TN Department of Education | College, Career and Technical Education

Introduction to Ecology and Conservation

Primary Career Cluster:	Energy and Sustainable Resources
Course Contact:	CTE.Standards@tn.gov
Course Code:	C33H15
Recommended Prerequisite:	None
Credit:	1
Grade Level:	9
Elective Focus-Graduation Requirement:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Ecological Research and Conservation courses.
Program Of Study (POS) Concentrator:	This course satisfies one out of two required courses to meet the Perkins V concentrator definition when taken in sequence in an approved program of study.
Program of Study Sequence:	This is the first course in the Ecological Research and Conservation program of study.
Aligned Student Organization:	Skills USA: http://www.skillsusatn.org/
Coordinating Work-Based Learning (WBL):	Teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html.
Tennessee Promoted Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html.
Teacher Endorsement(s):	014, 015, 016, 017, 048, 081, 126, 127, 128, 129, 150, 210, 211, 212, 414, 415, 416, 417, 418, 448, 926, 927, 928, 929, 950
Required Teacher Certifications:	None
Required Teacher Training:	None
Teacher Resources:	Best for All Central: https://bestforall.tnedu.gov/

Course at a Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st-century skills necessary to be successful in careers and life. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards that feed into intentionally designed programs of study.

Students engage in industry-relevant content through general education integration and experiences such as career & technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry-standard content and technology, solve industry-based problems, meaningfully interact with industry professionals, and use/produce industry-specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course; note this is not an exhaustive list.

- Participate in the CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry-specific skills that involve teamwork and project management.
- Participate in contests highlighting job demonstration, interviewing skills, community service activities, extemporaneous speaking, and job interviews.
- Participate in leadership activities such as the National Leadership and Skills Conference, National Week of Service, and 21st Century Skills.

Using Work-Based Learning (WBL) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1.1-1.4** | Invite a guest speaker to discuss the principles of ecosystems.
- **Standards 3.1-3.5**| Invite a professional from the Ecology and Conservation industry to discuss the importance of biodiversity.
- **Standard 9.1** | Invite a business partner to speak about ecological economics.
- **Standard 12.1** | Research careers in ecology and conservation including the roles and responsibilities of Ecologists and Conservationists. Present to middle school students interested in this program of study.

Course Description

Introduction to Ecology and Conservation is the first course of the Ecological Research and Conservation program of study. It introduces students to the fundamental concepts of ecology and conservation, focusing on ecosystems, biodiversity, and the impacts of human activities. This course focuses on basic ecological concepts and systems and explores relationships between organisms and their environment.

Course Standards

1. Ecosystem Fundamentals

1.1 Dynamics of Ecosystems: Explain the **components and dynamics of ecosystems.**

a. Highlight how the abiotic (e.g., soil and climate) and biotic (e.g., species, communities) components of the ecosphere interact with and impact one another.
b. Create or use a model to analyze the complex interactions among trophic levels, energy flow, nutrient cycling, and climate variables. Use computational tools and system dynamics models to predict shifts in ecosystem function under anthropogenic influences such as land use changes and climate changes.

1.2 Components of a Local Ecosystem: Synthesize the components of **local ecosystems,** using Tennessee's diverse habitats such as the Appalachian region and Mississippi River Delta as case studies. Compare and contrast **Tennessee's ecosystems**, from the East, Middle, and West Grand Divisions, related to the following areas: habitat types, niches, species distributions, and vertical and horizontal stratification in forests, wetlands, and grasslands.

1.3 Ecological Organization: Explain the **levels of ecological organization**, including organisms, populations, communities, ecosystems, and biosphere.

1.4 Ecological Interactions: Analyze **ecological interactions** and their implications to determine the suitability of an area for different types of development (e.g., agricultural, commercial, industrial expansion near the Tennessee River, primary residential, and urban sprawl near the Great Smoky Mountains).

2. Major Biomes and Their Characteristics

2.1 Biomes: Define the term **biome and illustrate the major biomes.**

a. Investigate local and Tennessee biomes and compare them with other state, national, and global biomes.
b. Compare and contrast the climates, seasons, soil characteristics, water availability, and other **defining features of each biome**.
c. Differentiate between biomes within the following categories: **aquatic, grasslands, forest, desert, and tundra**.
d. Recognize native plants and animals in a local ecosystem and compare their roles with those in other biomes.
e. Explain the climatic and geographical factors that shape ecosystems.
f. Identify and examine the uses of technology in monitoring, analyzing, and problem-solving ecological issues.
g. Assess how human and biodiversity population levels, using survey data, to help analyze the impact of conservation efforts and current statuses of unique ecological habitats.

2.2 Biome Succession: Evaluate and communicate the **significance of the stages of succession in Tennessee's biomes** and how disturbance regimes (human and natural) and pioneer species can influence succession in local ecosystems. Analyze i**mmature and mature ecosystems** and discuss indicators that can be observed to determine the **maturity and quality of the ecosystem**.

3. Energy Flow and Nutrient Cycling

3.1 Energy Flow and Nutrient Cycling: Utilize Tennessee-specific models to explain **energy flow, nutrient cycling, carbon cycle, and water purification** in local ecosystems such as Tennessee's forests and wetlands.

3.2 Energy Flow through Food Webs: Construct an explanation of **how energy is absorbed and transferred in the food web** and the role of decomposers in ecosystems. Analyze how the decomposition of organic matter contributes to nutrient cycling.

3.3 Thermodynamics: Evaluate and communicate the application of **the laws of thermodynamics in ecological contexts,** particularly in relation to energy transfer within local food webs and trophic levels.

3.4 Mathematical Model of Energy Flow: Create a **mathematical model or computational representation to explain energy flow** through an ecosystem. Using the first and second laws of thermodynamics, construct an explanation of the following:

a. necessity for constant energy input;
b. limitations on energy transfer from one trophic level to the next; and
c. limitations on the number of trophic levels that can be supported.

3.5 Producers, Consumers, and Decomposers: Use models to explain the **roles of producers, consumers, and decomposers** and their significance in ecosystems. Investigate how the balance between producers, consumers, and decomposers affects and impacts nutrient cycling.

3.6 Roles of Microorganisms: Investigate and explain how the roles of bacteria, fungi, and other **microorganisms in nutrient cycling and decomposition**. Analyze how microbial life impacts soil health and ecosystem functioning, particularly in managing water quality in the Tennessee River.

3.7 Importance of Microorganisms: Construct an evidence-based explanation regarding the **critical role of the microbial community in nutrient cycling.**

4. Biodiversity and Its Importance

4.1 Biodiversity in an Ecosystem: Explain the **importance of biodiversity** in an ecosystem. Assess **how various land uses might impact biodiversity** in national and state parks and forests. Summarize findings of the following topics:

a. impact of the intentional or unintentional introduction of non-native species to an ecosystem;
b. threatened and endangered species; and
c. agricultural practices that promote biodiversity.

4.2 Species Diversity: Analyze factors that contribute to **species diversity, genetic diversity, and ecosystem complexity**, integrating Mendelian genetics. Investigate how environmental factors such as climate,

elevation, and geographical features influence the diversity of species and genetic variation within populations, and how natural selection and evolutionary processes drive the adaptation and speciation of organisms.

4.3 Significance of Biodiversity: Research and communicate the **significance of biodiversity in maintaining ecosystem health** and supporting human well-being, including the following:

a. explain the role of biodiversity in ecosystem health; and
b. analyze and evaluate the importance of a keystone species and their roles within a local ecosystem.

4.4 Measuring Biodiversity: Analyze various techniques used to **assess biodiversity**, including species richness and diversity indices such as the Shannon-Wiener index and Simpson's Diversity index, using local data. Evaluate the strengths and limitations of different biodiversity assessment methods and synthesize findings from local conservation monitoring programs.

4.5 Biodiversity Data: Use mathematical and statistical methods to **quantify and compare biodiversity** within different habitats. Interpret the results in the context of ecological health and conservation.

a. Compare exponential and logistical population growth using graphical representations. Identify factors that may alter carrying capacity such as disease; natural disaster; available food; water and livable space; habitat fragmentation; and periodic weather changes.
b. Calculate changes in population size in ecosystems and analyze the impact on populations of geographic locales due to diseases, birth and death rates, urbanization, and natural events such as migration and seasonal changes.

5. Population Dynamics

5.1 Population Dynamics and Growth Models: Evaluate and communicate **population dynamics and growth models** and their impacts on ecosystems, assessing population trends under various ecological conditions.

5.2 Habitat Case Studies: Analyze and communicate information from **case studies of** s**pecific habitats** to understand how space impacts population growth; why species are adapted to their habitats; how species interact; and how communities change.

5.3 Factors Affecting Population Growth: Analyze and communicate **factors that affect population growth and decline**. (e.g., exponential versus logistic). Apply mathematical concepts to examine population growth.

5.4 Mathematical Models: Create **mathematical models to construct an explanation for population growth patterns and rates** observed in ecosystems. Account for both density-dependent and density-independent factors in your explanation. Investigate real-world applications, such as wildlife conservation and forest management.

5.5 Non-native and Extinct Species: Utilize models to predict how **the introduction of non-native species could disrupt the food chain** and **impact existing populations** in an ecosystem. Similarly, use models to predict how **species extinction might alter the food chain and affect the populations** within an ecosystem.

5.5 Carrying Capacity: Recognize **factors that could impact carrying capacity**, including disease, natural disasters, resource availability, habitat fragmentation, and environmental changes. Create a graph or chart to predict carrying capacity.

6. Ecological Stability

6.1 Ecological Stability and Resilience: Define **ecological stability and resilience**, with examples from Tennessee ecosystems, and explain how ecosystems recover from disturbances. Analyze the ecological resilience of Tennessee's sensitive habitats and the effect on the ecological health of the habitat.

6.2 Equilibrium in Ecological Stability: Investigate the concept of **equilibrium and disequilibrium in ecological systems**, such as the impact of invasive species on the stability of ecosystems**.**

6.3 Factors of Ecological Resilience: Identify key factors that contribute to **ecological resilience**, including biodiversity, species interactions, and ecosystem complexity in the context of local challenges such as urban development and climate change. Evaluate and communicate the role of **keystone species** and their **impact on ecosystem stability.**

7. Ecological Relationships

7.1 Ecological Succession: Create a model to describe **ecological primary and secondary succession in ecosystems**. Explain **ecological relationships and the interactions between different organisms and their environmen**ts, including the following:

a. predation,
b. competition,
c. mutualism,
d. commensalism,
e. parasitism, and
f. facilitation.

7.2 Interspecies Interactions: Analyze and interpret scientific data that observes **interspecies interactions**.

7.3 Ecosystem Model: Create a **model of an ecosystem** depicting the **interrelationships among organism**s with a variety of niches. Use the model to explain the resource needs of these organisms.

8. Ecological Cycles and Biogeochemical Cycles

8.1 Biogeochemical Cycles: Describe and communicate **components of a biogeochemical cycle**, including reservoirs, fluxes, and processes. Use models to describe major **biogeochemical cycles**, including carbon, water, nutrients, and nitrogen. Explain the importance of these cycles for sustaining life on Earth and how biogeochemical cycles are interconnected with changes in one cycle affecting others (e.g., how changes in the carbon cycle can affect the nitrogen and water cycles). Link biogeochemical cycles to the flow of energy in ecosystems, including energy sources such as oil, natural gas, and coal deposits.

9. Ecological Economics

9.1 Ecology and Economics: Describe the **relationship between ecology and economics**, the **economic value of an ecosystem**; **sustainable practices**; and **the role of policy in ecological economics**.

9.2 Economic Impacts: Assess and describe the **economic effects of environmental actions** such as overdevelopment, poaching, habitat destruction, and improper waste management.

10. Conservation Principles

10.1 Conservation Strategies: Identify **conservation strategies and their applications at the local, state, and national levels**.

1. Conservation Biology
2. Protected Areas
3. Wildlife Management
4. Habitat Restoration

10.2 Implications of Ecological Theories: Research and explain the **role of conservation organizations** and policies.

11. Ethics in Ecology and Conservation

11.1 Ecological and Conservation Agencies: Research and create a model to identify **federal, state, local, and non-profit agencies**. Explain the history and roles each agency has in the environment.

11.2 Environmental Laws: Research and communicate **environmental laws** and their implications in ecology and conservation.

12. Ecology and Conservation Careers

12.1 Careers in the Ecology and Conservation Sector: Identify career pathways in the ecology and conservation sector (e.g., Natural Sciences Manager, Environmental Engineers, Soil and Plant Scientists, Microbiologists, Biological Scientists, Conservation Scientists, Ecologists, etc.) **Investigate the skills and education required for these careers.** Analyze future job market trends and opportunities in the ecology and conservation sector.

12.2 Career and Technical Student Organization (CTSO) Introduction: Introduce the program's aligned CTSO-/***Skills USA**, through an interactive activity, such as a classroom competition**.**

13. Artificial Intelligence

13.1 Ethical Artificial Intelligence (AI): Explore the **ethical implications of AI usage** through interactive discussions and case studies, learning to identify bias, ensure fairness, and protect privacy in AI systems. Develop critical thinking skills to evaluate the **societal impact of AI technologies**, while fostering a sense of responsibility and ethical decision-making in the use of AI tools.

14. Data Analysis

14.1 Data Analysis in Ecology and Conservation: Research the uses of **data in Ecological and Conservation industries.** Include data that is generated by conservation agencies and externally by advocates and stakeholder groups. Explore examples of how the data is used, including the following:

a. Wildlife patterns and long-term trends;
b. Conservation planning;
c. Habitat assessments;
d. Threat analysis; and
e. Ecological research.

Standards Alignment Notes

*References to other standards include:

- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.