

ENVIRONMENTAL SCIENCE: COURSE OVERVIEW

The academic standards for Environmental Science establish the content knowledge and skills for Tennessee students necessary to prepare them for the rigorous levels of higher education and future job markets. The course provides students with an opportunity to develop an understanding of interrelationships in the natural world. In addition, it allows them to identify natural and man-made environmental problems and design and evaluate possible solutions for these problems. The academic standards for Environmental Science are research-based, supported by the National Research Council's *Framework for K-12 Science Education*. The standards establish the core ideas and practices of science and engineering that will prepare students to use scientific thinking to examine and evaluate knowledge encountered throughout their lives.

The major disciplinary core ideas utilized for Environmental Science include:

Environmental Science (EVSC)		
Life Sciences (LS)	Earth and Space Sciences (ESS)	Engineering, Technology, and Applications of Science (ETS)
From Molecules to Organisms: Structures and Process	Earth's Place in the Universe	Engineering Design
Ecosystems: Interactions, Energy, and Dynamics <ul style="list-style-type: none"> Interdependent relationships in ecosystems Cycles of matter and energy transfer in ecosystems Ecosystems dynamics, functioning, and resilience 	Earth's Systems <ul style="list-style-type: none"> Earth materials and systems Plate tectonics and large scale system interactions The roles of water in Earth's surface processes Weather and climate 	Links Among Engineering, Technology, Science, and Society <ul style="list-style-type: none"> Interdependence of science, engineering, and technology Influence of engineering, technology, and science on society and the natural world
Heredity: Inheritance and Variation of Traits	Earth and Human Activity <ul style="list-style-type: none"> Natural resources Natural hazards Human impacts on Earth systems Global climate change 	Applications of Science <ul style="list-style-type: none"> Importance of science practices in understanding the natural world
Biological Change: Unity and Diversity <ul style="list-style-type: none"> Natural selection Adaptation 		

Although science is a body of knowledge consisting of theories that explain data, science is also a set of practices that use analysis and argumentation to establish, extend, and refine knowledge. The science and engineering practices are used as a means to learn science by doing science. These practices are not intended to be a sequence of steps nor are they intended to be taught as a separate, introductory unit for the course. By combining content knowledge with skill, students discover how scientific knowledge is acquired and applied to solve problems or advance scientific knowledge further. In addition, there are seven crosscutting concepts that are fundamental to the nature of science and thus stretch across all science disciplines. The Environmental Science standards have been constructed by explicitly integrating practices and crosscutting concepts, iteratively and in combination, within each core idea to provide students with a well-rounded education in science.

Tennessee's state mathematics and literacy standards are integrated within the science standards. Special attention has been given to science literacy through the use of the science and engineering practices. Students are required to gather information from reliable sources to construct evidence-based arguments. STEM integration is supported both as a stand-alone disciplinary core idea, as well as being embedded in Life and Earth and Space Sciences Core Ideas.

By the end of the Environmental Science Course, it is expected that all students should be able to demonstrate the skills and content knowledge emphasized in the following standards.

ENVIRONMENTAL SCIENCE: ACADEMIC STANDARDS

EVSC.LS2: Ecosystems: Interactions, Energy, and Dynamics

- 1) Using a variety of data sources, construct an explanation for the impact of climate, latitude, altitude, geology, and hydrology patterns on plant and animal life in various terrestrial biomes.
- 2) Develop an explanation of behavioral and physical adaptations organisms have for life in aquatic habitats with varying chemical and physical features.
- 3) Using mathematical models, support arguments regarding the effects of biotic and abiotic factors on carrying capacity for populations within an ecosystem.
- 4) Compare and contrast production (photosynthesis, chemosynthesis) and respiratory (aerobic respiration, anaerobic respiration, consumption, decomposition) processes responsible for the cycling of matter and flow of energy through an ecosystem. Using evidence, construct an argument regarding the importance of homeostasis in maintaining these processes in ecosystems.
- 5) Use a mathematical model to explain energy flow through an ecosystem. Using the first and second laws of thermodynamics, construct an explanation for: A) necessity for constant energy input; B) limitations on energy transfer from one trophic level to the next; and, C) limitations on number of trophic levels that can be supported.
- 6) Evaluate the interdependence among major biogeochemical cycles (water, carbon, nitrogen, phosphorus) in an ecosystem and recognize the importance each cycle has in maintaining ecosystem stability.
- 7) Examine stability and change within an ecosystem by using a model of succession (primary or secondary) to predict impacts of disruption on an ecosystem.

EVSC.LS4: Biological Change: Unity and Diversity

- 1) Construct an explanation based on scientific evidence for mechanisms of natural selection that result in behavioral, anatomical, and physiological adaptations in populations.
- 2) Justify claims with scientific evidence that changes in environmental conditions lead to speciation and extinction.
- 3) Evaluate the impact of habitat fragmentation and destruction, invasive species, overharvesting, pollution, and climate change on biodiversity (genetic, species, and ecosystem).

- 4) Engage in argument from scientific evidence critiquing effectiveness of the Endangered Species Act. Give specific examples to support your argument.

EVSC.ESS2: Earth's Systems

- 1) Research the development of the theory of plate tectonics. Use the theory to construct an explanation for how changes in Earth's crust cause mountain formation, volcanoes, earthquakes, and tsunamis. Provide evidence to support the explanation using information pertaining to plate boundary types (divergent, convergent, transform).
- 2) Considering Earth's position within our solar system, use a model to demonstrate the causes of day length, seasons, and climate.
- 3) Analyze the composition of the Earth's atmosphere. Obtain information and use graphs to observe patterns regarding stability and change within the Earth's atmospheric composition (O₂, N₂, CO₂, etc.) over geologic time.
- 4) Differentiate weather and climate and analyze and interpret data examining naturally occurring patterns pertaining to each.
- 5) Plan and carry out an investigation examining the chemical and physical properties of water and the impact of water on Earth's topography. Analyze data and share findings.
- 6) Develop a model to explain soil formation and the flow of matter in the rock cycle.

EVSC.ESS3: Earth and Human Activity

- 1) Research Earth's natural resources (renewable and nonrenewable resources). Construct an argument from evidence supporting the claim that a particular type of resource is important for humans.
- 2) Interpret graphical data representing global human population growth over time. Look for patterns within this data and construct possible explanations for the patterns. Revise the explanations as needed based on research.
- 3) Obtain and evaluate information regarding demographics for a variety of countries. Construct an explanation for varying fertility rates and life expectancies between countries and throughout human history. Taking into account demographic transition, predict what trends are likely to occur in various countries over time.
- 4) Gather, organize, analyze, and present data on current land use trends by humans. Based on analysis, predict future trends.

- 5) Plan and carry out an investigation examining best management practices in water usage, agriculture, forestry, urban/suburban development, mining, or fishing and communicate findings.
- 6) Use a model to make predictions regarding the impact of topsoil loss due to erosion resulting from human activity. Design, evaluate, and revise a solution to preserve topsoil.
- 7) Construct an argument including claim, evidence, and scientific reasoning regarding the impact of the Green Revolution on agricultural practices, food availability, and the environment.
- 8) Research information on the environmental impacts of genetically modified organisms and engage in debate regarding pros and cons of this agricultural technology.
- 9) Evaluate ecosystem services provided by forests ecosystems. Construct an explanation for human impact on these services.
- 10) Using scientific data, analyze effectiveness of conservation versus preservation efforts. Obtain and communicate information on organizations involved in protecting natural resources.
- 11) Define problems and suggest solutions associated with using, conserving, and recycling energy and mineral resources taking into account economic, social, and environmental costs and benefits.
- 12) Ask questions about technology needed to develop alternative energy sources and obtain information from various sources to answer those questions.
- 13) Analyze and interpret data on the effects of land, water, and air pollution on the environment and on human health. Propose solutions for minimizing pollution from specific sources.
- 14) Obtain and communicate information on environmental laws pertaining to the regulation of pollution and on regulatory agencies. Provide a specific example of how a given business/industry would comply with such regulations.
- 15) Evaluate current methods of waste management and reduction and design possible improvements.
- 16) Obtain, evaluate, and communicate scientific information tracing the breakdown of ozone caused by chlorofluorocarbons and the effectiveness of efforts to address this environmental problem.
- 17) Using mathematics and computational thinking, analyze data linking human activity to climate change. Design solutions to address human impacts on climate change.

- 18) Use mathematics to calculate ecological footprints. Develop a personal plan for reducing your impact on the environment.

EVSC.ETS2: Links Among Engineering, Technology, Science, and Society

- 1) Engage in argument from evidence on the role engineering and technology play in a sustainable human society.
- 2) Research and communicate information on an environmental science career. Analyze the role of society, engineering, technology, and science in that career.

EVSC.ETS3: Applications of Science

- 1) Plan and carry out an investigation of a local ecosystem to assess human impacts. Based on your findings, design and evaluate a solution to minimize impacts.