TEKS Clarification Document

Science– Environmental Systems

2012 – 2013

Texas Education Service Center Curriculum Collaborative

ENVIRONMENTAL SYSTEMS

§112.31. Implementation of Texas Essential Knowledge and Skills for Science, High School, Beginning with School Year 2010-2011.
Source: The provisions of this §112.31 adopted to be effective August 4, 2009, 34 TexReg 5063; amended to be effective August 24, 2010, 35 TexReg 7230.

§112.37. Environmental Systems, Beginning with School Year 2010-2011.

(a) General requirements. Students shall be awarded one credit for successful completion of this course. Suggested prerequisite: one unit high school life science and one unit of high school physical science. This course is recommended for students in Grade 11 or 12.

(b) Introduction.

(1) Environmental Systems. In Environmental Systems, students conduct laboratory and field investigations, use scientific methods during investigations, and make informed decisions using critical thinking and scientific problem solving. Students study a variety of topics that include: biotic and abiotic factors in habitats, ecosystems and biomes, interrelationships among resources and an environmental system, sources and flow of energy through an environmental system, relationship between carrying capacity and changes in populations and ecosystems, and changes in environments.

(2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(3) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation can be experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.

(4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods and ethical and social decisions that involve the application of scientific information.

(5) Scientific systems. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in terms of space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

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E.1	***Scientific processes. The student, for at least 40% of instructional time, conducts hands – on laboratory and field investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:***
E.1A	**Demonstrate safe practices during laboratory and field investigations, including appropriate first aid responses to accidents that could occur in the field such as insect stings, animal bites, overheating, sprains, and breaks.** Demonstrate SAFE PRACTICES DURING FIELD AND LABORATORY INVESTIGATIONS Including, but not limited to: • Wearing appropriate safety equipment • Knowing the location and use of safety equipment • Following classroom safety guidelines, as outlined in the Texas Education Agency Texas Safety Standards, 2nd Edition • Handling organisms appropriately • Using lab equipment appropriately • Following field investigation guidelines • Limiting habitat disturbance/destruction

E.1B	**Demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.**
	
	Demonstrate
	
	AN UNDERSTANDING OF THE USE AND CONSERVATION OF RESOURCES AND THE DISPOSAL OR RECYCLING OF MATERIALS
	
	Including, but not limited to:
	• Use and conservation of resources
	  • Reducing pollution
	  • Being a wise consumer
	  • Decreasing reliance on fossil fuels
	  • Preserving habitats
	• Proper disposal or recycling of materials

E.2	***Scientific processes. The student uses scientific methods during field and laboratory investigations. The student is expected to:***
E.2A	**Know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section.**

ENVIRONMENTAL SYSTEMS	
	Know THE DEFINITION OF SCIENCE AND UNDERSTAND THAT IT HAS LIMITATIONS Including, but not limited to: • Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process". Understand SCIENCE HAS LIMITATIONS Including, but not limited to: • "... some questions are outside the realm of science because they deal with phenomena that are not scientifically testable." • Scientific inquiry may be limited by current technology.
E.2B	**Know that scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories.** Know THAT HYPOTHESES ARE TENTATIVE AND TESTABLE Including, but not limited to: • Evaluate statements to determine if they represent testable hypotheses. • Formulate testable hypotheses. • Collect data. • Evaluate data to determine whether it supports or does not support hypotheses. TxCCRS Note: I. Nature of Science – A3 – Formulate appropriate questions to test understanding of natural phenomena.
E.2C	**Know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but may be subject to change as new areas of science and new technologies are developed.** Know

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	SCIENTIFIC THEORIES ARE BASED ON NATURAL AND PHYSICAL PHENOMENA
	
	Including, but not limited to:
	• Scientific theories are well-established and highly reliable explanations.
	• Evaluate scientific theories that have been examined by multiple researchers.
	• Evaluate scientific theories that have changed over time.
	• Know that the development of new technologies may impact our knowledge of science.
	• Examine various scientific theories, laws, principles, hypotheses, and the evidence that supports them from the fields of biology, environmental science, as well as other sciences.
	  • Possible examples may include
	  • Laws of thermodynamics
	  • Theory of natural selection
	  • Theory of evolution
	  • Gene theory (Mendel)
	  • Germ theory of disease
	  • Gaia hypothesis
	
	TxCCRS Note:
	I. Nature of Science – A2 – Use creativity and insight to recognize and describe patterns in natural phenomena.
	I. Nature of Science – A4 – Rely on reproducible observations of empirical evidence when constructing, analyzing, and evaluating explanations of natural events and processes.

E.2D	**Distinguish between scientific hypotheses and scientific theories.** Distinguish BETWEEN SCIENTIFIC HYPOTHESES AND SCIENTIFIC THEORIES Including, but not limited to: • Distinguish between scientific hypotheses and scientific theories. • Evaluate statements and supporting evidence to determine whether a statement is a hypothesis or a scientific theory.
E.2E	**Follow or plan and implement investigative procedures, including making observations, asking questions, formulating testable hypotheses, and selecting equipment and technology.**

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	Follow or Plan, Implement INVESTIGATIVE PROCEDURE Including, but not limited to: • Observe natural phenomena. • Ask questions. • Formulate testable hypotheses. • Follow or design and conduct investigations. • Collaborate on joint projects. • Use models to make predictions. • Select appropriate equipment and technology. • Evaluate the quality and accuracy of information from research sources, such as search engines, databases, and other online tools.
E.2F	**Collect data individually or collaboratively, make measurements with precision and accuracy, record values using appropriate units, and calculate statistically relevant quantities to describe data, including mean, median, and range.** Collect DATA Including, but not limited to: • On an individual or collaborative basis • Record values using appropriate units. • Demonstrate use of appropriate equipment to collect data. Make MEASUREMENTS Including, but not limited to: • With precision and accuracy Calculate STATISTICALLY RELEVANT QUANTITIES TO DESCRIBE DATA

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	Including, but not limited to: • Mean • Median • Range

E.2G	**Demonstrate the use of course apparatuses, equipment, techniques, and procedures, including meter sticks, rulers, pipettes, graduated cylinders, triple beam balances, timing devices, pH meters or 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, 100-foot appraiser's tapes, tarps, shovels, trowels, screens, buckets, and rock and mineral samples.**
	
	Demonstrate
	
	THE USE OF COURSE APPARATUSES, EQUIPMENT, TECHNIQUES, AND PROCEDURES
	
	Including, but not limited to:
	• Appropriate use of equipment
	  • Meter sticks
	  • Rulers
	  • Pipettes
	  • Graduated cylinders
	  • Triple beam balances
	  • Timing devices
	  • pH meters or probes
	  • Thermometers
	  • Calculators
	  • Computers with Internet access
	  • Turbidity testing devices
	  • Hand magnifiers
	  • Work and disposable gloves
	  • Compasses
	  • First aid kits

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	• Binoculars • Field guides • Water quality test kits or probes • Soil test kits or probes • 100-foot appraiser's tapes • Tarps • Shovels • Trowels • Screens • Buckets • Rock and mineral samples

E.2H	**Use a wide variety of additional course apparatuses, equipment, techniques, materials, and procedures as appropriate such as air quality testing devices, cameras, flow meters, Global Positioning System (GPS) units, Geographic Information System (GIS) software, computer models, densiometers, clinometers, and field journals.**
	
	Use
	
	A WIDE VARIETY OF ADDITIONAL COURSE APPARATUSES, EQUIPMENT, TECHNIQUES, MATERIALS, AND PROCEDURES
	
	Including, but not limited to:
	• Additional equipment (as needed)
	  • Air quality testing devices
	  • Cameras
	  • Flow meters
	  • Global positions system (GPS) units
	  • Geographic information system (GIS) software
	  • Computer models
	  • Densiometers
	  • Clinometers
	  • Field journals

E.2I	**Organize, analyze, evaluate, build models, make inferences, and predict trends from data.**

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	Organize, Analyze, Evaluate, Build models, Make inferences, Predict TRENDS FROM DATA Including, but not limited to: • Using models • Analyze data using different modes of expression (narrative, numerical, graphical). • Accurately predict trends from data.
E.2J	**Perform calculations using dimensional analysis, significant digits, and scientific notation.** Perform CALCULATIONS Including, but not limited to: • Dimensional analysis • Significant digits • Scientific notation • Appropriate Standard International (SI) units
E.2K	**Communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.** Communicate VALID CONCLUSIONS Including, but not limited to: • Communicate conclusions in oral, written, and graphic forms. • Use essential vocabulary of the discipline to communicate conclusions. • Use appropriate writing practices consistent with scientific writing. • Use charts and graphs to represent data and conclusions. • Present scientific information in appropriate formats for various audiences. • Through

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	• Lab reports • Labeled drawings • Graphic organizers • Journals (science notebooks) • Summaries • Oral reports • Technology-based reports
E.3	***Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:***

E.3A	**In all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student.**
	
	Analyze, Evaluate, Critique
	
	SCIENTIFIC EXPLANATIONS
	
	Including, but not limited to:
	• Using
	  • Empirical evidence
	  • Scientific evidence
	  • Logical reasoning
	  • Experimental and observational testing
	  • Critical thinking
	
	TxCCRS Note:
	I. Nature of Science – A1 – Utilize skepticism, logic, and professional ethics in science.
	I. Nature of Science – A4 – Rely on reproducible observations of empirical evidence when constructing, analyzing, and evaluating explanations of natural events and processes.

E.3B	**Communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials.** Communicate, Apply

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	SCIENTIFIC INFORMATION
	
	Including, but not limited to:
	• Review scientific information from a variety of sources.
	• Summarize and communicate scientific information from a variety of sources.
	• Evaluate the quality and accuracy of information from research sources.
	  • Possible examples may include
	  • Search engines, databases, and other online tools
	  • Newspapers and other periodicals
	  • Published journal articles
	  • Marketing materials

E.3C	**Draw inferences based on data related to promotional materials for products and services.** Draw INFERENCES BASED ON DATA Including, but not limited to: • Examine data from promotional materials described in print, on television, and on the Internet. • Evaluate data from promotional materials for quality and accuracy. • Evaluate completeness and reliability of information from sources.
E.3D	**Evaluate the impact of research on scientific thought, society, and the environment.** Evaluate IMPACT OF RESEARCH Including, but not limited to: • Read technical and scientific articles to gain understanding of the impact of research. • Recognize how scientific discoveries are connected to technological innovations. • Understand how commonly held ethical beliefs impact scientific research.
E.3E	**Describe the connection between environmental science and future careers.**

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	Describe CONNECTIONS BETWEEN ENVIRONMENTAL SCIENCE AND FUTURE CAREERS Including, but not limited to: • Conduct research on contributions of various environmental science careers.

E.3F	**Research and describe the history of environmental science and contributions of scientists.**
	
	Research, Describe
	
	HISTORY OF ENVIRONMENTAL SCIENCE AND CONTRIBUTIONS OF SCIENTISTS
	
	Including, but not limited to:
	• Understand historical development of major theories in science.
	• History of environmental science
	  • Possible examples may include
	  • Publication of *Silent Spring*
	  • *An Essay on the Principle of Population (*Thomas Malthus)
	  • Creation of the Environmental Protection Agency
	  • Discovery of CO2 Accumulation in the atmosphere (1957)
	  • Chernobyl
	  • Three Mile Island
	  • Exxon Valdez oil spill
	• Contributions of scientists
	  • Possible examples may include
	  • John Snow (cholera transmitted through water)
	  • John Muir (conservationist)
	  • Rachel Carlson (author of *Silent Spring*)
	  • George Washington Carver (sustainability)
	  • Alice Hamilton (founder of occupational medicine)
	  • Thomas Malthus (author of *An Essay on the Principle of Population)*

E.4	***Science concepts. The student knows the relationships of biotic and abiotic factors within habitats, ecosystems, and biomes. The student is***

ENVIRONMENTAL SYSTEMS	
	expected to:

E.4A	**Identify native plants and animals using a dichotomous key.**
	
	Identify
	
	NATIVE PLANTS AND ANIMALS
	
	Including, but not limited to:
	• Using a dichotomous key
	  • Native plants
	  • Native animals
	
	TxCCRS Note:
	VI. Biology – G1 – Identify Earth's major biomes, giving their locations, typical climate conditions, and characteristic organisms present in each.
	X. Environmental Science – A1 – Recognize the Earth's systems.
	X. Environmental Science – A5 – Be familiar with Earth's major biomes.

E.4B	**Assess the role of native plants and animals within a local ecosystem and compare them to plants and animals in ecosystems within four other biomes.**
	
	Assess, Compare
	
	THE ROLE OF NATIVE PLANTS AND ANIMALS WITHIN A LOCAL ECOSYSTEM TO OTHER PLANTS AND ANIMALS
	
	Including, but not limited to:
	• Native plants and animals of the local ecosystem
	• Native plants and animals of ecosystems in other biomes
	  • Possible examples may include
	  • Desert
	  • Deciduous forest
	  • Rainforest
	  • Grassland
	  • Tundra
	  • Taiga
	  • Savanna

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	• Salt water • Fresh water TxCCRS Note: X. Environmental Science – A1 – Recognize the Earth's systems. X. Environmental Science – A4 – Know the features of the hydrosphere. X. Environmental Science – A5 – Be familiar with Earth's major biomes.

E.4C	**Diagram abiotic cycles, including the rock, hydrologic, carbon, and nitrogen cycles**.
	
	Diagram
	
	ABIOTIC CYCLES
	
	Including, but not limited to:
	• Abiotic cycles
	  • Rock
	  • Hydrologic
	  • Carbon
	  • Nitrogen
	  • Oxygen-water
	  • Sulfur
	  • Phosphorus
	• Chemical forms of each element at each stage of the cycle (TxCCRS)
	
	TxCCRS Note:
	X. Environmental Science – A1 – Recognize the Earth's systems.
	X. Environmental Science – A5 – Be familiar with Earth's major biomes.
	X. Environmental Science – A6 – Describe the Earth's major biogeochemical cycles.

E.4D	**Make observations and compile data about fluctuations in abiotic cycles and evaluate the effects of abiotic factors on local ecosystems and local biomes.** Make OBSERVATIONS

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	Including, but not limited to:
	• Fluctuations in abiotic cycles
	  • Precipitation data
	  • Temperature ranges
	  • Nutrient concentrations
	  • Energy
	
	Compile
	
	DATA
	
	Including, but not limited to:
	• Fluctuations in abiotic cycles
	  • Precipitation data
	  • Temperature ranges
	  • Nutrient concentrations
	  • Energy
	
	Evaluate
	
	THE EFFECTS OF ABIOTIC FACTORS ON LOCAL ECOSYSTEMS AND LOCAL BIOMES
	
	Including, but not limited to:
	• Impact of abiotic cycles on ecosystems and biomes
	  • Eutrophication
	
	TxCCRS Note:
	VI. Biology – C2 – Recognize variations in population sizes, including extinction, and describe mechanisms and conditions that produce these variations.
	X. Environmental Science – A1 – Recognize the Earth's systems.

E.4E	**Measure the concentration of solute, solvent, and solubility of dissolved substances such as dissolved oxygen, chlorides, and nitrates and describe their impact on an ecosystem.** Measure

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	THE CONCENTRATION OF SOLUTE, SOLVENT, AND SOLUBILITY OF DISSOLVED SUBSTANCES Describe IMPACT ON AN ECOSYSTEM Including, but not limited to: • Dissolved oxygen • Chlorides • Nitrates • Phosphates TxCCRS Note: X. Environmental Science – A1 – Recognize the Earth's systems.

E.4F	**Predict how the introduction or removal of an invasive species may alter the food chain and affect existing populations in an ecosystem.**
	
	Predict
	
	HOW INTRODUCTION OR REMOVAL OF AN INVASIVE SPECIES MAY ALTER THE FOOD CHAIN AND AFFECT EXISTING POPULATIONS
	
	Including, but not limited to:
	• Invasive species
	• Impacts
	  • Economic
	  • Biodiversity
	  • Habitat alteration
	
	TxCCRS Note:
	VI. Biology – G4 – Know the process of succession.

E.4G	**Predict how species extinction may alter the food chain and affect existing populations in an ecosystem.** Predict HOW SPECIES EXTINCTION MAY ALTER THE FOOD CHAIN AND AFFECT EXISTING POPULATIONS

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	Including, but not limited to: • Causes of extinction • Impact on food chain • Impact on existing populations
E.4H	**Research and explain the causes of species diversity and predict changes that may occur in an ecosystem if species and genetic diversity is increased or reduced.** Research, Explain CAUSES OF SPECIES DIVERSITY Including, but not limited to: • Causes of species diversity Predict CHANGES THAT MAY OCCUR IN AN ECOSYSTEM IF SPECIES AND GENETIC DIVERSITY IS INCREASED OR REDUCED Including, but not limited to: • Increase or reduction in biodiversity • Evolution through natural selection • Genetic diversity • Impact of changes to biodiversity
E.5	***Science concepts. The student knows the interrelationships among the resources within the local environmental system. The student is expected to:***
E.5A	**Summarize methods of land use and management and describe its effects on land fertility.** Summarize, Describe METHODS OF LAND USE AND MANAGEMENT, EFFECTS ON LAND FERTILITY Including, but not limited to: • Land use • Agriculture

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	• Intensive agriculture • Sustainable agriculture • Livestock • Mining • Recreation • Water source • Urban settlement • Transportation • Land management practices • Forestry • Tree plantations • Timber (cedar) management • Fire management • Rangeland • Grazing practices • Conversion to grasslands • Urban land development • Transportation • Infrastructure • Public lands • Mining • Fishing • Wildlife preservation/conservation • Aquatic, wetland, and riparian zone preservation TxCCRS Note: X. Environmental Science – E1 – Describe the different uses for land (land management). X. Environmental Science – E3 – Know the different methods used to increase food production. X. Environmental Science – E4 – Understand land and water usage and management practices.
E.5B	**Identify source, use, quality, and conservation of water.**

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	Identify
	
	SOURCE, USE, QUALITY, AND CONSERVATION OF WATER
	
	Including, but not limited to:
	• Interpret data on local water shed.
	  • Chemistry of water
	  • Source or use of water
	  • Determination of water quality
	  • Abiotic and biotic factors
	• Recognize management practices.
	  • Wastewater treatment
	• Conservation
	
	TxCCRS Note:
	X. Environmental Science – E4 – Understand land and water usage and management practices.

E.5C	**Document the use and conservation of both renewable and non-renewable resources as they pertain to sustainability.**
	
	Document
	
	USE AND CONSERVATION OF RENEWABLE AND NON-RENEWABLE RESOURCES
	
	Including, but not limited to:
	• Conservation methods
	• Sustainability
	• Renewable resources to include but not limited to
	  • Water
	  • Wind
	  • Timber
	  • Soil
	  • Agricultural products

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	• Non-renewable resources to include but not limited to
	  • Fossil fuels
	  • Aquifers
	  • Nuclear energy

E.5D	**Identify renewable and non-renewable resources that must come from outside an ecosystem such as food, water, lumber, and energy.** Identify RENEWABLE AND NON-RENEWABLE RESOURCES THAT MUST COME FROM OUTSIDE AN ECOSYSTEM Including, but not limited to: • Food • Water • Lumber • Energy

E.5E	**Analyze and evaluate the economic significance and interdependence of resources within the environmental system.**
	
	Analyze, Evaluate
	
	ECONOMIC SIGNIFICANCE AND INTERDEPENDENCE OF RESOURCES WITHIN THE ENVIRONMENTAL SYSTEM
	
	Including, but not limited to:
	• Economic significance of resources within the environmental system
	  • Analysis and evaluation
	  • Possible examples may include
	  • Cost-benefit analysis
	  • Non-market resource evaluation (social, health, environmental quality)
	  • Possible examples may include
	  • Lumber
	  • Organic materials
	  • Insects
	  • Recreation

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	• Interdependence of resources within the environmental system
	  • Abiotic and biotic
	  • Possible examples may include
	  • Sunlight
	  • Insects
	  • Soil
	  • Water

E.5F	**Evaluate the impact of waste management methods such as reduction, reuse, recycling, and composting on resource availability.**
	
	Evaluate
	
	IMPACT OF WASTE MANAGEMENT METHODS
	
	Including, but not limited to:
	• Land fertility
	• Aquatic viability
	• Human practice and impact on air, water, and soil quality
	• Impact of waste management methods impact on resource availability
	  • Reduction
	  • Reuse
	  • Recycling
	  • Renewal
	  • Composting
	  • Landfills
	  • Wastewater
	
	TxCCRS Note:
	X. Environmental Science – D2 – Understand the types, uses, and regulations of the various natural resources.
	X. Environmental Science – E4 – Understand land and water usage and management practices.

E.6	***Science concepts. The student knows the sources and flow of energy through an environmental system. The student is expected to:***
E.6A	**Define and identify the components of the geosphere, hydrosphere, cryosphere, atmosphere, and biosphere and the interactions among them.**

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Define, Identify

COMPONENTS OF THE ENVIRONMENTAL SYSTEM, INTERACTIONS AMONG THEM

Including, but not limited to:

- Geosphere
  - Characteristics (location, composition, interactions, and changes through time) that identify and distinguish between
    - Core
    - Mantle
    - Crust
    - Tectonic plates
  - Describe the processes that make up the rock cycle.
    - Weathering
    - Erosion
    - Deposition
- Hydrosphere
  - Composition and location of bodies of water
    - Fresh water
    - Salt water
  - Evaporation
- Currents
- Cryosphere
  - Characteristics
  - Effects of global warming
- Atmosphere
  - Physical and chemical characteristics
  - Regions
  - Factors that influence weather and climate
- Atmospheric circulation

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	• Atmosphere-ocean interactions
	• Biosphere
	  • Major terrestrial and aquatic biomes
	  • Locations
	  • Characteristic organisms
	  • Important physical factors
	  • Temperature
	  • Rainfall
	
	TxCCRS Note:
	VI. Biology – G1 – Identify Earth's major biomes, giving their locations, typical climate conditions, and characteristic organisms present in each.
	VI. Biology – G2 – Know patterns of energy flow and material cycling in Earth's ecosystems.
	X. Environmental Science – B1 – Know the various sources of energy for humans and other biological systems.

E.6B	**Describe and compare renewable and non-renewable energy derived from natural and alternative sources such as oil, natural gas, coal, nuclear, solar, geothermal, hydroelectric, and wind.**
	
	Describe, Compare
	
	RENEWABLE AND NON-RENEWABLE ENERGY DERIVED FROM NATURAL AND ALTERNATIVE SOURCES
	
	Including, but not limited to:
	• Renewable
	  • Solar
	  • Geothermal
	  • Hydroelectric (water)
	  • Wind
	  • Biomass
	  • Nuclear
	• Nonrenewable
	  • Nuclear
	  • Oil
	  • Natural gas

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	• Coal • Methods and practices of energy conservation (TxCCRS) TxCCRS Note: VI. Biology – G2 – Know patterns of energy flow and material cycling in Earth's ecosystems. X. Environmental Science – B1 – Know the various sources of energy for humans and other biological systems.
E.6C	**Explain the flow of energy in an ecosystem, including conduction, convection, and radiation.** Explain FLOW OF ENERGY IN AN ECOSYSTEM Including, but not limited to: • Conduction • Convection • Radiation TxCCRS Note: VI. Biology – G2 – Know patterns of energy flow and material cycling in Earth's ecosystems. X. Environmental Science – A6 – Describe the Earth's major biogeochemical cycles. X. Environmental Science – B1 – Understand energy transformations. X. Environmental Science – B1 – Know the various sources of energy for humans and other biological systems.
E.6D	**Investigate and explain the effects of energy transformations in terms of the laws of thermodynamics within an ecosystem.** Investigate, Explain EFFECTS OF ENERGY TRANSFORMATIONS IN TERMS OF THE LAWS OF THERMODYNAMICS WITHIN AN ECOSYSTEM Including, but not limited to: • Examples of effects of energy transfer within an ecosystem • Energy transformation in terms of the laws of thermodynamics TxCCRS Note: VI. Biology – G2 – Know patterns of energy flow and material cycling in Earth's ecosystems. X. Environmental Science – B1 – Understand energy transformations. X. Environmental Science – B1 – Know the various sources of energy for humans and other biological systems.

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E.6E	**Investigate and identify energy interactions in an ecosystem.**
	
	Investigate, Identify
	
	ENERGY INTERACTIONS IN AN ECOSYSTEM
	
	Including, but not limited to:
	• Biogeochemical cycles
	  • Carbon
	  • Oxygen-water
	  • Sulfur
	  • Nitrogen
	  • Phosphorus
	• Energy interactions between biosphere, atmosphere, and hydrosphere
	
	TxCCRS Note:
	X. Environmental Science – B1 – Understand energy transformations.

E.7	***Science concepts. The student knows the relationship between carrying capacity and changes in populations and ecosystems. The student is expected to:***
E.7A	**Relate carrying capacity to population dynamics.** Relate CARRYING CAPACITY TO POPULATION DYNAMICS Including, but not limited to: • Limiting factors • Types of population growth • Calculate carrying capacity (K). • Modeling carrying capacity and population dynamics • Recognize variations in population sizes. TxCCRS Note: VI. Biology – C2 – Recognize variations in population sizes, including extinction, and describe mechanisms and conditions that produce these

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	variations.
E.7B	**Calculate birth rates and exponential growth of populations.** Calculate BIRTH RATES AND EXPONENTIAL GROWTH OF POPULATIONS Including, but not limited to: • Initial population • Fertility rate • Growth rate • Birth rate • Death rate TxCCRS Note: X. Environmental Science – C1 – Recognize variations in population sizes, including human population and extinction, and describe mechanisms and conditions that produce these variations.
E.7C	**Analyze and predict the effects of non-renewable resource depletion.** Analyze, Predict THE EFFECTS OF NON-RENEWABLE RESOURCE DEPLETION Including, but not limited to: • Fossil fuels • Alternatives to fossil fuels • Water
E.7D	**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.** Analyze, Predict IMPACT ON POPULATIONS Including, but not limited to:

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	• Geographic locales
	  • Natural events
	  • Migration
	  • Seasonal changes
	  • Diseases
	  • Birth and death rates
	  • Recognition of patterns of change in populations
	  • Urbanization
	
	TxCCRS Note:
	I. Nature of Science – A2 – Use creativity and insight to recognize and describe patterns in natural phenomena.
	X. Environmental Science – C1 – Recognize variations in population sizes, including human population and extinction, and describe mechanisms and conditions that produce these variations.

E.8	***Science concepts. The student knows that environments change naturally. The student is expected to:***
E.8A	**Analyze and describe the effects on areas impacted by natural events such as tectonic movement, volcanic events, fires, tornadoes, hurricanes, flooding, tsunamis, and population growth.** Analyze, Describe EFFECTS ON AREAS IMPACTED BY NATURAL EVENTS Including, but not limited to: • Effects on resources, interactions • Impact on size and location of populations of organisms and habitats they occupy • Tectonic movement • Volcanic events • Fires • Tornadoes • Hurricanes • Flooding • Tsunamis • Population growth

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	TxCCRS Note: X. Environmental Science – A2 – Know the major features of the geosphere and the factors that modify them.
E.8B	**Explain how regional changes in the environment may have a global effect.** Explain HOW REGIONAL CHANGES IN THE ENVIRONMENT MAY HAVE A GLOBAL EFFECT Including, but not limited to: • Carbon emissions • Deforestation • Acid deposition • Water flow
E.8C	**Examine how natural processes such as succession and feedback loops restore habitats and ecosystems.** Examine HOW NATURAL PROCESSES RESTORE HABITATS AND ECOSYSTEMS Including, but not limited to: • Succession • Feedback loops TxCCRS Note: VI. Biology – G4 – Know the process of succession.
E.8D	**Describe how temperature inversions impact weather conditions, including El Niño and La Niña oscillations.** Describe HOW TEMPERATURE INVERSIONS IMPACT WEATHER CONDITIONS Including, but not limited to: • El Niño oscillations • La Niña oscillations

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	• Pollution TxCCRS Note: I. Nature of Science – A2 – Use creativity and insight to recognize and describe patterns in natural phenomena.
E.8E	**Analyze the impact of temperature inversions on global warming, ice cap and glacial melting, and changes in ocean currents and surface temperatures.** Analyze THE IMPACT OF TEMPERATURE INVERSIONS Including, but not limited to: • Global warming • Ice cap • Glacial melting • Changes in ocean currents • Surface temperatures
E.9	***Science concepts. The student knows the impact of human activities on the environment. The student is expected to:***
E.9A	**Identify causes of air, soil, and water pollution, including point and nonpoint sources.** Identify CAUSES OF AIR, SOIL, AND WATER POLLUTION Including but not limited to: • Industrial waste • Agricultural runoff • Pesticides • Transportation • Burning fossil fuels Including, but not limited to: • Ways that human activities have modified soil, water, air quality, and climate systems

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	• Use and consequences of pesticides (TxCCRS) • Organic vs. chemical pesticides • Use and consequences of herbicides (TxCCRS) • Use and consequences of fertilizers (TxCCRS) • Methods used to increase food production • Point and nonpoint sources TxCCRS Note: X. Environmental Science – A3 – Know the major features of the atmosphere. X. Environmental Science – E5 – Understand how human practices affect air, water, and soil quality.
E.9B	**Investigate the types of air, soil, and water pollution such as chlorofluorocarbons, carbon dioxide, pH, pesticide runoff, thermal variations, metallic ions, heavy metals, and nuclear waste.** Investigate TYPES OF AIR, SOIL, AND WATER POLLUTION Including, but not limited to: • Chlorofluorocarbons • Carbon dioxide • pH • Nitrates • Phosphates • Pesticide runoff • Thermal variations • Metallic ions • Heavy metals • Nuclear waste TxCCRS Note: X. Environmental Science – A3 – Know the major features of the atmosphere. X. Environmental Science – A4 – Know the features of the hydrosphere. X. Environmental Science – E5 – Understand how human practices affect air, water, and soil quality.

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E.9C	**Examine the concentrations of air, soil, and water pollutants using appropriate units.** Examine THE CONCENTRATIONS OF AIR, SOIL, AND WATER POLLUTANTS USING APPROPRIATE UNITS Including, but not limited to: • Air • Soil • Water Including, but not limited to: • Chlorofluorocarbons • Carbon dioxide • pH • Nitrates • Phosphates • Pesticide runoff • Thermal variations • Metallic ions • Heavy metals • Nuclear waste TxCCRS Note: X. Environmental Science – E5 – Understand how human practices affect air, water, and soil quality.
E.9D	**Describe the effect of pollution on global warming, glacial and ice cap melting, greenhouse effect, ozone layer, and aquatic viability.** Describe THE EFFECT OF POLLUTION Including, but not limited to: • Global warming

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	• Glacial and ice cap melting • Greenhouse effect • Ozone layer • Aquatic viability TxCCRS Note: X. Environmental Science – E5 – Understand how human practices affect air, water, and soil quality.

E.9E	**Evaluate the effect of human activities, including habitat restoration projects, species preservation efforts, nature conservancy groups, hunting, fishing, ecotourism, all terrain vehicles, and small personal watercraft, on the environment.**
	
	Evaluate
	
	THE EFFECT OF HUMAN ACTIVITIES ON THE ENVIRONMENT
	
	Including, but not limited to:
	• Nature conservancy groups
	• Habitat restoration projects
	  • Replanting forests
	  • Restoring of natural habitats
	• Species preservation efforts
	• Hunting
	• Fishing
	• Ecotourism
	• All-terrain vehicles
	• Small personal watercraft
	
	TxCCRS Note:
	X. Environmental Science – E5 – Understand how human practices affect air, water, and soil quality.

E.9F	**Evaluate cost-benefit trade-offs of commercial activities such as municipal development, farming, deforestation, over-harvesting, and mining.** Evaluate

ENVIRONMENTAL SYSTEMS	
	COST-BENEFIT TRADE-OFFS OF COMMERCIAL ACTIVITIES Including, but not limited to: • Municipal development • Farming • Deforestation • Over-harvesting • Mining TxCCRS Note: X. Environmental Science – E1 – Describe the different uses for land (land management). X. Environmental Science – E5 – Understand how human practices affect air, water, and soil quality.

E.9G	**Analyze how ethical beliefs can be used to influence scientific practices such as the methods for increasing food production.**
	
	Analyze
	
	HOW ETHICAL BELIEFS CAN BE USED TO INFLUENCE SCIENTIFIC PRACTICES
	
	Including, but not limited to:
	• Methods for increasing food production
	  • Sustainable agriculture
	  • Organic agriculture
	  • Genetically modified organisms
	  • Livestock practices
	
	TxCCRS Note:
	X. Environmental Science – E3 – Know the different methods used to increase food production.

E.9H	**Analyze and evaluate different views on the existence of global warming.** Analyze, Evaluate DIFFERENT VIEWS Including, but not limited to:

ENVIRONMENTAL SYSTEMS	
	• Existence of global warming
E.9I	**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.** Discuss THE IMPACT OF RESEARCH AND TECHNOLOGY ON SOCIAL ETHICS AND LEGAL PRACTICES IN SITUATIONS Including, but not limited to: • Design of new buildings • Recycling • Emission standards
E.9J	**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.** Research THE ADVANTAGES AND DISADVANTAGES OF "GOING GREEN" Including, but not limited to: • Organic gardening and farming • Natural methods of pest control • Hydroponics • Xeriscaping • Energy efficient homes and appliances • Hybrid cars
E.9K	**Analyze past and present local, 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.** Analyze PAST AND PRESENT LOCAL, STATE, AND NATIONAL LEGISLATION Including, but not limited to:

ENVIRONMENTAL SYSTEMS	
	• Texas automobile emissions regulations • National Park Service Act • Clean Air Act • Clean Water Act • Soil and Water Resources Conservation Act • Endangered Species Act TxCCRS Note: X. Environmental Science – D1 – Name and describe major environmental policies and legislation. X. Environmental Science – D2 – Understand the types, uses and regulations of the various natural resources.
E.9L	**Analyze past and present international treaties and protocols such as the Environmental Antarctic Treaty System, Montreal Protocol, and Kyoto Protocol.** Analyze PAST AND PRESENT INTERNATIONAL TREATIES AND PROTOCOLS Including, but not limited to: • Antarctic Treaty System • Montreal Protocol • Kyoto Protocol

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