

Environmental Science

Environmental Science introduces students to a broad view of the biosphere and the physical attributes that affect it. The standards include the study of ecosystems and natural resources, human impacts on Earth's systems, and changing patterns of weather and climate. Environmental Science provides a “deep dive” into the ways systems interconnect, interact, and influence events over long and short periods of time.

Students are challenged to evaluate and synthesize current findings from multiple sources of reliable, scholarly information to address issues or suggest possible solutions for environmental problems. The Environmental Science course incorporates safe laboratory investigations that enable students actively to explore the environment. Students are encouraged to apply evidence-based reasoning to investigate how Earth's systems interact with biotic, abiotic, and anthropogenic influences. Hands-on experiences in the lab spark curiosity and build interest in learning about the environment. These hands-on experiences are especially valuable for students interested in science, technology, engineering, and mathematics (STEM) careers related to environmental science. Although environmental legislation is not included in the standards, the exploration and application of these laws and policies can be an extension of learning environmental science.

The disciplinary core ideas in Environmental Science are “Ecosystems: Interactions, Energy, and Dynamics,” “Unity and Diversity,” “Earth's Systems,” and “Earth and Human Activity.” The academic language of core ideas is used in context to communicate claims, evidence, and reasoning for phenomena and to engage in argument from evidence to justify and defend claims.

Embedded in the content standards are the disciplinary core ideas of the Engineering, Technology, and Applications of Science (ETS) domain, which require students to use design strategies in conjunction with knowledge and understanding of science and technology to solve practical problems. Engineering standards are denoted with a gear icon . Through participation in the engineering design process, students will evaluate and refine a current solution designed to protect natural resources and design and defend a sustainability plan to reduce an individual's ecological footprint.

Although not included as discrete standards, these practices should be embedded throughout each unit:

- Measurement - Choose appropriate measurement tools and record measurements with the correct units.
- Mathematics - Calculate ratios, rates, percentages, and unit conversions to represent and solve scientific and engineering problems.
- Graphic literacy - Read, analyze, and interpret graphs, charts, and tables to address a scientific question or solve a problem.

Each content standard completes the stem “*Students will...*”

Ecosystems: Interactions, Energy, and Dynamics		
Matter and Energy Flow	<ol style="list-style-type: none"> 1. Use mathematical representations to illustrate how the first two laws of thermodynamics demonstrate energy transfers throughout ecosystems, including food chains, food webs, and trophic levels, at various levels of biological organization. 2. Obtain, evaluate, and communicate information to model the cycling of matter through the biosphere, atmosphere, hydrosphere, and geosphere, including the flow of carbon, water, nitrogen, phosphorus, and sulfur. 	Energy and Matter
Unity and Diversity		
Biodiversity	<ol style="list-style-type: none"> 3. Construct an explanation of how biotic and abiotic factors affect biodiversity and populations in ecosystems. <i>Examples: Explain how factors such as biomass, reproductive strategies, succession, climate, and geography affect an organism's chances of surviving and reproducing through successive generations.</i> 	Cause and Effect
	<ol style="list-style-type: none"> a. Support a claim that biodiversity is a natural resource which fosters ecosystem resilience, including the role of keystone, invasive, native, endemic, and indicator species. b. Analyze and interpret data collected through geographic research and field investigations to describe Alabama’s biodiversity by region. <i>Examples: Use relief, topographic, and physiographic maps or information on rivers, forests, and watersheds to investigate species distributions and diversity.</i> 	Scale, Proportion, and Quantity

Earth's Systems

System Interactions	<p>4. Engage in an evidence-based argument to explain how Earth's systems affect the biosphere and the biosphere affects Earth's systems over various amounts of time. <i>Examples: Use data to make a claim that microbial life increases the formation of soil or that corals create reefs and argue that these processes can alter patterns of erosion and deposition along coastlines.</i> Clarification: This discussion should consider Earth's geological history.</p> <p>5. Obtain, evaluate, and communicate information regarding how short-term and long-term natural cyclic fluctuations cause ecosystem change. <i>Examples: Explain how the eruption of volcanoes alters global temperatures or how the El Niño-Southern Oscillation shifts weather patterns. Share information regarding how forest fires can cause deforestation which increases water runoff and soil erosion. Describe how hurricanes destroy dunes and increase coastal flooding.</i></p>	Stability and Change
<h2 style="text-align: center;">Earth and Human Activity</h2>		
Natural Resources	<p>6. Obtain, evaluate, and communicate information to describe the use of renewable and nonrenewable energy sources. <i>Examples: Describe the similarities and differences among fossil fuels. Gather and share information to describe different sources of renewable energy from biomass such as biodiesel, cellulosic ethanol, and algae.</i></p>	Cause and Effect
	<p>a. Analyze and interpret data on the origins and availability of renewable and nonrenewable forms of energy to predict consumption trends. <i>Examples: Use a solar irradiance map to predict the best area for a solar thermal power plant. Analyze the distribution of fossil fuel reserves around the globe to identify energy-rich and energy-poor areas and predict future trends in types of fuel used and rates of consumption.</i></p>	Structure and Function

	<p>b. Construct an argument based on data about the risks and benefits of using renewable and nonrenewable energy sources in Alabama.</p>	<p>Scale, Proportion, and Quantity</p>
<p>Human Impact</p>	<p>7. Obtain, evaluate, and communicate information to describe the development, management, and recycling of mineral resources. <i>Example: Research technologies used to mine and process rare Earth metals for electronics. Gather information and draw conclusions about the sustainability of plastics recycling.</i></p>	<p>Cause and Effect</p>
	<p>8. Construct or revise a claim based on evidence of the effects of human activities on Earth's systems, natural resources, and ecosystem services. <i>Examples: Construct a claim that excess nitrogen and phosphorus causes algal blooms, deforestation disrupts carbon storage, or excess atmospheric sulfur leads to acid rain. Construct a claim that changing rain patterns cause flooding or desertification. Construct a claim that temperature cycles affect the timing of migrations and the flowering of plants, causing a disjunction in pollination.</i></p> <p>a. Evaluate published information from computational models which illustrate the effects of an increase in atmospheric carbon dioxide on photosynthesis and the effect of ocean acidification on marine populations.</p> <p>b.  Use engineering practices to evaluate and refine a current solution designed to protect natural resources from anthropogenic sources of atmospheric, terrestrial, or aquatic pollution. <i>Example: Create mechanisms to remove plastic from the ocean or particulates from industrial exhaust.</i></p>	

	<p>9. Obtain, evaluate, and communicate information based on evidence to explain how key natural resources, natural hazards, and climate variability influence human activity and welfare.</p> <p>a. Communicate scientific information about how environmental change may disproportionately impact people in certain socioeconomic groups or geographic locations.</p> <p><i>Examples: People in lower socioeconomic groups or those who are unhoused are more affected by rising temperatures and heat islands than others. Populations living at lower sea levels are more impacted by sea level rise than those who live at higher elevations. People living in floodplains are more likely to experience seasonal flooding than those living on higher ground.</i></p> <p>10. Use mathematics and graphic models to communicate how human activity may affect genetic variation in organism populations, including threatened and endangered species.</p>	Patterns
<p>Human Population and Global Change</p>	<p>11. Construct an explanation of how human populations undergo growth and decline.</p> <p><i>Examples: Explain how birth and death rates, infant mortality, nutrition, and other factors increase or decrease human populations.</i></p> <p>Clarification: Use of mathematical calculations to determine growth rate is not required.</p> <p>a. Analyze and interpret data on human population trends in developing and developed countries and in the global population as a whole.</p> <p><i>Example: Use fertility and mortality rates to predict population growth and average population age during different stages of the demographic transition model. Compare age structure diagrams of developing and developed countries to determine differences in population growth rates. Use total fertility rates to predict global population growth rate.</i></p>	

	<p>b. Construct explanations of the types of environmental impacts produced by human populations in each stage of the demographic transition model.</p> <p><i>Example: Current American quality of life standards from post-industrial development (driving a car; heating and cooling a house) can have a negative impact on the environment. As quality of life, educational opportunities, and gross national product increase, individual resource consumption increases. Transitioning populations may generate increased local solid waste pollution.</i></p>	<p>Scale, Proportion, and Quantity</p>
	<p>12. Obtain, evaluate, and communicate information to describe the effects of human population growth on global ecosystems.</p> <p>a. Evaluate and communicate information describing the impact of measures used to increase the food supply for the growing human population, including the use of GMOs, monocultures, integrated pest management (IPM), and precision agriculture.</p> <p>b. Evaluate and communicate information describing the effects of urbanization on the environment.</p> <p><i>Examples: Creating impervious surfaces such as roads, parking lots, and sidewalks increases flash flooding in low-lying urban areas. Urban sprawl leads to increased use of fossil-fuel-powered transportation and higher levels of local air pollution. An increase in pavement and rooftops and a decrease in green space leads to heat islands.</i></p>	<p>Cause and Effect</p>
	<p>13. ⚙️ Design and defend a sustainability plan to reduce an individual's ecological footprint, taking into account how market forces and societal demands influence personal choices.</p>	<p>Scale, Proportion, and Quantity</p>