## Agricultural and Environmental Systems Career Field

## Environmental Systems Management

**Subject Code: 010725**

**Outcome & Competency 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.

**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**

1.1.1. 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.

**Competencies**

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.

**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.

**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.

**Competencies**

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: 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.

1.12.2. 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.

**Strand 3. Biotechnology**

Learners engage in the scientific process, learn fundamental processes using modern tools and laboratory techniques, adhere to safety protocols, and bring a biotechnology product to the market.

**Outcome: 3.1. Research and Experiments**

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

**Competencies**

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.

**Strand 4. Power Systems**

Learners apply principles of tool use, power transmission, hydraulics, two- and four-stroke cycle combustion, exhaust, ignition, fuel, starting and charging, steering, HVAC, and lubrication systems to operate, maintain and repair equipment.

**Outcome: 4.2. Equipment Operations**

Operate and maintain mechanical equipment and power systems.

**Competencies**

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.

**Strand 5. Structural Engineering**

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

**Outcome: 5.4. Surveying and Mapping**

Perform surveying procedures to construct a site plan.

**Competencies**

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.

**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 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 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: 6.3. 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.

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.

**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.

6.4.3. 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.

**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.

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.

**Competencies**

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.

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

Control and process solid waste using current and alternative technologies.

**Competencies**

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.

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

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

**Competencies**

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.

**Outcome: 6.9. Hazardous Materials and Waste Management**

Follow and apply handling, storage and recording procedures for hazardous materials and waste.

**Competencies**

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.

**Outcome: 6.10. Ecosystems**

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

**Competencies**

6.10.5. 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.