Texas Science

Environmental Systems (2021): Grades 10, 11, 12

Adopted 2021

The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to explain phenomena or design solutions using appropriate tools and models. The student is expected to: ENV.1

A. ask questions and define problems based on observations or information from text, phenomena, models, or investigations; ENV.1.A

B. apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems; ENV.1.B

C. use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards; ENV.1.C

D. use appropriate tools such as meter sticks, metric rulers, pipettes, graduated cylinders, standard laboratory glassware, balances, timing devices, pH meters or probes, various data collecting probes, thermometers, calculators, computers, internet access, turbidity testing devices, hand magnifiers, work and disposable gloves, compasses, first aid kits, binoculars, field guides, water quality test kits or probes, soil test kits or probes, 30 meter tape measures, tarps, shovels, trowels, screens, buckets, rock and mineral samples equipment, air quality testing devices, cameras, flow meters, Global Positioning System (GPS) units, Geographic Information System (GIS) software, computer models, densiometers, spectrophotometers, stereomicroscopes, compound microscopes, clinometers, field journals, various prepared slides, hand lenses, hot plates, Petri dishes, sampling nets, waders, leveling grade rods (Jason sticks), protractors, inclination and height distance calculators, samples of biological specimens or structures, core sampling equipment, and kick nets; ENV.1.D

E. collect quantitative data using the International System of Units (SI) and qualitative data as evidence; ENV.1.E

F. organize quantitative and qualitative data using probeware, spreadsheets, lab notebooks or journals, models, diagrams, graphs paper, computers, or cellphone applications; ENV.1.F

G. develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and ENV.1.G

H. distinguish between scientific hypotheses, theories, and laws. ENV.1.H

The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to: ENV.2	**A.** identify advantages and limitations of models such as their size, scale, properties, and materials; ENV.2.A
	B. analyze data by identifying significant statistical features, patterns, sources of error, and limitations; ENV.2.B
	C. use mathematical calculations to assess quantitative relationships in data; and ENV.2.C
	D. evaluate experimental and engineering designs. ENV.2.D
The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to: ENV.3	**A.** develop explanations and propose solutions supported by data and models consistent with scientific ideas, principles, and theories; ENV.3.A
	B. communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and ENV.3.B
	C. engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence. ENV.3.C
The student knows the contributions of scientists and recognizes the importance of scientific research and innovation on society. The student is expected to: ENV.4	**A.** analyze, evaluate, and critique scientific explanations and solutions by using empirical evidence, logical reasoning, and experimental and observational testing, so as to encourage critical thinking by the student; ENV.4.A
	B. relate the impact of past and current research on scientific thought and society, including research methodology, cost-benefit analysis, and contributions of diverse scientists as related to the content; and ENV.4.B
	C. research and explore resources such as museums, planetariums, observatories, libraries, professional organizations, private companies, online platforms, and mentors employed in a science, technology, engineering, and mathematics (STEM) field in order to investigate STEM careers. ENV.4.C
The student knows the relationships of biotic and abiotic factors within habitats, ecosystems, and biomes. The student is expected to: ENV.5	**A.** identify native plants and animals within a local ecosystem and compare their roles to those of plants and animals in other biomes, including aquatic, grassland, forest, desert, and tundra; ENV.5.A
	B. explain the cycling of water, phosphorus, carbon, silicon, and nitrogen through ecosystems, including sinks, and the human interactions that alter these cycles using tools such as models; ENV.5.B
	C. evaluate the effects of fluctuations in abiotic factors on local ecosystems and local biomes; ENV.5.C
	D. measure the concentration of dissolved substances such as dissolved oxygen, chlorides, and nitrates and describe their impacts on an ecosystem; ENV.5.D

	E. use models to predict how the introduction of an invasive species may alter the food chain and affect existing populations in an ecosystem; ENV.5.E
	F. use models to predict how species extinction may alter the food chain and affect existing populations in an ecosystem; and ENV.5.F
	G. predict changes that may occur in an ecosystem if genetic diversity is increased or decreased. ENV.5.G
The student knows the interrelationships among the resources within the local environmental system. The student is expected to: ENV.6	**A.** compare and contrast land use and management methods and how they affect land attributes such as fertility, productivity, economic value, and ecological stability; ENV.6.A
	B. relate how water sources, management, and conservation affect water uses and quality; ENV.6.B
	C. document the use and conservation of both renewable and non-renewable resources as they pertain to sustainability; ENV.6.C
	D. identify how changes in limiting resources such as water, food, and energy affect local ecosystems; ENV.6.D
	E. analyze and evaluate the economic significance and interdependence of resources within the local environmental system; and ENV.6.E
	F. evaluate the impact of waste management methods such as reduction, reuse, recycling, upcycling, and composting on resource availability in the local environment. ENV.6.F
The student knows the sources and flow of energy through an environmental system. The student is expected to: ENV.7	**A.** describe the interactions between the components of the geosphere, hydrosphere, cryosphere, atmosphere, and biosphere; ENV.7.A
	B. relate biogeochemical cycles to the flow of energy in ecosystems, including energy sinks such as oil, natural gas, and coal deposits; ENV.7.B
	C. explain the flow of heat energy in an ecosystem, including conduction, convection, and radiation; and ENV.7.C
	D. identify and describe how energy is used, transformed, and conserved as it flows through ecosystems. ENV.7.D
The student knows the relationship between carrying capacity and changes in populations and ecosystems. The student is expected to: ENV.8	**A.** compare exponential and logistical population growth using graphical representations; ENV.8.A
	B. identify factors that may alter carrying capacity such as disease; natural disaster; available food, water, and livable space; habitat fragmentation; and periodic changes in weather; ENV.8.B

	C. calculate changes in population size in ecosystems; and ENV.8.C
	D. analyze and make predictions about the impact on populations of geographic locales due to diseases, birth and death rates, urbanization, and natural events such as migration and seasonal changes. ENV.8.D
The student knows that environments change naturally. The student is expected to: ENV.9	**A.** analyze and describe how natural events such as tectonic movement, volcanic events, fires, tornadoes, hurricanes, flooding, and tsunamis affect natural populations; ENV.9.A
	B. explain how regional changes in the environment may have global effects; ENV.9.B
	C. examine how natural processes such as succession and feedback loops can restore habitats and ecosystems; ENV.9.C
	D. describe how temperature inversions have short-term and long-term effects, including El Niño and La Niña oscillations, ice cap and glacial melting, and changes in ocean surface temperatures; and ENV.9.D
	E. analyze the impact of natural global climate change on ice caps, glaciers, ocean currents, and surface temperatures. ENV.9.E
The student knows how humans impact environmental systems through emissions and pollutants. The student is expected to: ENV.10	**A.** identify sources of emissions in air, soil, and water, including point and nonpoint sources; ENV.10.A
	B. distinguish how an emission becomes a pollutant based on its concentration, toxicity, reactivity, and location within the environment; ENV.10.B
	C. investigate the effects of pollutants such as chlorofluorocarbons, greenhouse gases, pesticide runoff, nuclear waste, aerosols, metallic ions, and heavy metals, as well as thermal, light, and noise pollution; ENV.10.C
	D. evaluate indicators of air, soil, and water quality against regulatory standards to determine the health of an ecosystem; and ENV.10.D
	E. distinguish between the causes and effects of global warming and ozone depletion, including the causes, the chemicals involved, the atmospheric layer, the environmental effects, the human health effects, and the relevant wavelengths on the electromagnetic spectrum (IR and UV). ENV.10.E
The student understands how individual and collective actions impact environmental systems. The student is expected to: ENV.11	**A.** evaluate the negative effects of human activities on the environment, including overhunting, overfishing, ecotourism, all-terrain vehicles, and personal watercraft; ENV.11.A
	B. evaluate the positive effects of human activities on the environment, including habitat restoration projects, species preservation efforts, nature conservancy groups, game and wildlife management, and ecotourism; and ENV.11.B

	C. research the advantages and disadvantages of "going green" such as organic gardening and farming, natural methods of pest control, hydroponics, xeriscaping, energy-efficient homes and appliances, and hybrid cars. ENV.11.C
The student understands how ethics and economic priorities influence environmental decisions. The student is expected to: ENV.12	**A.** evaluate cost-benefit trade-offs of commercial activities such as municipal development, food production, deforestation, over-harvesting, mining, and use of renewable and non-renewable energy sources; ENV.12.A
	B. evaluate the economic impacts of individual actions on the environment such as overbuilding, habitat destruction, poaching, and improper waste disposal; ENV.12.B
	C. analyze how ethical beliefs influence environmental scientific and engineering practices such as methods for food production, water distribution, energy production, and the extraction of minerals; ENV.12.C
	D. discuss the impact of research and technology on social ethics and legal practices in situations such as the design of new buildings, recycling, or emission standards; and ENV.12.D
	E. argue from evidence whether or not a healthy economy and a healthy environment are mutually exclusive. ENV.12.E
The student knows how legislation mediates human impacts on the environment. The student is expected to: ENV.13	**A.** describe past and present state and national legislation, including Texas automobile emissions regulations, the National Park Service Act, the Clean Air Act, the Clean Water Act, the Soil and Water Resources Conservation Act, and the Endangered Species Act; and ENV.13.A
	B. evaluate the goals and effectiveness of past and present international agreements such as the environmental Antarctic Treaty System, the Montreal Protocol, the Kyoto Protocol, and the Paris Climate Accord. ENV.13.B