# Agricultural and Environmental Systems Career Field

## Natural Resources

**Subject Code: 010710**

**Outcome & Competency Descriptions**

**Course Description:**

Students will learn the principles of plant science and apply management practices for the protection and conservation of natural resources. Students will observe plant associations in nature and discover the basic principles of phytogeography, ecology, and conservation Students will learn the fundamentals of soils, land use, water, waste, and wildlife management to identify human impacts on natural resources. Furthermore, students will learn to identify, track, and monitor wildlife, forest, water, air, soil, and energy development to protect and conserve renewable and non-renewable resources. Throughout the course, students will apply communications, business principles and leadership skills to demonstrate career readiness in a natural resource’s related career

**Strand 1. Business Operations/21st Century Skills**

Learners apply principles of economics, business management, marketing and employability in an entrepreneur, manager and employee role to the leadership, planning, developing and analyzing of business enterprises related to the career field.

**Outcome: 1.1. Employability Skills**

Develop career awareness and employability skills (e.g., face-to-face, online) needed for gaining and maintaining employment in diverse business settings.

**Competencies**

1.1.2. Identify the scope of career opportunities and the requirements for education, training, certification, licensure and experience.

1.1.7. Apply problem-solving and critical-thinking skills to work-related issues when making decisions and formulating solutions.

**Outcome: 1.2. Leadership and Communications**

Process, maintain, evaluate and disseminate information in a business. Develop leadership and team building to promote collaboration.

**Competencies**

1.2.1. Extract relevant, valid information from materials and cite sources of information.

1.2.2. Deliver formal and informal presentations.

**Outcome: 1.3. Business Ethics and Law**

Analyze how professional, ethical and legal behavior contributes to continuous improvement in organizational performance and regulatory compliance.

**Competencies**

1.3.1. Analyze how regulatory compliance (e.g., United States Department of Agriculture [USDA], Food and Drug Administration [FDA], United States Department of Interior [USDI], Ohio Livestock Care Standards, water quality standards, local water regulations, building codes) affects business operations and organizational performance.

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**Outcome: 1.11. Principles of Business Economics**

Examine and employ economic principles, concepts and policies to accomplish organizational goals and objectives.

**Competencies**

1.11.8. Identify the relationships between economy, society and environment that lead to sustainability.

**Outcome: 1.12. Site and Personal Safety Procedures**

Follow site and personal safety procedures in specific situations with specialized tools and equipment, evaluate the situation and take corrective action.

**Competencies**

1.12.1. Use Occupational Safety and Health Administration (OSHA) defined procedures for identifying employer and employee responsibilities, working in confined spaces, managing worker safety programs, using ground fault circuit interrupters (GFCIs), maintaining clearance and boundaries and labeling.

1.12.7. Select, use, store, maintain and dispose of personal protective equipment (PPE), appropriate to job tasks, conditions and materials.

1.12.8. Identify safety hazards and take corrective measures.

1.12.9. Identify, inspect and use safety equipment appropriate for the task.

1.12.10. Follow established procedures for the administration of first aid and contact emergency medical personnel when necessary.

1.12.12. Apply inspection, rejection criteria, hitch configurations and load handling practices to slings and rigging hardware.

1.12.13. Demonstrate the proper use of American National Standards Institute (ANSI) hand signals.

1.12.17. Identify symptoms of exposure to health-threatening environments (e.g., temperature; chemical noise, vibration, harshness [NVH] hazards).

**Strand 2. Animal Science**

Learners apply principles of animal anatomy, physiology, genetics, behavior, nutrition, and production to the research and development, selection and reproduction, health and management of animals in domestic and natural environments.

**Outcome: 2.3. Care and Management**

Apply animal care, management and record procedures to ensure animal husbandry and welfare, including managing environmental conditions to ensure animal health and performance.

**Competencies**

2.3.1. Identify species-specific terminology (gender, age, reproductive status).

2.3.3. Determine the biotic and abiotic factors (e.g., air, ventilation) that impact the animals’ environment.

2.3.6. Calculate a facility or habitat’s carrying capacity and its impact on animal health.

2.3.7. Identify and recognize predator-prey relationships and implement control measures.

**Outcome: 2.4. Recognizing Diseases and Disorders**

Evaluate animal conditions for species-specific diseases and disorders to assess an animal’s health and welfare.

**Competencies**

2.4.5. Describe zoonotic diseases and explain the health risk on humans and animals.

2.4.6. Implement disease prevention methods and procedures including the use of personal protective equipment.

**Strand 5. Structural Engineering**

Learners apply principles of practice related to the management and maintenance of food, agriculture and natural resources systems.

**Outcome: 5.5. Geographic Information Systems (GIS)**

Employ GIS computer applications to interpret data, maps and land use.

**Competencies**

5.5.1. Interpret and evaluate the accuracy of digital imagery and aerial photography.

5.5.2. Explain map projections and the use of scales.

5.5.6. Demonstrate ranging methods.

5.5.8. Determine one’s position on the earth using GPS.

5.5.9. Integrate GPS data into GIS applications.

**Strand 6. Environmental Science**

Learners apply earth, life, and physical sciences to the production, extraction, processing, protection, use, and renewal of both renewable and non-renewable resources.

**Outcome: 6.1. Soils**

Apply knowledge of soil characteristics and soil information resources to overcome any existing soil use limitations while maintaining or improving soil quality.

**Competencies**

6.1.1. Identify soil forming factors and explain how they produce variability in soils.

6.1.2. Describe the relationship among physical properties of soils.

6.1.3. Collect, test and analyze soil samples for physical and chemical properties.

6.1.4. Identify and describe factors (e.g., climate, soil texture, mineralogy, soil organisms, drainage co-efficient, land use, vegetation types, management practices) affecting organic matter and its function in soil quality.

6.1.5. Determine land use and identify land capabilities classes.

6.1.6. Identify and describe soil conservation practices to reduce soil erosion and compaction.

6.1.7. Compare and contrast the causes and effects of soil erosion.

6.1.8. Describe soil limitations in agronomic, urban and natural resource practices.

6.1.9. Evaluate soil survey data and implement management decisions.

6.1.10. Assess basic processes (e.g., slope stability, water control, earth material control, vegetative treatment, soil amendments) of soil reclamation.

**Outcome: 6.2. Water Quality**

Analyze, interpret, and manage the biological, chemical and physical properties of water quality.

**Competencies**

6.2.1. Assess and explain the interactions between human activities and the Earth’s hydrosphere (e.g., septic systems, desalinization, point and non-point source pollution).

6.2.2. Measure pH, dissolved oxygen (DO), biochemical oxygen demand (BOD), nitrogen and phosphorus in lentic and lotic waters to determine water quality.

6.2.3. Measure vegetation, temperature, turbidity, macroinvertebrate populations, and bacterial quality in lentic and lotic waters to determine water quality.

6.2.4. Explain the hydrological and how human and animal activity impacts the cycle.

6.2.5. Explain the biotic and abiotic factors affecting water quality.

6.2.6. Monitor and analyze water quality and quantity.

6.2.7. Identify and describe best management and industry (e.g., agriculture, timber production, construction) production practices that maintain or improve water quality.

**Outcome: 6.3. Air Quality**

Analyze, interpret and manage the biological, chemical and physical properties of air quality.

**Competencies**

6.3.1. Determine the chemical and physical properties of air (e.g., composition, density, pressure).

6.3.2. Explain biogeochemical cycles (e.g., nitrogen, oxygen, sulfur) and how they relate to the biosphere, geosphere and atmosphere.

6.3.3. Explain the effects of carbon dioxide sequestration on air quality.

6.3.4. Analyze the importance of air quality to humans and other living organisms.

6.3.5. Explain human and natural factors (e.g., transportation, farming practices, greenhouse gases, forest fires, volcanic eruptions) affecting air quality.

**Outcome: 6.4. Water Use and Management**

Collect, analyze and interpret data for a localized water use and management plan.

**Competencies**

6.4.1. Explain the domains of hydrology.

6.4.2. Describe the geological and meteorological principles affecting water supplies.

6.4.4. Identify and describe uses of surface water flow measurements (e.g., stage, stage-discharge curve, peak stage, instantaneous flow, estimation of annual discharge).

6.4.5. Interpret surface water flow measurements (e.g., stage, stage-discharge curve, peak stage, instantaneous flow, estimation of annual discharge).

6.4.6. Evaluate water collection, storage and distribution systems (e.g., wells, ponds, runoff, waterways, irrigation).

6.4.7. Identify and describe watersheds and their structures (e.g., flowing waters, still water, and upland areas.).

6.4.8. Identify and describe risk factors for potential surface water and groundwater contamination.

6.4.9. Identify and describe best management practices that conserve and sustain water.

**Outcome: 6.5. Potable Water Treatment**

Monitor the water treatment processes for potable water at a specific site.

**Competencies**

6.5.1. Identify and assess the characteristics of potable water treatment and the sources of water.

6.5.2. Collect and analyze water samples to determine potability.

**Outcome: 6.7. Solid Waste and Renewable Resource Management**

Control and process solid waste using current and alternative technologies.

**Competencies**

6.7.6. Describe and monitor solid waste disposal procedures and management procedures (e.g., composting, incineration, recycling, burial, bio-digester).

**Outcome: 6.8. Contaminants and Pollution Control**

Assess an affected area, determine the source and type of contaminant and respond.

**Competencies**

6.8.2. Determine the types, sources and impact of natural and man-made contaminants.

6.8.3. Monitor, analyze and quantify levels of contaminants from point and non-point sources.

6.8.5. Describe the environmental impact from both industrial and nonindustrial processes.

6.8.6. Identify, comply with and implement best management practices for contaminant control, remediation and prevention (e.g., biological, sanitation, buffer strips).

**Outcome: 6.10. Ecosystems**

Evaluate biotic and abiotic components and relationships in ecosystems to apply restoration and conservation practices that maintain functionality.

**Competencies**

6.10.1. Describe ecological levels, including population, community, ecosystem and biosphere.

6.10.2. Distinguish the flow of energy through ecosystems.

6.10.3. Identify and classify interactions among organisms, including predation, symbiosis and competition, to determine species interdependent relationships.

6.10.4. Describe the process of succession and its impact on ecosystems.

6.10.5. Connect biotic interactions with the abiotic environment.

6.10.6. Describe biogeochemical cycles (e.g., carbon, nitrogen, phosphorous, hydrological) and their roles in maintaining equilibrium in an ecosystem.

6.10.7. Identify interactions of ecosystems to differentiate biomes.

6.10.8. Select and implement restoration ecology practices to repair damaged ecosystems.

6.10.9. Identify and describe the impact of native, non-native, invasive species on ecosystems.

6.10.10. Describe the relationship between evolution and ecosystems.

**Outcome: 6.11. Habitat Management and Restoration**

Develop a plan for the management and restoration of a specific habitat.

**Competencies**

6.11.1. Differentiate the properties and characteristics of habitats.

6.11.2. Examine sites and place them into ecological classifications.

6.11.3. Evaluate the current and historical (e.g., industrialism, agriculture, climate change) impacts of human interactions on ecosystems and habitats.

6.11.4. Identify and differentiate extinct, endangered, threatened, and species of concern.

6.11.5. Survey and monitor species within a habitat.

6.11.6. Explain the role of various stakeholders, including individuals, non-governmental organizations (NGOs), corporations and governments in habitat restoration and conservation.

6.11.7. Implement techniques used in habitat management, mitigation, enhancement and restoration.

6.11.8. Develop a management plan for the restoration and sustainability of a specific habitat using environmental practices that enhance biological diversity.

6.11.9. Implement habitat restoration and sustainability management plan environmental practices.

**Strand 8. Plant Science**

Learners apply principles of plant anatomy, physiology, nutrition and genetics to the research and development, selection and reproduction, planting, fertilization, health, harvesting and management of plants in a domestic and/or natural environment.

**Outcome: 8.1. Plant Nutrition**

Select and apply macronutrients and micronutrients based on deficiencies identified from the use of industry-driven testing, application, methods and optimum management strategies that account for environmental factors.

**Competencies**

8.1.1. Compare and contrast organic and inorganic sources of macronutrients and micronutrients.

8.1.2. Describe the functions of macronutrients and micronutrients in plants and the role that microorganisms play in plant nutrition.

8.1.4. Identify symptoms and causes of plant nutrient deficiencies and toxicities.

8.1.7. Distinguish between biotic and abiotic factors (e.g., soil type, minerals, pH, microorganisms) that influence and optimize the availability of nutrients for plants.

8.1.10. Determine the nutrient content of organic and inorganic fertilizers.

**Outcome: 8.2. Plant Reproduction**

Propagate plants and cultivars for specific characteristics under a variety of production systems.

**Competencies**

8.2.1. Identify the reproductive anatomy of plants and describe their physiological functions.

8.2.2. Describe how biotic and abiotic factors (e.g., insects, light, temperature, microorganisms, moisture, location) influence plant reproduction.

8.2.3. Compare and contrast variations of plant reproductive systems among plant species.

8.2.4. Describe how artificial selection methods are used in plant breeding to improve plant traits.

**Outcome: 8.3. Pest Management**

Develop and implement an integrated pest management (IPM) plan by scouting and identifying specific plant pests and the damage they cause and applying specialized control methods.

**Competencies**

8.3.1. Identify and classify insects, weeds, pathogens, animal pests, and describe the damages they cause.

8.3.2. Examine the interrelationships of the disease triangle among host, pathogen and the environment.

8.3.5. Describe native and transgenic adaptations and modifications that have led to plant tolerance or resistance to fungal, bacteria and insect pests.

8.3.7. Develop an IPM plan, based on pest life cycles, available treatments, application methods and evaluate its impact on the environment (e.g. drift, application rate and long-term soil health).

**Outcome: 8.4. Growth and Management**

Explain, manage and manipulate plants through all stages of growth and development.

**Competencies**

8.4.1. Identify and classify plants using taxonomy.

8.4.2. Identify plant anatomical structures and their functions.

8.4.3. Identify and classify seeds.

8.4.4. Identify and classify plants and describe management decisions at all stages.

8.4.5. Explain the requirements of photosynthesis and identify the products and byproducts.

8.4.6. Explain the process and importance of transpiration in plant growth and development.

8.4.7. Understand aerobic respiration and its relationship to plant growth and management.

8.4.8. Explain primary and secondary plant growth.

8.4.9. Identify the plant responses to plant growth regulators and different forms of tropism.

8.4.10. Understand the environmental and artificial factors that influence plant germination, growth and development.

8.4.11. Select, evaluate and prepare soil or media for planting.

8.4.13. Evaluate and implement planting practices.

8.4.15. Evaluate and implement transplanting practices.

8.4.16. Control plant growth through mechanical and chemical means.

8.4.21. Distinguish between biotic and abiotic factors that influence plant stress.

**Strand 9. Energy**

Learners apply principles of physics, chemistry, the earth sciences and mathematics to energy sources, transformations, acquisition, applications and their impacts.

**Outcome: 9.1. Energy**

Identify energy sources according to their economic viability, sustainability and environmental impact.

**Competencies**

9.1.1. Identify, compare and contrast fossil fuel sources (e.g., oil, natural gas, and coal) and the technology used to generate energy.

9.1.2. Identify, compare and contrast renewable energy sources and the technology used to generate energy.

9.1.3. Identify, compare and contrast alternative and emerging energy sources and technology used to generate energy (e.g., fuel cells, hydrogen, nuclear).

9.1.4. Identify the social, economic and environmental drivers and barriers that influence the development and use of energy sources.