# Agricultural and Environmental Systems Career Field

## Environmental Systems Management

**Subject Code: 010725**

**Course and Unit Descriptions**

**Course Description:**

Students will analyze and interpret biological, chemical, and physical properties of soil, water, and air. They will determine the source and type of environmental contamination evaluate pollution control measures and monitor treatment processes for potable water, wastewater, and solid waste. Throughout the course, learners will develop and implement environmental plans using principles governing ecosystems in relation to resource development and industrial processes.

**Unit: Safety and Equipment Operation**

Students will demonstrate their knowledge of safety rules and regulations. Students will learn the procedures of first aid and contacting emergency personnel when necessary. Students will inspect and provide basic maintenance to basic machinery and equipment in a facility or worksite.

**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:**

1.12.1 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.

1.12.2 Interpret safety signs and symbols.

1.12.4 Describe how working under the influence of drugs and alcohol increases the risk of accident, lowers productivity, raises insurance costs, and reduces profits.

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.

1.12.15 Select and operate fire extinguishers based on the class of fire.

**Outcome 4.2**

Equipment Operations: Operate and maintain mechanical equipment and power systems.

**Competency:**

4.2.1 Follow original equipment manufacturer (OEM) recommended operating procedures and adjustment specifications as found in the operator's manual.

4.2.2. Differentiate among the functions, limitations and proper use of equipment, equipment controls, and instrumentation.

4.2.3. Perform pre- and post-operation inspections and adjustments and report malfunctions.

4.2.4. Perform appropriate start-up, operating, and shut-down procedures.

4.2.5. Select and operate equipment and attachments needed to complete the task per the original equipment manufacturer (OEM) operator's manual.

**Unit: Ecosystems**

Students will learn the components of an ecosystem and along with inventorying and evaluating the habitats of a specific ecosystem.

**Outcome 6.10**

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

**Competency:**

6.10.5 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.

**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 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: Water**

Students will assess water quality using basic indicators. Students will analyze and interpret the properties of water as well as water sources. Students will be able to create and implement water management plans.

**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), biological oxygen demand (BOD), nitrogen, and phosphorus in lentic and lotic waters to determine water quality.

6.2.3. Measure vegetation, temperature, turbidity, and 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 6.4**

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.

6.4.3 Identify and describe types of tests (e.g., Well Yield Test, Pumping Test) used to determine groundwater potential and discharge rates.

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.

**Unit: Air**

Students will measure levels of oxygen, carbon dioxide, and particulate matter while assessing the air quality and determining its impact on the environment.

**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., volcanic eruptions, forest fires, greenhouse gases, farming practices, transportation) affecting air quality.

6.3.6 Monitor and evaluate air composition, quality, and quantity with direct reading instruments (e.g., combustible gas, oxygen, ammonia).

6.3.7 Assess the potential for air contamination at a specific site.

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

**Unit: Pollution and Contaminants**

Students will test for the presence of contaminants in an environment and follow the proper reporting procedures. Students will be able to assess affected areas and determine the sources and types of contaminants while responding appropriately.

**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.

6.8.4. Monitor noise and light pollution and recommend abatement measures.

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).

6.8.7. Identify, describe, and recommend a remediation strategy for the release of contaminants to soil, surface water, or groundwater.

6.8.8. Monitor and conduct remediation activities.

6.8.10 Identify and describe requirements to develop and implement various emergency response plans.

6.8.11 Identify and contact local emergency response teams.

6.8.12 Analyze environmental conditions that influence environmental response.

**Unit: Solid Waste**

Using available technology, students will collect and dispose of solid wastes while identifying all associated risks.

**Outcome 6.7**

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

**Competency:**

6.7.1 Collect, analyze, and treat solid waste materials (e.g., livestock mortalities, manure, garbage, food waste).

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.

6.7.5. Describe and monitor solid waste disposal procedures (e.g., landfill, compost).

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, sludge, methane, manure).

6.7.8 Describe standard operating procedures and identify design requirements for specific purposes (e.g., landfill, lagoon, leachate treatment).

6.7.9 Evaluate site closure methods and post-closure monitoring.

6.7.10 Determine type and volume of solid waste generated by an operation or facility.

**Unit: Water Treatment**

Students will select and monitor water treatment processes for potable water and wastewater at a specific site.

**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.

6.5.2 Collect and analyze water samples to determine potability.

6.5.3 Describe components of a water treatment facility.

6.5.4 Monitor the water treatment process (e.g., aeration, flocculation, sedimentation, filtration, disinfection).

6.5.5 Monitor the control and treatment of chemical and biological contaminants (e.g., trihalomethanes, lead, bacteria, nitrates) in water.

6.5.6 Describe taste and odor control in water treatment.

6.5.7 Identify methods for backflow prevention.

**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 and analyze wastewater samples using industry approved standard operating procedures.

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

6.6.4. Identify abnormal and normal conditions in wastewater collection and treatment systems.

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

6.6.6. Identify and describe methods for cross-connection and backflow prevention.

6.6.7. Locate, identify, and inventory wastewater assets.

**Unit:  Law, Regulations, and Hazardous Materials**

Students will identify and describe government regulations and societal issues as related to specific business enterprises or environmental projects. Students will follow the proper handling, storage, and recording of hazardous materials.

**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.

**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]).

6.9.3 Demonstrate appropriate responses for major types of hazardous materials disasters.

6.9.4. Locate and use information addressing hazardous substance discharge.

6.9.5. Demonstrate safe management, handling, disposal, and recycling procedures for hazardous materials and waste.

6.9.6. Perform site assessments to detect and identify the presence and storage of hazardous materials.

6.9.7. Identify and describe collection procedures for hazardous materials and waste and interpret results.

6.9.8. Identify and describe procedures to transport and store hazardous materials in accordance with regulations.

6.9.9 Prepare and maintain hazardous material handling documentation.

6.9.10 Identify hazardous materials that can be recycled.

**Unit: GPS and GIS**

Students will use geographic information system (GIS) and computer aided design (CAD) software to produce and interpret maps. Students will use digital elevation methods to determine their position and integrate information into GIS.

**Outcome 5.4**

Surveying and Mapping: Perform surveying procedures to construct a site plan.

**Competency:**

5.4.1 Identify civil drafting symbols and abbreviations.

5.4.2 Interpret maps, topographic site plans, deeds, and aerial or satellite imagery for site planning.

5.4.3 Perform site measurements.

5.4.4 Integrate map and surveying data into geographic information system (GIS) or computer aided design (CAD) software.

5.4.5 Identify topographical and existing features of areas, including property lines, benchmarks, utilities, streets and setbacks, on survey maps, parcel maps, and plats.

**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.

5.5.3 Describe GIS data structures (e.g., vector, grid, triangulated irregular network [TIN]).

5.5.4 Explain digital elevation methods (e.g., digital elevation model [DEM], global positioning system [GPS]).

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

5.5.9 Integrate GPS data into GIS applications.

**Unit: Business Leadership & Employability Skills**

Students will develop critical thinking and problem-solving skills using a variety of practical scenarios. Students will demonstrate leadership skills through participation with peer groups, support services, and professional organizations.

**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.

1.1.5. Develop strategies for self-promotion in the hiring process (e.g., filling out job applications, resumé writing, interviewing skills, portfolio development).

**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.

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

1.2.4 Use negotiation and conflict-resolution skills to reach solutions.

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

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

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

**Unit: Research Management**

Students will learn how to use technology to compile research and analyze information to draw conclusions. Students will use available technology to create reports and using communication skills, present their findings to small groups.

**Outcome 1.4**

Knowledge Management and Information Technology: Demonstrate current and emerging strategies and technologies used to collect, analyze, record, and share information in business operations.

**Competency:**

1.4.1 Use office equipment to communicate (e.g., phone, radio equipment, fax machine, scanner, public address systems).

1.4.2 Select and use software applications to locate, record, analyze, and present information (e.g., word processing, e-mail, spreadsheet, databases, presentation, Internet search engines).

1.4.3 Verify compliance with security rules, regulations, and codes (e.g., property, privacy, access, accuracy issues, client and patient record confidentiality) pertaining to technology specific to the industry pathway.

1.4.4 Use system hardware to support software applications.

**Outcome 3.1**

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

**Competency:**

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

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.