



Department: Science

Course Name: Environmental Science

The overarching essential questions of this course are, “*How is the environment one interconnected system?*”; “*How does human activity affect the environment?*” and “*How do scientists study the environment?*”

Students will engage in the process of scientific inquiry while examining important concepts from earth science, biology, chemistry, and physics. Mathematics and technology are also woven throughout the course as students focus on the collection and analysis of data. The big ideas and concepts addressed throughout the year will be interdependence of the living and nonliving components of the environment, stability and changes in ecosystems and populations over time, human impact on the environment, energy extraction and use, and natural resource management.

Students will concurrently acquire understanding of scientific concepts and proficiency in scientific-process skills. Rather than being examined in isolation, the tenets of science will be the tools used for teaching the scientific content of the course through a hands-on, student-centered approach. This course aims to cultivate scientific literacy in students, as it is becoming increasingly necessary in our technology-oriented society.

UNIT 1 – Ecosystem Structure

In this unit, students will explore how ecosystems are structured. Learning about the needs of organisms will prepare students to understand the interdependence of organisms and their relationship with the ecosphere. They will investigate biotic and abiotic factors in an ecosystem and how those factors interact.

LEARNING GOALS

Enduring Understandings

Ecosystems have an organization to them.

Many factors determine the conditions found in an ecosystem.

Many different living things interact with biotic and abiotic factors present in an environment.

Essential Questions

How are living things dependent on each other and the environment?

How do different factors interact to form the diversity of ecosystems present on Earth today?

Content and Skills:

Students will know and be able to:

1. Distinguish between the biotic and the abiotic factors in an ecosystem.
2. Identify what organisms need to survive.
3. Trace how matter is cycled through ecosystems.
4. Trace the movement of matter and energy in food webs.
5. Describe how energy is transferred from the sun to producers and consumers.
6. Illustrate energy and matter transfers in a food web.
7. Diagram energy flow and biomass in a community using an energy pyramid.
8. Explain the difference between niche and habitat.
9. Explain why different species can occupy the same habitat, but not the same niche (without competition).
10. Describe the types of interactions among organisms (predator/prey, competition, parasitism, mutualism, commensalism) and how they contribute to ecosystem stability.
11. Explain the importance of keystone species to ecosystem stability.

12. Explain and describe factors that determine climate.
13. Explain how interactions among temperature, precipitation, latitude and altitude determine the global biomes.
14. Identify key features (temperature, precipitation, characteristic plants and animals) of the following terrestrial biomes: Tropical rainforest, temperate deciduous forests, taiga, savanna, grasslands, deserts, tundra.
15. Identify key features of the following aquatic biomes: lakes, ponds, wetlands, rivers, estuaries, coral reefs.
16. Describe adaptations that plants and animals have in biomes listed above.
17. Explain the importance of biome diversity to humans by identifying resources.

Standards Addressed

CT SDE Frameworks

9.7 - Elements on Earth move among reservoirs in the solid earth, oceans, atmosphere and organisms as part of biogeochemical cycles.

- ◆ Elements on Earth exist in essentially fixed amounts and are located in various chemical reservoirs.

The Core Scientific Inquiry, Literacy and Numeracy Standards (D. INQ 1-10)

NGSS

Disciplinary Core Ideas:

LS2.A: Interdependent Relationships in Ecosystems

LS2.B: Cycles of Matter and Energy Transfer in Ecosystems

LS2.C: Ecosystem Dynamics, Functioning and Resilience

UNIT 2 - Population Dynamics and Human Population Growth

In this unit students will explore how different factors affect the growth of populations. Students will look at ways humans manipulate their environment and how uncontrolled human population growth has negative impacts on the planet.

LEARNING GOALS

Enduring Understandings

The size and growth of populations of organisms are controlled by various factors.

Humans have the ability to manipulate the environmental factors that could limit their population growth.

Essential Questions

How and why do populations change over time?

What is the carrying capacity of the Earth?

How does human population growth impact the environment?

What can be done to limit human population growth?

Content and Skills:

Students will know and be able to:

1. Compare and contrast population density and dispersion.
2. Describe exponential population growth and its impact in comparison to logistic growth.
3. Describe four factors (birth rate, death rate, immigration, emigration) that affect population size.
4. Describe reproductive potential and how it impacts the growth rate of a population.
5. Explain how density dependent and density independent limiting factors regulate population size.
6. Describe carrying capacity.
7. Describe how interactions among organisms (competition, predation) affect population size.
8. Explain how technological advances have affected the size and growth rate of human populations throughout history. (D 45)
9. Describe properties scientists use to predict population sizes (age structure, survivorship, fertility rates, migration).
10. Make predictions about population trends based on age structure.
11. Describe the four stages of the demographic transition.
12. Compare population growth problems in more developed countries and in less developed countries.
13. Describe worldwide population projections into the next century.

Standards Addressed:

CT SDE Frameworks

10.6 - Living organisms have the capability of producing populations of unlimited size, but the environment can support only a limited number of individuals from each species.

- ◆ Human populations grow due to advances in agriculture, medicine, construction and the use of energy.
- ◆ Humans modify ecosystems as a result of rapid population growth, use of technology and consumption of resources

The Core Scientific Inquiry, Literacy and Numeracy Standards (D. INQ 1-10)

NGSS

Disciplinary Core Ideas:

LS2.A: Interdependent Relationships in Ecosystems

LS4.C: Adaptation

ESS3.A: Natural Resources

UNIT 3 - How Natural Forces and Human Activities Change Biodiversity of Ecosystems

In this unit students will explore different factors that can cause ecosystems to change. Ecosystems are dynamic, and may change quickly or slowly over time. Natural forces and interactions create the conditions that exist in an area, but they can also change those conditions. Changes in one part of an ecosystem can cause changes in other parts of that system.

Biodiversity, the multiplicity of genes, organisms, and ecosystems, is important to humans as we rely on them for survival. Biodiversity provides people with food, energy, materials, medicines and other goods. Not only does this help to sustain people's lives, but it forms the basis of local and national economies and promotes social and political stability. Biodiversity also provides important ecological services and has cultural, recreational, aesthetic, spiritual, emotional, psychological and other scientific benefits. The resources of biological communities can be used within sustainable limits, however human activities may reduce biodiversity. Habitat destruction, overexploitation, introduction of invasive species, and climate change significantly impact global biodiversity. Sustaining biodiversity is essential to all life on Earth.

LEARNING GOALS

Enduring Understandings

Ecosystems can be influenced by many different factors.

Ecosystems are dynamic and that influences the living things in them.

Biodiversity is important to the livelihood of animals and humans alike.

Essential Questions

How do natural forces and human activities cause changes in biodiversity of ecosystems?

What can be done about factors that alter ecosystems and biodiversity?

Content and Skills:

Students will know and be able to:

1. Describe ways in which biodiversity is important to ecosystems and humans
2. Describe ways in which species are threatened (habitat destruction, invasive species, harvesting, hunting, poaching, pollution) and evaluate which of those threats have the largest impact
3. Define and state examples of endangered and threatened species
4. Compare and contrast primary and secondary succession and the changes in biodiversity which occur
5. Describe the composition and structure of the Earth
6. Explain how tectonic plate action influences factors which influence biodiversity
7. Describe how wind and water alter Earth's surface over time
8. Compare and contrast surface and deep ocean currents
9. Describe how the ocean helps regulate the atmospheric temperature of the Earth
10. Describe how natural phenomena (tsunamis, hurricanes, earthquakes, volcanoes, ENSO, etc.) alter ecosystems locally and globally
11. Describe efforts to save species and protect biodiversity
12. Explain the importance of protecting entire ecosystems

Standards Addressed:

CT SDE Enrichment Content Standards

Ecology - Stability in an ecosystem is a balance between competing effects.

The Core Scientific Inquiry, Literacy and Numeracy Standards (D. INQ 1-10)

NGSS

Disciplinary Core Ideas:

LS4.D: Biodiversity and Humans

ESS2.A: Earth Materials and Systems

ESS2.B: Plate Tectonics and Large Scale System Interactions

ESS2.C: The Roles of Water in Earth's Surface Processes

ESS2.D: Weather and Climate

ESS3.B: Natural Hazards

UNIT 4 - Energy Resources

In this unit, students will explore different sources of energy resources used to power our world. Some of these resources are renewable and some are nonrenewable. Advantages and disadvantages of all different sources will be discussed. Extraction of energy resources has social, economic, environmental and political costs and benefits. Energy resources are not uniformly distributed across the planet and this can contribute to geopolitical conflicts. As the human population increases, nonrenewable energy resources become scarcer. Students will look at ways to conserve energy and reduce their consumption and how advances in science and technology can change the sources of energy we use in the future.

LEARNING GOALS

Enduring Understandings

Ecosystems can be influenced by many different factors.

Ecosystems are dynamic and that influences the living things in them.

Biodiversity is important to the livelihood of animals and humans alike.

Essential Questions

How do natural forces and human activities cause changes in biodiversity of ecosystems?

What can be done about factors that alter ecosystems and biodiversity?

Content and Skills:

Students will know and be able to:

1. Explain, using examples, how energy can be transformed from one form to another.
2. Describe the various ways humans use energy resources and reasons we need energy for our survival.
3. Compare and contrast renewable and nonrenewable energy sources.
4. Describe commonly used nonrenewable fuels and recognize their origins (coal, oil, gas, nuclear).
5. Analyze the current availability of non-renewable, fossil fuel energy sources and various predictions regarding future availability.
6. Evaluate the environmental impact of extracting and using fossil fuels.
7. Evaluate the environmental impact of using nuclear power.
8. Describe various forms of renewable energy (solar, wind, hydroelectric, geothermal, biomass) in terms of how energy is produced (what is the raw material and what are the energy requirements, relative cost, and availability), renewal rates and limitations.
9. Describe newer energy technologies (tidal power, OTEC, hydrogen).
10. Compare advantages and disadvantages of solar, wind, hydroelectric, geothermal, biomass, tidal, OTEC, hydrogen powers.
11. Identify patterns of energy use and production in the United States and in the world..
12. Describe the relationship between energy consumption and living standards in different parts of the world.
13. Evaluate how world-wide distribution of energy resources impact geopolitical relations.
14. Explain the difference between energy efficiency and energy conservation.
15. Identify ways that you can conserve energy in your daily life.

Standards Addressed:

CT SDE Frameworks

9.3 - Various sources of energy are used by humans and all have advantages and disadvantages.

- ◆ During the burning of fossil fuels, stored chemical energy is converted to electrical energy through heat transfer processes.
- ◆ In nuclear fission, matter is transformed directly into energy in a process that is several million times as energetic as chemical burning.
- ◆ Alternative energy sources are being explored and used to address the disadvantages of using fossil and nuclear fuels.

The Core Scientific Inquiry, Literacy and Numeracy Standards (D. INQ 1-10)

NGSS

Disciplinary Core Ideas:

ESS3.A: Natural Resources

UNIT 5 - How Humans Use and Change Air and Land Environments

In this unit, students will explore how we use our land environments and how this use impacts the environment and other living things. Human activities that cause air pollution and climate change will be discussed.

LEARNING GOALS

Enduring Understandings

All materials needed for humans to maintain their current way of life have impacts on the environment.

Essential Questions

How does the consumption of resources change the land environment?

How does the consumption of resources change the atmosphere?

What are possible solutions to problems caused by humans altering the land and atmosphere?

Content and Skills:

Students will know and be able to:

1. Describe the composition of the atmosphere and how the greenhouse effect allows living things to survive on the Earth.
2. Name primary air pollutants and their sources.
3. Describe short and long term effects of air pollution on human health.
4. Explain the causes of indoor air pollution and how it can be prevented.
5. Explain how the release of sulfur and nitrogen into the atmosphere can form acid rain, and how acid rain affects water sources, organisms and human-made structures (D 22).
6. Describe how countries are working to solve the problem of acid precipitation.
7. Explain why carbon dioxide content in the atmosphere is increasing.
8. Explain how the accumulation of carbon dioxide (CO₂) in the atmosphere increases Earth's "greenhouse" effect and may cause climate changes. (D 23)
9. Describe the impact of climate change on human health and the environment.
10. Identify ecosystem services provided by grasslands, forest lands, wetlands and aquatic ecosystems.
11. Describe the benefits and disadvantages of land uses such as farmland, rangeland, parks, wilderness areas and residential areas.
12. Create a model that simulates land use development with the combined input of various members of a community.
13. Describe the environmental effects of deforestation.
14. Explain how land development, transportation options and consumption of resources may affect the environment. (D 25)
15. Compare and contrast subsurface mining and surface mining and their potential environmental consequence.
16. Explain the difference between reclamation and remediation.
17. Explain the short- and long-term impacts of landfills and incineration of waste materials on the quality of the environment. (D18)
18. Describe human efforts to reduce the consumption of raw materials (reducing, reusing, recycling, composting) and improve air quality. (D 26)

Standards Addressed:CT SDE Frameworks

9.8 - The use of resources by human populations may affect the quality of the environment.

- ◆ Emission of combustion by-products, such as SO₂, CO₂ and NO_x by industries and vehicles is a major source of air pollution.
- ◆ Accumulation of metal and non-metal ions used to increase agricultural productivity is a major source of water pollution.

9.9 - Some materials can be recycled, but others accumulate in the environment and may affect the balance of the Earth systems.

- ◆ New technologies and changes in lifestyle can have positive and/or negative effects on the environment.

The Core Scientific Inquiry, Literacy and Numeracy Standards (D. INQ 1-10)

NGSSDisciplinary Core Ideas:

ESS2.D: Weather and Climate

ESS3.A: Natural Resources

ESS3.C: Human Impacts on Earth's Systems

ESS3.D: Global Climate Change

UNIT 6 - Water Resources

In this unit, students will explore how we rely on and utilize our water environments and how this use impacts the environment and other living things.

LEARNING GOALS

Enduring Understandings

All materials needed for humans to maintain their current way of life have impacts on the environment.

Essential Questions

How does the consumption of resources change the water environments?

What are possible solutions to problems caused by humans using and altering water?

Content and Skills:

Students will know and be able to:

1. Describe the distribution of Earth's water resources.
2. Describe the relationship between groundwater and surface water in a watershed.
3. Identify ways that water can be conserved.
4. Identify patterns of global water use.
5. Identify how water is used in homes, in industry and in agriculture.
6. Describe and evaluate the current role of aquaculture in providing food for the human population.
7. Compare point source pollution and nonpoint source pollution.
8. Describe thermal pollution.
9. Describe groundwater pollution and explain why remediation is difficult.
10. Explain how the accumulation of mercury, phosphates and nitrates affects the quality of water and the organisms that live in rivers, lakes and oceans (D24).
11. Compare and contrast natural and artificial eutrophication.
12. Model biomagnification of toxins through an aquatic food chain.

Standards Addressed:

CT SDE Frameworks

9.8 - The use of resources by human populations may affect the quality of the environment.

Accumulation of metal and non-metal ions used to increase agricultural productivity is a major source of water pollution.

9.9 - Some materials can be recycled, but others accumulate in the environment and may affect the balance of the Earth systems. New technologies and changes in lifestyle can have positive and/or negative effects on the environment.

The Core Scientific Inquiry, Literacy and Numeracy Standards (D. INQ 1-10)

NGSS

Disciplinary Core Ideas:

ESS2.D: Weather and Climate

ESS3.A: Natural Resources

ESS3.C: Human Impacts on Earth's Systems

ESS3.D: Global Climate Change

