**Natural Resources**

Subject Code: 010710

Course & Unit Descriptions

**Course Description:**

Students will apply science principles and management practices to the protection of renewable and non-renewable natural resources. Students will learn fundamentals of land use as well as watershed, wildlife, fishery and forest management. Furthermore, students will learn management practices related to managing air and water quality along with requirements for managing solid and liquid waste. Throughout the course, students will apply communications, business principles and leadership skills.

**Unit: Safety**

Students will demonstrate their knowledge of safety rules and regulations, safety signs and signals. Students will describe health practices, safety practices and demonstrate the appropriate responses for major types of hazardous materials disasters. Students will identify potential hazards and their prevention.

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.

1.12.5 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.

**Unit: Waste Management**

Students will identify the management practices needed to handle and process wastewater and solid waste.

Outcome 3.8

Research and Experiments: Conduct a problem-based study, applying scientific methodology and using descriptive statistics to communicate and support predictions and conclusions.

Competency:

3.8.1 Identify research problems and structure a statistical experiment, simulation or study related to the problem.

3.8.2 Design a research plan, including the significance of the problem, purpose, variables, hypotheses, objectives, methods of study and a list of materials.

3.8.3 Distinguish between dependent, independent and control variables in an experiment.

3.8.4 Establish and implement procedures for systematic collection, organization and use of data.

3.8.5 Select and apply sampling methods that appropriately represent the population to be studied.

3.8.6 Define the concepts of confidence limit and significant figures.

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

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

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

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

3.8.12 Prepare and present findings using scientific reports.

Outcome 5.8

Water Distribution Systems: Calculate the demand for specific water applications and design and install water supply and drainage components.

Competency:

5.8.1 Calculate water demand for specific applications.

5.8.2 Compare the types, applications and operating principles of pumps and controls.

5.8.3 Locate water system entry points, walls and chases.

5.8.4 Identify components of supply and drainage systems and describe their functions.

5.8.13 Compare and contrast sources of contamination in water supplies and methods of filtering and disinfecting water.

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.

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.

6.6.3 Identify, analyze and reconcile the components of wastewater.

6.6.4 Troubleshoot wastewater collection and treatment systems.

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., mortalities, manure, garbage).

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

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

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

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 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.

**Unit: Alternative/Renewable Energy**

Students will research and identify different types of alternate and renewable resources available.

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 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 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.

9.1.5 Calculate fuel equivalents among energy sources.

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

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

**Unit: Sustainable Agriculture - Animals**

Students will identify animals that can be grown in either production or urban areas for sustainability. Students will implement practices that can be applied for sustainable agriculture while following all local, state, and government regulations.

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.

1.3.4 Identify how federal and state consumer protection laws affect products and services.

Outcome 2.1

Nutrition: Analyze, formulate, prepare and administer a ration for a population of specific animal species based on the economics, nutrition and availability of feed and evaluate the feed's effects on animals.

Competency:

2.1.1 Identify the traditional and alternative types, compositions, quality and compatibility of feeds, feed additives and feed byproducts.

Outcome 2.2

Body Systems: Describe the interrelationships of animal body systems with growth, development, health, maintenance, reproduction and economic production.

Competency:

2.2.1 Describe external anatomical parts and their functions.

2.2.2 Identify the anatomical parts of the digestive system and describe their physiology.

2.2.3 Identify anatomical components of nerve tissue and the nervous system, including regions of the brain, spinal nerves and the sympathetic and parasympathetic system, and describe their physiology.

2.2.4 Identify the anatomical components of the skeletal system, including the types and forms of bones, and describe their physiology.

2.2.5 Identify the anatomy of the musculature systems, including striated, cardiac and smooth muscle, and describe their physiology.

2.2.6 Compare and contrast bone growth, muscle growth and fat deposition in relation to developmental patterns.

2.2.7 Describe the physical characteristics, components and functions of blood.

2.2.8 Describe the components of the cardiovascular system and their functions, including factors affecting blood flow.

2.2.9 Describe the integumentary system (e.g., skin, hair, nails, wool, feathers), related structures and functions.

2.2.10 Describe the function and components of the respiratory system and pulmonary ventilation and the factors influencing respiratory rates.

2.2.11 Describe the urinary system structures and functions, including excretion and osmoregulation.

2.2.12 Differentiate between the male and female reproductive system, structures and functions.

2.2.13 Describe the endocrine system, its structures and the role of hormones.

2.2.14 Describe the immune system and the lymphatic system’s role in immunity.

2.2.15 Identify the anatomy and describe the physiology of the mammary system.

Outcome 2.3

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

Competency:

2.3.1 Identify species-specific terminology based on gender and age.

2.3.2 Identify, classify, evaluate and select animal species or breeds for a desired outcome.

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

2.3.5 Perform species-specific animal identification techniques (e.g., chipping, tagging, branding, notching, tattooing).

2.3.7 Estimate an operation’s or environment's carrying capacity and its impact on animal health.

2.3.8 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.

Competency:

2.4.7 Identify and describe zoonotic diseases.

2.4.8 Explain the health risk of zoonotic diseases on humans and their historical significance and future implications.

Outcome 2.7

Animal Behavior: Apply management practices to assure quality animal care, considering species-specific behaviors, human safety, social influences, public perception and regulations associated with animal welfare.

Competency:

2.7.1 Understand social influences, public perception and regulations that are associated with animal welfare.

2.7.2 Describe the adaptations and special senses (e.g., sight, hearing, smell, touch) of animals and how they contribute to animal behavior.

2.7.3 Identify and describe the innate behavioral patterns of animals.

2.7.4 Identify social relationships involved in behavioral adjustment and adaptation (e.g., animal-to-animal and human-to-animal interaction).

2.7.7 Handle, restrain and move animals, while ensuring the safety of the animals and their handlers.

**Unit: Sustainable Agriculture - Plants**

Students will identify plants that can be grown in either production or urban areas for sustainability. Students will implement practices that can be applied for sustainable agriculture while following all local, state, and government regulations.

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.

1.3.4 Identify how federal and state consumer protection laws affect products and services.

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, vegetation, soil texture, drainage, management practices, landscape) affecting organic matter and its function in soil quality.

6.1.5 Determine land use and identify land capabilities classes.

6.1.6 Apply 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 of soil reclamation.

Outcome 7.7

Biosecurity: Connect the sources and causes of contamination and develop the protocols to implement bio-security procedures.

Competency:

7.7.1 Investigate sources and origins of agents that can contaminate processed and unprocessed food products.

7.7.2 Identify activities and biological agents that contribute to the risk of acquiring or preventing a specific disease.

Outcome 8.1

Plant Nutrition: Select and apply macronutrients and micronutrients based on deficiencies, identified using testing application methods and optimum management that account for environmental factors.

Competency:

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

Outcome 8.2

Plant Reproduction: Propagate and cultivate plants for specific characteristics and economic variables for both greenhouses and crops.

Competency:

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 and optimize plant reproduction.

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

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 apply specialized control methods.

Competency:

8.3.1 Identify and classify insect, weed, disease and animal pests.

8.3.2 Examine the interrelationships among plants, pests, humans and the environment.

8.3.4 Determine and implement pest management safety practices (e.g., safety data sheets [SDSs], United States Environmental Protection Agency [EPA], United States Occupational Safety and Health Administration [OSHA], personal protective equipment [PPE], worker protection standards [WPS], refuge management strategy).

8.3.9 Develop an IPM plan, based on pest life cycles, available treatments, application methods and the impact on the environment.

8.3.10 Select application methods and implement an IPM plan.

Outcome 8.4

Growth and Management: Manage and manipulate plant development through the selection, planting and growing of seeds and plants, based on global demand, economic importance and growing conditions.

Competency:

8.4.1 Identify and classify plants using taxonomy.

8.4.2 Identify plant anatomical structures and tissues.

8.4.3 Identify and classify seeds and plants at all stages of growth.

8.4.4 Explain requirements necessary for photosynthesis to occur and identify the products and byproducts of photosynthesis.

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

8.4.6 Identify the principles of primary and secondary plant growth.

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

8.4.8 Understand the influence of environmental factors on plant growth, development and maintenance.

8.4.9 Manipulate natural and artificial factors to influence plant germination, growth and development.

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

8.4.11 Understand and evaluate the process by which plants are selected.

8.4.12 Evaluate and implement planting practices (e.g., population rate, germination, seed vigor, inoculation, seed and plant treatments, type of planter, cuttings, pot in pot).

8.4.13 Evaluate and implement transplanting practices.

8.4.14 Control plant growth through mechanical and chemical means.

8.4.15 Analyze plant water requirements and provide water through artificial or natural means.

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

8.4.17 Recognize plant disease symptoms, prevention, avoidance and treatments.

Outcome 8.5

Harvesting: Evaluate and implement harvesting methods to maximize yield.

Competency:

8.5.1 Identify characteristics of grains, seeds, vegetables, fruits and ornamental plants that indicate crop maturity.

8.5.2 Describe safety precautions to take when harvesting.

8.5.3 Adjust to environmental conditions to enhance the harvesting of plant products.

8.5.4 Evaluate techniques to maximize yield through mechanical or hand harvesting methods.

8.5.5 Calculate potential yield and loss due to harvesting.

Outcome 8.6

Handling and Storage: Handle and store plants and plant products to maximize quality.

Competency:

8.6.1 Describe safety precautions in handling and storage practices.

8.6.2 Adjust to environmental conditions to enhance the handling and storage of plant products.

8.6.3 Apply harvesting, handling and storage techniques to minimize loss and maximize economic return.

8.6.4 Calculate potential yield and loss due to processing and storage.

8.6.5 Explain the proper conditions to maintain the quality of plants and plant products held in storage.

8.6.6 Maintain and enhance the quality of plant products through the manipulation of handling and storage techniques (e.g., temperature, humidity, retardants, light, chemicals, contamination).

8.6.7 Prepare products for sale, transportation and storage.

**Unit: Environmental Monitoring**

Using available technology like GIS, students will read and interpret maps to identify areas that are being monitored for air and water quality. Students will describe EPA regulations needed to monitor environmental quality along with testing for air and water contaminant sources.

Outcome 5.5

Geographic Information Systems (GIS): Employ GIS computer applications to interpret data, maps and land use.

Competency:

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]).

5.5.5 Interpret spatial interpolation and two- and three-dimensional functional spatial analyses.

5.5.6 Demonstrate ranging methods.

5.5.7 Identify sources of errors in GIS and formulate corrections and solutions.

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

5.5.9 Integrate GPS data into GIS applications.

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), temperature and macroinvertebrate populations to determine water quality.

6.2.3 Measure hardness, nitrogen, phosphorus, vegetation and physical characteristics of lentic and lotic waters to determine water quality.

6.2.4 Explain the hydrological cycle (e.g., condensation, evaporation, transpiration) 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 Implement procedures and management 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., 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 indicator, oxygen meter).

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

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.

6.4.4 Identify the criteria for water well designs.

6.4.5 Measure surface water volume and discharge rates.

6.4.6 Conduct channel flow analyses.

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

6.4.8 Define, delineate and assess the volume of watersheds and streams.

6.4.9 Assess the potential for surface water and groundwater contamination at a specific site.

6.4.10 Implement management practices that conserve and sustain water.

Outcome 6.8

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

Competency:

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.

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

6.8.7 Identify, comply with and implement contaminant control, remediation and prevention practices (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.

Competency:

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 Determine the impact of native and 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.

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 Explain the impacts of an increasing human population on habitats.

6.11.4 Evaluate the current and historical interactions between human activities and habitats.

6.11.5 Differentiate threatened, endangered, extirpated and extinct species.

6.11.6 Survey and monitor species within a habitat.

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

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

6.11.9 Implement practices to enhance biological diversity.

**Unit: Business, Communications & Leadership**

Students will identify the business, leadership and management practices needed to operate in the natural resources industry.

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).

1.1.6 Explain the importance of work ethic, accountability and responsibility and demonstrate associated behaviors in fulfilling personal, community and workplace roles.

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

1.1.8 Identify the correlation between emotions, behavior and appearance and manage those to establish and maintain professionalism.

1.1.9 Give and receive constructive feedback to improve work habits.

1.1.10 Adapt personal coping skills to adjust to taxing workplace demands.

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.

1.2.4 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.

1.2.6 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.

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:

1.4.2 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.

Outcome 1.11

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

Competency:

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