. Develop plans to ensure responsible and sustainable production and processing of natural resources.

AG-NR 3.1: Plan for the production, harvesting, processing, and/or use of natural resources in a responsible and sustainable manner.

Sample Indicators:

- *Describe forest harvest techniques and procedures.*
- *Describe wildlife harvest techniques and procedures.*
- *Describe fish harvest techniques and procedures.*
- *Describe how minerals and ores are extracted and processed.*
- *Describe how oil is extracted and processed.*
- *Describe hydroelectric generation techniques and procedures.*
- *Describe how public recreation use is a product.*
- *Develop plans for production, use, or harvesting of a natural resource in a given environment.*

4. Demonstrate responsible control and management procedures and techniques to protect or maintain natural resources.

AG-NR 4.1: Employ techniques and equipment needed to manage and/or prevent fire.

Sample Indicators:

- *Demonstrate personal fire prevention precautions while working in natural environments.*
- *Participate in wildfire prevention community service project.*
- *Explain the use of prescribed burns.*
- *Meet industry standards for fire suppression training (e.g., National Wildfire Coordinating Group Firefighter Certification Standards).*

AG-NR 4.2: Employ appropriate techniques to prevent the spread of animal and plant diseases affecting natural resource systems.

Sample Indicators:

- *Identify observable diseases impacting plants and animals.*
- *Describe how to report observance of disease infestations.*
- *Use appropriate techniques and equipment when working with bio-hazards.*

AG-NR 4.3: Manage invasive species infestations that threaten natural resource systems.

Sample Indicators:

- *Identify and classify insects.*
- *Identify insect damage signs.*
- *Describe how to report observance of insect infestation.*
- *Identify examples of invasive species that threaten natural resource systems.*
- *Plan for control techniques to manage spread of invasive species.*

Plant Systems (AG-PL)

1. Develop and implement a crop management plan for a given production goal that accounts for environmental factors.

AG-PL 1.1: Develop a fertilization plan using the results of an analysis and evaluation of nutritional requirements and environmental conditions.

Sample Indicators:

- *Describe nutrient sources.*
- *Determine plant nutrient requirements for optimum growth.*
- *Identify function of plant nutrients in plants.*
- *Determine the environmental factors that influence and optimize plant growth.*
- *Apply nutrients to plants for economic growth.*
- *Describe nutrient application methods and appropriate practices.*

AG-PL 1.2: Evaluate soil/media nutrients using tests of appropriate materials and/or by examining data.

Sample Indicators:

- *Collect and test soil/media and/or plant tissue.*
- *Interpret tests of soil/media and/or plant tissue.*
- *Identify soil slope, structure, and type.*
- *Evaluate soil/media permeability and water-holding capacity.*
- *Determine the chemical properties of soil/media.*
- *Determine land use capability.*
- *Determine the biological functions of microorganisms of soil/media.*

AG-PL 1.3: Determine the influence of environmental factors on plants.

Sample Indicators:

- *Describe plant response to light color, intensity, and duration.*
- *Determine the optimal and allowable air and soil temperature and water conditions for plant growth.*
- *Describe the optimal and allowable characteristics of the growing media for plant growth.*

AG-PL 1.4: Manage water conditions for plant growth.

Sample Indicators:

- *Explain how soil draining and water-holding capacity can be improved.*
- *Design an irrigation schedule that makes the most efficient use of irrigation water.*
- *Identify categories of soil water.*

AG-PL 1.5: Manage characteristics of growing media.

Sample Indicators:

- *Explain the various types and components of growing media.*
- *Describe techniques to reduce soil compaction.*
- *Modify composition of growing media to better meet plant growth needs.*

2. Apply the principles of classification, plant anatomy, and plant physiology to plant production and management.

AG-PL 2.1: Examine unique plant properties to identify/describe functional differences in plant structures including roots, stems, flowers, leaves, and fruit.

Sample Indicators:

- *Identify plant structures (e.g., seeds).*
- *Describe physiological functions of plants.*
- *Describe germination process and conditions.*

AG-PL 2.2: Classify plants based on physiology for taxonomic or other classifications.

Sample Indicators:

- *Classify plants as monocots or dicots.*
- *Classify plants as annuals, biennials, or perennials.*
- *Classify plants according to growth habit.*
- *Classify plants by type.*
- *Classify plants by economic value.*
- *Classify plants by agricultural use.*
- *List the scientific names and key characteristics of agriculturally important plants.*

AG-PL 2.3: Apply knowledge of plant anatomy and plant structures to plant systems activities.

Sample Indicators:

- *Identify root types, tissues, and components.*

- *Explain active and passive transport through root systems.*
- *Identify the components of plant stems.*
- *Explain translocation.*
- *Explain how plant management techniques can impact mineral transport and translocation.*
- *Identify the different types of flowers and flower forms.*
- *Explain how flower structures impact plant breeding and production.*
- *Describe the types and components of seeds and fruits.*
- *Explain how plants are managed for the production of seeds and fruit.*

AG-PL 2.4: Apply knowledge of plant physiology and energy conservation to plant systems activities.

Sample Indicators:

- *Explain how plant management relies on understanding of light-dependent and light-independent reactions of photosynthesis.*
- *Relate plant growth, management, and harvesting strategies in response to stages of cellular respiration in plants.*
- *Use plant growth regulators to product desired responses from plants.*

3. Propagate, culture, and harvest plants and plant products based on current industry standards.

AG-PL 3.1: Develop a production plan that applies the fundamentals of plant management.

Sample Indicators:

- *Identify and select seeds and plants*
- *Manipulate and evaluate environmental conditions (e.g., irrigation, mulch shading) to foster plant germination, growth and development.*
- *Evaluate and demonstrate planting practices (e.g., population rate, germination/seed vigor, inoculation, seed and plant treatments).*
- *Evaluate and demonstrate transplanting practices.*
- *Prepare soil/media for planting.*
- *Control plant growth (e.g., pruning, pinching, disbudding, topping, detasseling, staking, cabling, shearing, shaping).*
- *Prepare plants and plant products for distribution.*

AG-PL 3.2: Harvest crops using methods that apply fundamentals of plant management.

Sample Indicators:

- *Determine crop maturity.*
- *Identify harvesting practices and equipment.*
- *Demonstrate common harvesting techniques.*
- *Calculate yield and loss.*
- *Identify options for crop storage.*

- *Maintain quality of plants products in storage.*
- *Prepare plants and plant products for distribution.*

AG-PL 3.3: Handle crops using method that apply fundamentals of plant management.
Sample Indicators:
- *Demonstrate techniques for grading, handling, and packaging plants and plant products for distribution.*
- *Predict typical loss of plants or plant products in the process of handling, packing and/or distribution.*

AG-PL 3.4: Store crops using methods that apply fundamentals of plant management.
Sample Indicators:
- *Identify methods for storing plants and plant products.*
- *Explain how cellular respiration affects plant and plant product storage.*
- *Explain the proper conditions for storage of plants and plant products.*

AG-PL 3.5: Produce crops using a plant management plan.
Sample Indicators:
- *Inspect propagation material for pest and diseases,*
- *Prepare growing media/soil for planting.*
- *Prepare a schedule for production that accommodates environmental setting (natural, greenhouse, or modified).*
- *Demonstrate proper plant procedures and post-planting care.*
- *Control growth through mechanical, cultural, and mechanical means.*

AG-PL 3.6: Develop and implement an integrated pest management plan.
Sample Indicators:
- *Identify major weeds, beneficial insects, insect pests, and plant diseases for region and crop.*
- *Diagram the life cycles of major plant pests and diseases.*
- *Explain the proper selection and use of pesticide controls and formulations.*
- *Compare the risks and benefits of chemical and non-chemical pest controls.*

AG-PL 3.7: Demonstrate plant propagation techniques.
Sample Indicators:
- *Explain pollination, cross-pollination, and self-pollination of flowering plants.*
- *Design plants to control the pollination of flowering plants.*
- *Demonstrate seed-sowing techniques that result in favorable germination, viability, and vigor.*
- *Demonstrate proper procedures in budding or grafting plant materials.*
- *Propagate plants by micropropagation.*
- *Explain the principles and processes of recombinant DNA technology in plants.*
- *Compare plant breeding and genetic modification.*

AG-PL 3.8: Apply principles and practices of sustainable agriculture to plant production.

Sample Indicators:

- *Calculate the economic, environmental, and human health costs and benefits of incorporating sustainable plant production practices.*
- *Plan the production of plants or plant products that incorporate sustainable practices.*
- *Identify the certifying options for crops and plants produced using sustainable techniques.*

AG-PL 3.9: Demonstrate the application of biotechnology to plant production.

Sample Indicators:

- *Explain the principles and processes of recombinant DNA technology in plants.*
- *List the current applications of biotechnology in plant production.*

4. Apply principles of design in plant systems to enhance an environment (e.g., floral, forest landscape, and farm).

AG-PL 4.1: Create a design using plants that demonstrates an application of basic design elements and principles.

Sample Indicators:

- *Conduct a site evaluation for physical condition and design implications.*
- *Apply elements of design (e.g., line, form, texture, color).*
- *Incorporate principles of design (e.g. space, scale, proportion, order).*
- *Use landscape design drawing tools including Computer-Aided Design (CAD) and industry-specific software.*
- *Select hard goods, supplies, and tools used in design.*
- *Select plant(s) for design.*

Power, Structural & Technical Systems (AG-PST)

1. Apply physical science principles and engineering applications related to mechanical equipment, structures, and biological systems to solve problems and improve performance in AFNR power, structural, and technical systems.

AG-PST 1.1: Select energy sources for power generation.

Sample Indicators:

- *Identify petroleum sources (e.g., gasoline, diesel).*
- *Identify alternative sources (e.g., ethanol, biodiesel, air, wood, geothermal, solar).*
- *Compare environmental impact of energy sources.*
- *Compare efficiency of energy sources.*
- *Compare characteristics of energy sources.*

- *Discuss efficiency of systems (e.g., fuel cells, chemical, wind, hydro, nuclear, electric, mechanical, solar, biological).*

AG-PST 1.2: Use hand and power tools commonly required in power, structural, and technical systems
Sample Indicators:
- *Identify petroleum sources (e.g., gasoline, diesel).*
- *Demonstrate use of measurement tools.*
- *Demonstrate use of hand tools and instruments used for service, construction, and fabrication.*
- *Demonstrate use of power tools and instruments used for service, construction, and fabrication.*

AG-PST 1.3: Investigate solutions to AFNR power, structural, and technical systems.
Sample Indicators:
- *Use the scientific method to guide investigation.*
- *Apply knowledge of physical science principles to identify the cause of the problem and to brainstorm solutions.*
- *Use engineering approach in the design and testing of potential solutions.*

AG-PST 1.4: Design or modify equipment, structures, or biological systems to improve performance of an AFNR enterprise or business unit.
Sample Indicators:
- *Generate ideas that will improve performance.*
- *Build rapid prototypes to test ideas and new designs.*
- *Evaluate success of prototypes.*
- *Determine feasibility of full-scale production of new design or modification.*
- *Plan production of design or modification.*

2. Operate and maintain mechanical equipment related to AFNR power, structural, and technical systems.

AG-PST 2.1: Maintain machinery and equipment by performing scheduled service routines.
Sample Indicators:
- *Lubricate machinery and equipment.*
- *Ensure presence and function of safety systems and hardware.*
- *Service electrical systems.*
- *Perform machine adjustments (e.g., belts, drive chains).*
- *Service filtration systems.*
- *Maintain fluid levels.*
- *Maintain vehicle, machinery, and equipment cleanliness and appearance.*
- *Maintain fluid conveyance components (e.g., hoses and lines, valves, nozzles).*
- *Design a preventive maintenance schedule.*
- *Identify causes of malfunctions and failures.*

- *Calibrate metering, monitoring, and sensing equipment.*

AG-PST 2.2: Perform service routines to maintain power units and equipment.
Sample Indicators:
- *Test and service electrical systems.*
- *Troubleshoot malfunctions and failures in equipment.*
- *Service filtration systems on power units.*
- *Perform equipment lubrication.*
- *Develop a preventive maintenance schedule.*

AG-PST 2.3: Operate machinery and equipment while observing all safety precautions.
Sample Indicators:
- *Describe function of machine controls and instrumentation.*
- *Perform appropriate start-up procedures.*
- *Select proper machine(s) for specific task(s).*
- *Safely operate equipment.*
- *Perform pre-operation inspection.*
- *List applicable laws for on- and off-highway operation.*

3. Service and repair mechanical equipment and poser systems used in AFNR power, structural and technical systems.

AG-PST 3.1: Service and repair the components of internal combustion engines using procedures for troubleshooting and evaluating performance.
Sample Indicators:
- *Describe principles of operation.*
- *Identify engine systems and components.*
- *Analyze and troubleshoot engines.*
- *Perform overhaul procedures.*
- *Evaluate engine performance through post-rebuild testing.*

AG-PST 3.2: Service and repair power transmission systems following manufacturer's guidelines.
Sample Indicators:
- *Describe features, benefits, and applications of various power transmission systems.*
- *Describe principles of operation of various power transmission systems.*
- *Perform calculations involving speed, torque, and power relationships.*
- *Describe features, benefits, and applications of mechanical transmission components (e.g., belts, chains, gears, bearings, seals, universals).*
- *Inspect, analyze, and repair hydrostatic transmissions.*

- *Inspect, analyze, and repair differentials and final drives.*
- *Inspect, analyze, and repair clutches and brakes.*
- *Inspect, analyze, and repair gear-type transmissions including power shift.*
- *Inspect, analyze, and repair auxiliary drives.*

AG-PST 3.3: Service and repair hydraulic systems by evaluating performance using maintenance manuals.

Sample Indicators:

- *Describe features, benefits, and applications of types of hydraulic systems.*
- *Describe physical principles of operation.*
- *Interpret symbols and schematic drawings.*
- *Describe the application and operation of major components.*
- *Inspect, analyze, and repair hydraulic components (e.g., pumps, valves).*
- *Inspect, analyze, and repair fluid conveyance components (e.g., hoses, lines).*
- *Evaluate system cleanliness.*
- *Identify hydraulic fittings and ports.*

AG-PST 3.4: Service and repair steering, suspension, traction, and vehicle performance systems by checking performance parameters.

Sample Indicators:

- *Evaluate traction, ballasting, and weight transfer.*
- *Evaluate vehicle stability.*
- *Determine optimum vehicle performance, e.g., horsepower management, fuel efficiency.*
- *Troubleshoot, adjust, and repair suspension systems.*
- *Inspect and repair steering systems.*

AG-PST 3.5: Execute the safe and proper use of construction/fabrication hand tools in the workplace.

Sample Indicators:

- *Demonstrate proper use of measurement and layout tools.*
- *Apply proper use of measurement and layout tools in construction/fabrication of an actual project.*
- *Demonstrate safe and proper techniques in using hand and power tools in construction/fabrication.*
- *Demonstrate hand and power tool usage to construct/fabricate an actual project according to blueprints or plans.*
- *Identify and demonstrate proper hand and power tool maintenance procedures.*

AG-PST 3.6: Service electrical systems by troubleshooting from schematics.

Sample Indicators:

- *Describe features and applications of electrical systems.*
- *Interpret symbols and wiring diagrams.*

- *Test and troubleshoot electrical systems and components (e.g., battery, charging, starting, lighting, instrumentation, accessories).*
- *Troubleshoot and install instrumentation and data acquisition system (e.g., Global Positioning System (GPS), spraying, planting, harvesting monitors).*
- *Diagnose and repair control systems and sensors (e.g., engine, transmission, implement).*
- *Describe features and applications of electrical systems.*
- *Interpret symbols and wiring diagrams.*
- *Test and troubleshoot electrical systems and components (e.g., battery, charging, starting, lighting, instrumentation, accessories).*
- *Troubleshoot and install instrumentation and data acquisition system (e.g., Global Positioning System (GPS), spraying, planting, harvesting monitors).*
- *Diagnose and repair control systems and sensors (e.g., engine, transmission, implement).*

4. Plan, build and maintain AFNR structures.

AG-PST 4.1: Create sketches and plans of agricultural structures.

Sample Indicators:

- *Use current technology to develop simple plans and sketches.*
- *Identify symbols and drawing techniques used to develop simple plans and sketches.*
- *Use scale measurement and dimension to develop simple plans and sketches.*

AG-PST 4.2: Apply structural plans, specifications, and building codes.

Sample Indicators:

- *Identify components of an architectural drawing.*
- *Complete appropriate local permit applications.*
- *Follow applicable structural codes.*

AG-PST 4.3: Determine requirements and estimate costs for construction materials and procedures.

Sample Indicators:

- *Identify criteria for materials based on use or application of structure.*
- *Prepare request for construction bid.*
- *Prepare a project cost estimate.*

AG-PST 4.4: Follow architectural and mechanical plans to construct AFNR structures.

Sample Indicators:

- *Construct metal structures using welding fabrication processes.*
- *Install glass, ridged panels, and/or film plastics.*
- *Construct with concrete, brick, stone or masonry.*
- *Insulate a structure.*

- *Construct wood or metal building frames.*
- *Install pipes and plumbing equipment and fixtures.*
- *Install electrical wiring and fixtures.*
- *Paint or protect with coatings.*

5. Use control, monitoring, geospatial, and other technologies in AFNR power, structural, and technical systems.

AG-PST 5.1: Execute procedures and techniques for monitoring and controlling electrical systems using basic principles of electricity.

Sample Indicators:

- *Show proficiency in use of various meters.*
- *Discuss importance of and techniques for grounding.*
- *Show understanding of codes and regulations.*
- *Discuss various energy sources.*

AG-PST 5.2 Design control systems by referencing electrical drawings.

Sample Indicators:

- *Develop and read schematic drawings for a control system.*
- *Identify and describe uses of various components of control systems (i.e., transistors, relays, HVAC, logic controllers).*
- *Discuss the importance of maintenance schedules.*

AG-PST 5.3 Use geospatial technologies in AFNR applications.

Sample Indicators:

- *Describe principles of global positioning, Geographical Information Systems (GIS), and remote sensing.*
- *List examples of geospatial technology applications in AFNR.*
- *Install and test geospatial technologies in AFNR applications.*