# Agricultural and Environmental Systems Career Field

## Environmental Science for Agricultural & Natural Resources

**Subject Code: 010720**

**Course and Unit Descriptions**

**Course Description:**

Students will study relationships between organisms in an ecosystem and the impact of those relationships on the environment. Students will investigate how different ecosystems function and respond to changes in various biological, chemical, and geological processes. Students will examine fundamentals of resource development, agriculture sustainability, energy needs, and pollution control. Students will develop a basic understanding of the scientific method and learn to analyze and interpret data gathered from studies on the ecosystem. Throughout this course, students will develop responses to current and historic environmental problems and develop management strategies for responsible conservation and development of resources to meet world demand.

**Unit: Application of Research and Experimentation**

Studentswill develop a basic understanding of the scientific method and apply it to research and experiments within the field of Environmental Science for Agriculture and Natural Resources.

**Outcome 3.1**

Research and Experiments: Use scientific methodology to conduct problem-based studies, develop products, and interpret results.

**Competency:**

3.1.1. Design a research plan, including the significance of the problem, purpose, hypotheses, objectives, appropriate controls, independent variables, dependent variables, methods of study, and a list of materials.

3.1.2. Examine sources for credibility.

3.1.3. Apply sampling methods that appropriately represent the population and implement procedures for systematic data collection.

3.1.4. Explain the importance and design of trialing, and the information gained from it.

3.1.5. Document results of the experiment in a laboratory notebook, including a statement of purpose, experimental design, observations, results, conclusions, and next steps.

3.1.6. Create, interpret, and use tabular and graphical displays and describe the data.

3.1.7. Compute measures of central tendency to interpret results and draw conclusions.

3.1.8. Define the concepts of confidence limit and significant figures.

3.1.9. Use t-test and p-value to determine statistical significance of results.

3.1.10. Describe the relationships among variables using correlations and draw conclusions.

3.1.11. Draw conclusions based on observations and data analyses, recognizing that experimental results must be open to the scrutiny of others.

3.1.12. Prepare and present findings using scientific reports.

3.1.13. Evaluate experimental failure and use integrity to communicate findings

3.1.14. Describe how biotechnology products are produced and used in the United States.

**Unit: Agriculture and Food Resources**

Students will identify world food issues, principal types of agriculture and challenges of Agricultural. Students willidentify solutions to agricultural problems anddevelop a restoration and/or land use plan.

**Outcome 6.11**

Habitat Management and Restoration: Develop a plan for the management and restoration of a specific habitat.

**Competency:**

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, extirpated, 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.

**Unit: Environmental Quality**

The student will determine air and water quality according to industry standards and recommend protection and restoration techniques.

**Outcome 6.2**

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

**Competency:**

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 cycle 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.

**Competency:**

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.

**Competency:**

6.4.1. Explain the domains of hydrology.

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

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.

**Unit: Soil**

Students will determine and analyze the physical, biological, and chemical properties of soils and other plant growing media. Students will utilize their knowledge of soil characteristics to overcome soil use limitations.

**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.

**Competency:**

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.

**Unit: Environmental Contaminants and Solid Waste Management**

Students will identify types of environmental contaminants and hazardous waste; determine treatment/disposal of contaminants and hazardous waste; identify best practices to clean up contaminated sites; explain biomagnifications and relevant laws.

**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.

**Competency:**

1.12.2. Interpret safety signs and symbols.

1.12.5. Identify the location of emergency flush showers, eyewash fountains, Safety Data Sheets (SDSs), fire alarms, and exits.

1.12.6. Identify procedures for the handling, storage, and disposal of hazardous materials.

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.

**Outcome 6.5**

Potable Water Treatment: Monitor the water treatment processes for potable water at a specific site.

**Competency:**

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

**Outcome 6.6**

Wastewater Operations: Monitor the wastewater collection and treatment methods for a specific site.

**Competency:**

6.6.1. Identify the components of a wastewater treatment system.

6.6.2. Collect wastewater samples using industry approved standard operating procedures.

6.6.3. Identify, analyze, and reconcile the components of wastewater using industry approved standard operating procedures.

6.6.5. Describe the processes in wastewater treatment (e.g., mixing, coagulation, flocculation, disinfection, treatment system, effluent disposal, solids management).

**Outcome 6.7**

Solid Waste and Renewable Resource Management: Control and process solid waste using current and alternative technologies.

**Competency:**

6.7.2. Distinguish the risks associated with solid waste accumulation, utilization and disposal.

6.7.3. Determine an acceptable site for solid waste disposal.

6.7.4. Compare the processes of aerobic and anaerobic waste decomposition.

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

6.7.7. Explain the control processes and potential uses for solid waste byproducts (e.g., leachate, ash, landfill gas, biosolids, methane, manure).

**Outcome 6.8**

Contaminants and Pollution Control: Assess an affected area, determine the source and type of contaminant and respond.

**Competency:**

6.8.1. Collect, record, and analyze environmental samples and interpret the results.

6.8.2. Determine the types, sources and impact of natural, human-made contaminants, and high-risk 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.

6.8.7. Identify, describe, and recommend remediation strategies for a release of contaminant to soil, surface water or groundwater.

6.8.11. Identify and contact local emergency response teams.

**Outcome 6.9**

Hazardous Materials and Waste Management: Follow and apply handling, storage and recording procedures for hazardous materials and waste.

**Competency:**

6.9.1. Identify and differentiate solid waste, hazardous waste, toxic waste and radioactive waste streams.

6.9.2. Describe health and safety practices for reducing risks from hazardous materials (e.g., safety data sheet [SDS], employer notification forms, personal protective equipment [PPE]).

6.9.10. Identify hazardous materials that can be recycled.

**Unit: Ecosystem Structure**

Students will identify the components of an ecosystem and determine conservation and restoration practices according to specific ecosystem characteristics.

**Outcome 6.10**

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

**Competency:**

6.10.1. Describe ecological levels, including population, community, ecosystem, biome, 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.

6.10.10. Describe the relationship between evolution and ecosystems.

**Unit: Sustainable Energy**

Students will identify energy use, alternative energy sources, energy conservation, environmental ramifications, and end-use efficiency improvements that will allow for sustainability of resources.

**Outcome 9.1**

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

**Competency:**

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.

9.1.6. Trace the transformations of energy within a system (e.g., mechanical to electrical, chemical to mechanical).

9.1.7. Identify and describe best management practices (e.g., carbon sequestration, conservation, animal safety, efficiency) that lessen environmental impact.

**Unit: Forest Management Practices**

Students will identify sustainable forest management practices and develop stewardship practices that maintain forest productivity, biodiversity, relevant ecological, and economic function.

**Outcome 6.10**

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

**Competency:**

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

**Unit: Population Studies**

Using industry standards, students will use identification tools to manage populations in a habitat. Students will follow all local, state, and federal guidelines to manage ecosystems and habitats.

**Outcome 1.3**

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

**Competency:**

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.

1.3.5 Access and implement safety compliance measures (e.g., quality assurance information, safety data sheets [SDSs], product safety data sheets [PSDSs], United States Environmental Protection Agency [EPA], United States Occupational Safety and Health Administration [OSHA]) that contribute to the continuous improvement of the organization.

**Outcome 1.11**

Principles of Business Economics: Examine and employ economic principles, concepts, and policies to accomplish organizational goals and objectives.

**Competency:**

1.11.7 Describe how economic performance and culture are interdependent.

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

1.11.9 Describe how laws and regulations influence domestic and international trade.

**Outcome 2.4**

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

**Competency:**

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

**Outcome 6.10**

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

**Competency:**

6.10.9 Determine the impact of native and non-native invasive species on ecosystems.

**Outcome 6.11**

Habitat Management and Restoration: Develop a plan for the management and restoration of a specific habitat.

**Competency:**

6.11.5 Survey and monitor species within a habitat.

**Unit: Public Relations**

Using communication skills, students will facilitate presentations to local and community groups on the importance of responsible conservation and resource development.

**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.

**Competency:**

1.1.1. Identify the knowledge, skills, and abilities necessary to succeed in careers.

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

1.1.3. Develop a career plan that reflects career interests, pathways, and secondary and postsecondary options.

1.1.4. Describe the role and function of professional organizations, industry associations, and organized labor, and use networking techniques to develop and maintain professional relationships.

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.

**Competency:**

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

1.2.2. Deliver formal and informal presentations.

1.2.3. Identify and use verbal, nonverbal, and active listening skills to communicate effectively.

1.2.5. Communicate information (e.g., directions, ideas, vision, workplace expectations) for an intended audience and purpose.

1.2.6. Use proper grammar and expression in all aspects of communication.

1.2.7. Use problem-solving and consensus-building techniques to draw conclusions and determine next steps.

1.2.10. Use interpersonal skills to provide group leadership, promote collaboration, and work in a team.

1.2.11. Write professional correspondence, documents, job applications, and resumés.

1.2.12. Use technical writing skills to complete forms and create reports.