

## Natural Resource Management CTAG Alignment

This document contains information about three (3) Career-Technical Articulation Numbers (CTANs) for the Natural Resource Management Career-Technical Assurance Guide (CTAG).

The CTANs are:

1. Environmental Science
2. Field Botany
3. Field Zoology

1. **Environmental Science** CTAN alignment with the Natural Resource Management Pathway in the Agriculture and Environmental Systems Career Field Technical Content Standards of the Ohio Department of Education

**General Course Description:** A course for majors and non-majors that introduces current human caused environmental problems such as air, water and soil pollution, wastes, chemicals and energy resources. Provides an introduction to science, the scientific method, basic biological and ecological concepts and applies these to current environmental issues. Students will investigate how different ecosystems function and respond to changes in various biological, chemical, and geological processes. Both historical and recent examples will be examined to illustrate how human activities impact natural systems and vice versa.

**Advising Notes:**

- Student must access credit within 3 years of program completion.

**Semester Credit Hours:** 3.0

**Postsecondary Learning Outcomes:**

<p><b>Learning Outcomes</b></p> <p><i>Asterisked Learning Outcomes are considered essential in the postsecondary curriculum.</i></p> <p><b>The student will be able to:</b></p>	<p><b>Competencies from the Natural Resources Pathway of the Agriculture and Environmental Systems Career Field Technical Content Standards</b></p>
<p>1. Develop a basic understanding of the scientific method.*</p>	<p><b>Outcome 3.8: Research and Experiments</b></p> <p>3.8.1. Identify research problems and structure a statistical experiment, simulation, or study related to the problem.</p> <p>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.</p> <p>3.8.3. Distinguish between dependent, independent and control variables in an experiment.</p> <p>3.8.4. Establish and implement procedures for systematic collection, organization, and use of data.</p>

	<p>3.8.5. Select and apply sampling methods that appropriately represent the population to be studied.</p> <p>3.8.6. Define the concepts of confidence limit and significant figures.</p> <p>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.</p> <p>3.8.9. Describe the relationships among variables using correlations and draw conclusions.</p> <p>3.8.10. Create, interpret and use tabular and graphical displays and describe the data.</p> <p>3.8.11. Draw conclusions based on observations and data analyses, recognizing that experimental results must be open to the scrutiny of others.</p> <p>3.8.12. Prepare and present findings using scientific reports.</p>
<p>2. Describe the roles of organisms in ecosystems and how populations, communities, and ecosystems change over time*</p>	<p><b>Outcome 6.10 Ecosystems</b></p> <p>6.10.1. Describe ecological levels including population, community, ecosystem, and biosphere.</p> <p>6.10.2. Distinguish the flow of energy through ecosystems.</p> <p>6.10.3. Identify and classify interactions among organisms, including predation, symbiosis, and competition to determine species interdependent relationships.</p> <p>6.10.4. Describe the process of succession and its impact on ecosystems.</p> <p>6.10.5. Connect biotic interactions with the abiotic environment.</p> <p>6.10.6. Describe biogeochemical cycles (e.g., carbon, nitrogen, phosphorous, hydrological) and their roles in maintaining equilibrium in an ecosystem.</p> <p>6.10.7. Identify interactions of ecosystems to differentiate biomes.</p> <p>6.10.8. Select and implement restoration ecology practices to repair damaged ecosystems.</p> <p><b>Outcome 6.11 Habitat Management and Restoration</b></p> <p>6.11.1. Differentiate the properties and characteristics of habitats.</p> <p>6.11.2. Examine sites and place them into ecological classifications.</p> <p>6.11.3. Explain the impact of an increasing human population on habitats.</p> <p>6.11.4. Explain the current and historical interactions between human</p>

	<p>activities and habitats.</p> <p>6.11.5. Differentiate threatened, endangered, extirpated, and extinct species.</p> <p>6.11.6. Survey and monitor species within a habitat.</p> <p>6.11.7. Explain the role of various stakeholders, including individuals, non-governmental organizations (NGOs), corporations, and governments in habitat restoration and conservation.</p> <p>6.11.8. Implement techniques used in habitat management, mitigation, enhancement, and restoration.</p> <p>6.11.9. Implement practices to enhance biological diversity.</p>
<p>3. Explain the cycling of matter and the flow of energy through ecosystems.*</p>	<p><b>Outcome 6.2 Water</b></p> <p>6.2.4. Explain the hydrological cycle (e.g., condensation, evaporation, transpiration) and how human and animal activity impacts the cycle.</p> <p><b>Outcome 6.3 Air</b></p> <p>6.3.2. Explain biogeochemical cycles (e.g., nitrogen, oxygen, sulfur) and how they relate to the biosphere, geosphere, and atmosphere.</p> <p><b>Outcome 6.10 Ecosystems</b></p> <p>6.10.2. Distinguish the flow of energy through ecosystems.</p> <p>6.10.3. Identify and classify interactions among organisms, including predation, symbiosis, and competition to determine species interdependent relationships.</p> <p>6.10.6. Describe biogeochemical cycles (e.g., carbon, nitrogen, phosphorous, hydrological) and their roles in maintaining equilibrium in an ecosystem.</p>
<p>4. Identify the various causes of current environmental issues involved in sustaining the world's human population.*</p>	<p><b>Outcome: 1.2 Leadership and Communication</b></p> <p>1.2.1. Extract relevant, valid information from materials and cite sources of information.</p> <p>1.2.2. Deliver formal and informal presentations.</p> <p><b>Outcome: 1.11 Principles of Business Economics</b></p> <p>1.11.8. Identify the relationships between economy, society and environment that lead to sustainability.</p> <p><b>Outcome: 2.4 Diagnosis Diseases and Disorders</b></p> <p>2.4.7. Identify and describe zoonotic diseases.</p>

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

**Outcome: 6.1 Soils**

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.

**Outcome: 6.2 Water**

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)

**Outcome: 6.3 Air**

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).

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

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

**Outcome: 6.8 Contaminants and Pollution Control**

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

**Outcome: 6.10 Ecosystems**

6.10.2. Distinguish the flow of energy through ecosystems.

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

**Outcome: 6.11 Habitat Management and Restoration**

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.

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

	<p>governments in habitat restoration and conservation.</p> <p>6.11.9. Implement practices to enhance biological diversity.</p> <p>6.11.10. Develop a management plan for the sustainability of a specific habitat using environmental practices.</p> <p><b>Outcome 9.1 Energy</b></p> <p>9.1.1. Identify, compare, and contrast fossil fuel sources and the technology used to generate energy.</p> <p>9.1.2. Identify, compare, and contrast renewable energy sources and the technology used to generate energy.</p> <p>9.1.3. Identify, compare, and contrast alternative energy sources and technology used to generate energy (e.g., fuel cells, hydrogen, nuclear).</p> <p>9.1.4. Identify the social, economic, and environmental drivers and barriers that influence the development and use of energy sources.</p>
<p>5. Describe current and historical patterns of energy production and use, and evaluate alternative forms of energy.*</p>	<p><b>Outcome 9.1 Energy</b></p> <p>9.1.1. Identify, compare, and contrast fossil fuel sources and the technology used to generate energy.</p> <p>9.1.2. Identify, compare, and contrast renewable energy sources and the technology used to generate energy.</p> <p>9.1.3. Identify, compare, and contrast alternative energy sources and technology used to generate energy (e.g., fuel cells, hydrogen, nuclear).</p> <p>9.1.4. Identify the social, economic, and environmental drivers and barriers that influence the development and use of energy sources.</p> <p>9.1.5. Calculate fuel equivalents among energy sources.</p> <p>9.1.6. Trace the transformations of energy within a system (e.g., mechanical to electrical, chemical to mechanical).</p> <p>9.1.7. Determine best management practices (e.g., carbon sequestration, conservation, animal safety, efficiency) that lessen environmental impact.</p> <p>9.1.8. Perform an energy evaluation to determine the best social, economic, and environmental solution.</p>

6. Discuss the chief problems of supply, consumption, and pollution of our air, water, soil, and biological resources.\*

**Outcome: 6.1 Soils**

- 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: 6.2 Water**

- 6.2.1. Assess the interactions between human activities and the Earth's hydrosphere (e.g., septic systems, desalinization, point and nonpoint source pollution).
- 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.
- 6.2.7. Implement procedures and management practices that maintain or improve water quality.

**Outcome: 6.3 Air**

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

**Outcome: 6.4 Water Use and Management**

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

**Outcome: 6.5 Potable Water Treatment Operations**

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

**Outcome: 6.6 Wastewater Treatment Operations**

6.6.1. Identify the components of a wastewater treatment system.

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

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 implement solid waste management methods (e.g., composting, incineration, recycling, burial).

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

**Outcome 6.8 Contaminants and Pollution Control**

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

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 a point source and a nonpoint source.

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).

6.8.8. Recommend a remediation strategy for a release of contaminant to soil, surface water, or groundwater.

**Outcome: 6.9 Hazardous Materials Management**

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

6.9.10. Identify hazardous materials that can be recycled.

**Outcome: 6.10 Ecosystems**

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.

**Outcome: 6.11 Habitat Management and Restoration**

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 impact 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

	<p>governments in habitat restoration and conservation.</p> <p>6.11.8. Implement techniques used in habitat management, mitigation, enhancement, and restoration.</p> <p><b>Outcome: 9.1 Energy</b></p> <p>9.1.1. Identify, compare, and contrast fossil fuel sources and the technology used to generate energy.</p> <p>9.1.2. Identify, compare, and contrast renewable energy sources and the technology used to generate energy.</p> <p>9.1.3. Identify, compare, and contrast alternative energy sources and technology used to generate energy (e.g., fuel cells, hydrogen, nuclear).</p> <p>9.1.4. Identify the social and economic drivers and barriers that influence the development and use of energy sources.</p> <p>9.1.7. Determine best management practices (e.g., carbon sequestration, conservation, animal safety, efficiency) that lessen environmental impact.</p> <p>9.1.8. Perform an energy evaluation to determine the best social, economic, and environmental solution.</p>
<p>7. Identify the key policies and legislation associated with environmental protection.*</p>	<p><b>Outcome: 1.3 Business Ethics and Law</b></p> <p>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.</p> <p><b>Outcome: 1.11 Principles of Business Economics</b></p> <p>1.11.7. Describe how economic performance and culture are interdependent.</p> <p>1.11.8. Identify the relationships between economy, society and environment that lead to sustainability.</p> <p>1.11.9. Describe how laws and regulations influence domestic and international trade.</p> <p><b>Outcome: 6.8 Contaminants and Pollution Control</b></p> <p>6.8.7. Identify, comply with and implement contaminant control, remediation and prevention practices (e.g., biological,</p>

sanitation, buffer strips).

6.8.11. Identify and contact local emergency response teams.

**Outcome: 6.9 Hazardous Materials Management**

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 sheets [SDS], employer notification forms, personal protective equipment [PPE]).

**Outcome: 6.11 Habitat Management and Restoration**

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

6.11.5. Differentiate threatened, endangered, extirpated and extinct species.

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

**2. Field Botany** CTAN alignment with the Natural Resource Management Pathway in the Agriculture and Environmental Systems Career Field Technical Content Standards of the Ohio Department of Education

**General Course Description:** The course provides students with an understanding of plant morphology, physiology, reproduction, metabolism, and the interrelationships between plants and their environment. The student will learn to identify common vascular and nonvascular plants as well as human uses and impacts of a variety of plant species.

**Advising Notes:**

- Must access credit within 3 years of program completion

**Semester Credit Hours:** 3.0

**Postsecondary Learning Outcomes:**

<p><b>Learning Outcomes</b></p> <p><i>Asterisked Learning Outcomes are considered essential in the postsecondary curriculum.</i></p> <p><b>The student will be able to:</b></p>	<p><b>Competencies from the Natural Resources Pathway of the Agriculture and Environmental Systems Career Field Technical Content Standards</b></p>
<p>1. Compare and contrast basic plant morphology and physiology.*</p>	<p><b>Outcome: 8.1 Plant Nutrition</b></p> <p>8.1.2. Describe the functions of macronutrients and micronutrients in plants and the role that microorganisms play in plant nutrition.</p> <p><b>Outcome: 8.2 Plant Reproduction</b></p> <p>8.2.1. Identify the reproductive anatomy of plants and describe their physiological functions.</p> <p>8.2.2. Describe how biotic and abiotic factors (e.g., insects, light, temperature, microorganisms, moisture, location) influence and optimize plant reproduction.</p> <p>8.2.3. Compare and contrast variations of plant reproductive systems among plant species.</p> <p><b>Outcome: 8.3 Pest Management</b></p> <p>8.3.1. Identify and classify insect, weed, disease, and animal pests.</p> <p>8.3.2. Examine the interrelationships among plants, pests, humans and the environment.</p>

	<p><b>Outcome: 8.4 Growth and Management</b></p> <p>8.4.1. Identify and classify plants using taxonomy.</p> <p>8.4.2. Identify plant anatomical structures and tissues.</p> <p>8.4.3. Identify and classify seeds and plants at all stages of growth.</p> <p>8.4.4. Explain requirements necessary for photosynthesis to occur and identify the products and byproducts of photosynthesis.</p> <p>8.4.5. Understand aerobic respiration and its relationship to plant growth and management.</p> <p>8.4.6. Identify the principles of primary and secondary plant growth.</p> <p>8.4.7. Identify the plant responses to plant growth regulators and different forms of tropism.</p> <p>8.4.8. Understand the influence of environmental factors on plant growth, development, and maintenance.</p>
<p>2. Identify and describe the diversity and taxonomy of plants.*</p>	<p><b>Outcome: 6.11 Habitat Management and Restoration</b></p> <p>6.11.1. Differentiate the properties and characteristics of habitats.</p> <p>6.11.3. Explain the impacts of an increasing human population on habitats.</p> <p>6.11.4. Explain the current and historical interactions between human activities and habitats.</p> <p>6.11.5. Differentiate threatened, endangered, extirpated and extinct species.</p> <p>6.11.6. Survey and monitor species within a habitat.</p> <p><b>Outcome: 8.4 Growth and Management</b></p> <p>8.4.1. Identify and classify plants using taxonomy.</p>
<p>3. Identify the impacts of plants on humans and how humans have impacted various plant species.*</p>	<p><b>Outcome: 1.11 Principles of Business Economics</b></p> <p>1.11.8. Identify the relationships between economy, society, and environment that lead to sustainability.</p>

**Outcome: 6.10 Ecosystems**

- 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.

**Outcome: 6.11 Habitat Management and Restoration**

- 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.

	<p>6.11.9. Implement practices to enhance biological diversity.</p> <p><b>Outcome: 8.3 Pest Management</b></p> <p>8.3.1. Identify and classify insect, weed, disease, and animal pests.</p> <p>8.3.2. Examine the interrelationships among plants, pests, humans and the environment.</p>
<p>4. Observe plant associations in nature and discover the basic principles of phytogeography, ecology, and conservation.*</p>	<p><b>Outcome: 6.1 Soils</b></p> <p>6.1.1. Identify soil-forming factors and explain how they produce variability in soils.</p> <p>6.1.2. Describe the relationship among physical properties of soils.</p> <p>6.1.4. Identify factors (e.g., climate, vegetation, soil texture, drainage, management practices, landscape) affecting organic matter and its function in soil quality</p> <p><b>Outcome: 6.2 Water</b></p> <p>6.2.1. Assess and explain the interactions between human activities and the Earth's hydrosphere (e.g., septic systems, desalinization, and point and non-point source pollution).</p> <p><b>Outcome: 6.3 Air</b></p> <p>6.3.2. Explain biogeochemical cycles (e.g., nitrogen, oxygen, sulfur) and how they relate to the biosphere, geosphere, and atmosphere.</p> <p>6.3.4. Analyze the importance of air quality to humans and other living organisms.</p> <p><b>Outcome: 6.10 Ecosystems</b></p> <p>6.10.1. Describe ecological levels including population, community, ecosystem, and biosphere.</p> <p>6.10.2. Distinguish the flow of energy through ecosystems.</p> <p>6.10.3. Identify and classify interactions among organisms, including predation, symbiosis, and competition to determine species</p>

	<p>interdependent relationships.</p> <p>6.10.4. Describe the process of succession and its impact on ecosystems.</p> <p>6.10.5. Connect biotic interactions with the abiotic environment.</p> <p>6.10.6. Describe biogeochemical cycles (e.g., carbon, nitrogen, phosphorous, hydrological) and their roles in maintaining equilibrium in an ecosystem.</p> <p>6.10.7. Identify interactions of ecosystems to differentiate biomes.</p> <p>6.10.8. Select and implement restoration ecology practices to repair damaged ecosystems.</p> <p><b>Outcome: 6.11 Habitat Management and Restoration</b></p> <p>6.11.3. Explain the impacts of an increasing human population on habitats.</p> <p>6.11.4. Evaluate the current and historical interactions between human activities and habitats.</p> <p>6.11.5. Differentiate threatened, endangered, extirpated, and extinct species.</p> <p>6.11.6. Survey and monitor species within a habitat.</p> <p>6.11.7. Explain the role of various stakeholders, including individuals, non-governmental organizations (NGOs), corporations, and governments in habitat restoration and conservation.</p> <p>6.11.8. Implement techniques used in habitat management, mitigation, enhancement, and restoration.</p> <p>6.11.9. Implement practices to enhance biological diversity.</p> <p><b>Outcome: 8.3 Pest Management</b></p> <p>8.3.1. Identify and classify insect, weed, disease, and animal pests.</p> <p>8.3.2. Examine the interrelationships among plants, pests, humans and the environment.</p>
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<p>5. Utilize resources to identify plant species.*</p>	<p><b>Outcome: 1.2 Leadership and Communication</b></p> <p>1.2.1. Extract relevant, valid information from materials and cite sources of information.</p> <p>1.2.2. Deliver formal and informal presentations.</p> <p><b>Outcome: 8.4 Growth and Management</b></p> <p>8.4.1. Identify and classify plants using taxonomy.</p> <p>8.4.2. Identify plant anatomical structures and tissues.</p> <p>8.4.3. Identify and classify seeds and plants at all stages of growth.</p>
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**3. Field Zoology** CTAN alignment with the Natural Resource Management Pathway in the Agriculture and Environmental Systems Career Field Technical Content Standards of the Ohio Department of Education

**General Course Description:** The course will focus on animal identification, morphology, physiology, ecology, biogeography, and systematics of species common to the region, stressing the environmental aspects that affect their distribution. The basic principles of ecology and wildlife management are covered with emphasis on the interrelationships between an animal and its physical and biological surroundings as well as their economic impacts on society.

**Advising Notes:**

- Must access credit within 3 years of program completion

**Semester Credit Hours:** 3.0

**Postsecondary Learning Outcomes:**

<p><b>Learning Outcomes</b></p> <p><i>Asterisked Learning Outcomes are considered essential in the postsecondary curriculum.</i></p> <p><b>The student will be able to:</b></p>	<p><b>Competencies from the Natural Resources Pathway of the Agriculture and Environmental Systems Career Field Technical Content Standards</b></p>
<p>1. Identify and utilize the system of invertebrate and vertebrate taxonomy.*</p>	<p><b>Outcome: 2.2 Body Systems</b></p> <p>2.2.1. Describe external anatomical parts and their functions.</p> <p><b>Outcome: 2.3 Care and Management</b></p> <p>2.3.2. Identify, classify, evaluate, and select animal species or breeds for desired outcome.</p> <p>2.3.3. Determine the biotic and abiotic factors (e.g., air, ventilation) that impact the animals' environment.</p> <p><b>Outcome: 6.11 Habitat Management and Restoration</b></p> <p>6.11.5. Differentiate threatened, endangered, extirpated, and extinct species.</p>
<p>2. Learn the morphological and physiological characteristics of the major animal taxa.*</p>	<p><b>Outcome: 2.1 Nutrition</b></p> <p>2.1.2. Determine the role of nutrients and the nutritional requirements of different animal life processes and species.</p> <p><b>Outcome: 2.2 Body Systems</b></p> <p>2.2.1. Describe external anatomical parts and their functions.</p>

- 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.
  - 2.2.7. 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**
- 2.3.3. Determine the biotic and abiotic factors (e.g., air, ventilation) that impact the animals' environment.

3. Describe the ecology and behavior of animals.\*

**Outcome: 2.1 Nutrition**

2.1.2. Determine the role of nutrients and the nutritional requirements of different animal life processes and species.

**Outcome: 2.3 Care and Management**

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

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

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 Diagnosing Diseases and Disorders**

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**

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).

**Outcome: 6.10 Ecosystems**

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.

	<p>6.10.5. Connect biotic interactions with the abiotic environment.</p> <p>6.10.6. Describe biogeochemical cycles (e.g., carbon, nitrogen, phosphorous, hydrological) and their roles in maintaining equilibrium in an ecosystem.</p> <p>6.10.7. Identify interactions of ecosystems to differentiate biomes.</p> <p>6.10.8. Select and implement restoration ecology practices to repair damaged ecosystems.</p> <p><b>Outcome: 6.11 Habitat Management and Restoration</b></p> <p>6.11.1. Differentiate the properties and characteristics of habitats.</p> <p>6.11.2. Examine sites and place them into ecological classifications.</p> <p>6.11.3. Explain the impact of an increasing human population on habitats.</p> <p>6.11.4. Explain the current and historical interactions between human activities and habitats.</p> <p>6.11.5. Differentiate threatened, endangered, extirpated and extinct species.</p> <p>6.11.6. Survey and monitor species within a habitat.</p> <p>6.11.7. Explain the role of various stakeholders, including individuals, non-governmental organizations (NGOs), corporations, and governments in habitat restoration and conservation.</p> <p>6.11.8. Implement techniques used in habitat management, mitigation, enhancement, and restoration.</p> <p>6.11.9. Implement practices to enhance biological diversity.</p>
<p>4. Comprehend the development of evolutionary and systematic theories, and the impact of fauna on society.*</p>	<p><b>Outcome: 1.2 Leadership and Communication</b></p> <p>1.2.1. Extract relevant, valid information from materials and cite sources of information.</p> <p>1.2.2. Deliver formal and informal presentations.</p> <p><b>Outcome: 1.11 Principles of Business Economics</b></p> <p>1.11.8. Identify the relationships between economy, society, and environment that lead to sustainability.</p>

**Outcome: 6.10 Ecosystems**

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

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6.10.7. Identify interactions of ecosystems to differentiate biomes.

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

**Outcome: 6.11 Habitat Management and Restoration**

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 impact of an increasing human population on habitats.

6.11.4. Explain 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.
5. Utilize proper equipment and methods to sample the fauna and analyze and report the data.*	<p><b>Outcome: 1.2 Leadership and Communication</b></p> <p>1.2.1. Extract relevant, valid information from materials and cite sources of information.</p> <p><b>1.2.2. Deliver formal and informal presentations.</b></p> <p><b>Outcome: 1.11 Principles of Business Economics</b></p> <p>1.11.8. Identify the relationships between economy, society, and environment that lead to sustainability.</p> <p><b>Outcome: 3.8 Research and Experiments</b></p> <p>3.8.1. Identify research problems and structure a statistical experiment, simulation, or study related to the problem.</p> <p>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.</p> <p>3.8.3. Distinguish between dependent, independent and control variables in an experiment.</p> <p>3.8.4. Establish and implement procedures for systematic collection, organization, and use of data.</p> <p>3.8.5. Select and apply sampling methods that appropriately represent the population to be studied.</p> <p>3.8.6. Define the concepts of confidence limit and significant figures.</p> <p>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.</p> <p>3.8.9. Describe the relationships among variables using correlations and draw conclusions.</p> <p>3.8.10. Create, interpret and use tabular and graphical displays and describe the data.</p>

	<p>3.8.11. Draw conclusions based on observations and data analyses, recognizing that experimental results must be open to the scrutiny of others.</p> <p>3.8.12. Prepare and present findings using scientific reports.</p> <p><b>Outcome: 5.5 Geographic Information Systems (GIS)</b></p> <p>5.5.1. Interpret and evaluate the accuracy of digital imagery and aerial photography.</p> <p>5.5.2. Explain map projections and the use of scales.</p> <p><b>Outcome: 6.11 Habitat Management and Restoration</b></p> <p>6.11.6. Survey and monitor species within a habitat.</p>
<p>6. Utilize resources to identify local fauna.*</p>	<p><b>Outcome: 1.2 Leadership &amp; Communication</b></p> <p>1.2.1. Extract relevant, valid information from materials and cite sources of information.</p> <p>1.2.2. Deliver formal and informal presentations.</p> <p><b>Outcome: 2.2 Body Systems</b></p> <p>2.2.1. Describe external anatomical parts and their functions.</p> <p><b>Outcome: 2.3 Care and Management</b></p> <p>2.3.2. Identify, classify, evaluate, and select animal species or breeds for desired outcome.</p> <p>2.3.3. Determine the biotic and abiotic factors (e.g., air, ventilation) that impact the animals' environment.</p> <p>2.3.5. Perform species-specific animal identification techniques (e.g., chipping, tagging, branding, notching, tattooing)</p> <p>2.3.8. Identify and recognize predator-prey relationships and implement control measures.</p> <p><b>Outcome: 2.7 Animal Behavior</b></p> <p>2.7.2. Describe the adaptations and special senses (e.g., sight, hearing, smell, touch) of animals and how they contribute to animal behavior.</p> <p>2.7.3. Identify and describe the innate behavioral patterns of animals.</p>

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

2.7.5. Interpret an animal's intent based on its vocalization, body posture, and chemical means of communication.

**Outcome: 6.11 Habitat Management and Restoration**

6.11.5. Differentiate threatened, endangered, extirpated, and extinct species.

6.11.6. Survey and monitor species within a habitat.