Environmental Science

Core Ideas/Crosscutting Concepts:

Introduction
Environmental Science is a combination and an application of Biology, Chemistry, Physics and Geology.

The history of the environmental movement is driven by individuals and small groups.

There are 4 major justifications for protecting the environment.

The Scientific Method is the only relevant method applicable to Environmental Science.

All Scientific discoveries are based on observation of the natural world

Inquiry/STEM
What is Environmental Science?

What is a case study?

What are the justifications for protecting the environment?

What drives the environmental movement?

How does one assess scientific literature?

What is the Scientific Method?

Learning Targets:

Science Inquiry and Application
All students must use the following scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas:

Identify questions and concepts that guide scientific investigations;

Design and conduct scientific investigations;

Use technology and mathematics to improve investigations and communications;

Formulate and revise explanations and models using logic and evidence (critical thinking);

Recognize and analyze explanations and models; and

Communicate and support a scientific argument.

Core Ideas/Crosscutting Concepts:

Organisms and Environment
Meaning and significance of Biomes, Ecosystems, Communities and the individual organism to the environment.

Individuals and species interact with their environment through 7 interactions.

The rules for Systematic Nomenclature

The significance of the Competitive Exclusion Principle

Species adapt and evolve

The role of Invasive species in the modification of ecosystems.

Inquiry/STEM
How is the environment organized?

How do species interact with the environment and other species?

How do scientists identify and name organisms?

How do species with similar requirements interact?

How do invasive species modify ecosystems and what role has man played in the introduction of exotic species?

Learning Targets:

Earth Systems: Interconnected Spheres of Earth

Biosphere

Evolution and adaptation in populations

Ecosystems (equilibrium, species interactions, stability)

Species depletion and extinction

Core Ideas/Crosscutting Concepts:

Biological, Chemical and Geological Cycles
Conservation of Matter and Energy:

Laws of Thermodynamics

Trophic Levels and efficiency of Energy Transfer

Food Chains, Food Webs and Ecological Pyramids

Keystone Species

Photosynthesis and Respiration

Chemical Cycles:

Nitrogen

Carbon

Phosphorus

Sulfur

Calcium

Geological Time and Time Scale

Tectonic Cycle:

Tectonic Plate Boundaries

Earthquakes

Seismic waves

Richter and Mercalli scales

Tsunamis

Inquiry/STEM
How does energy travel through an ecosystem?

Are some species more important to the functioning of an ecosystem than others?

What is the significance of chemical cycles to life?

What significance does geological time have on evolution and the environment?

What are the environmental impacts of the Tectonic Cycle?

Learning Targets:

Earth Systems: Interconnected Spheres of Earth

Biosphere

Ecosystems (equilibrium, species interactions, stability)

Atmosphere

Atmospheric properties and currents

Lithosphere

Geologic events and processes

Hydrosphere

Surface and ground water flow patterns and movement

Movement of matter and energy through the hydrosphere, lithosphere, atmosphere and biosphere

Biogeochemical cycles

Core Ideas/Crosscutting Concepts:

Types of Ecosystems
Primary and secondary succession

Terrestrial, Aquatic and Marine Ecosystems

Ecosystem productivity

Ecosystems and human impact including edge effect

Restoration ecology

Human intervention and natural processes

Ecosystem management

Inquiry/STEM

How do ecosystems establish themselves and evolve over time?

What are the characteristics of the principle terrestrial, aquatic and marine ecosystems?

How does one measure ecosystem productivity?

How does human activity impact ecosystems?

How can we reverse the trend of ecosystem destruction and restore functioning ecosystems?

Water Resources
Global distribution, properties and origin of water

Hydrological cycle and water budget

Water use in the U.S.

Misuse of water

Groundwater and aquifers

Ocean Resources

Inquiry/STEM
What is the distribution and properties of water?

Where did the water come from?

How does water cycle through the environment?

How do we use our water resources in the U.S.?

How has man misused water resources?

What is groundwater?

What are our ocean resources and how does man impact these resources?

Learning Targets:

Earth Systems: Interconnected Spheres of Earth

Biosphere

Biodiversity

Ecosystems (equilibrium, species interactions, stability)

Hydrosphere

Surface and ground water flow patterns and movement

Movement of matter and energy through the hydrosphere, lithosphere, atmosphere and biosphere

Ecosystems

Earth's Resources

Water and water pollution

Wildlife and wilderness

Global Environmental Problems and Issues

Potable water quality, use and availability

Species depletion and extinction

Food production and availability

Cryosphere

Core Ideas/Crosscutting Concepts:

Air Pollution

Big Ideas:

Classification of air pollutants

History of air pollution

Thermal inversions

Sources and health effects of air pollution

Photochemical smog

Clean Air Act

Global air pollution issues

Impacts of Acid Rain

Indoor air pollution
Mold
Formaldehyde
Radon
Asbestos

Sick Building Syndrome

Noise pollution

Essential Questions:

What are the major types of air pollution?

How has air pollution developed over time?

What is a Thermal Inversion?

What causes photochemical smog?

How has the U.S. responded to air pollution?

What are some of the global air pollution issues?

How does Acid Rain form?

What are the sources of Indoor Air Pollution?

What is a Sick Building?

Learning Targets:

Earth's Resources

Air and air pollution

Global Environmental Problems and Issues

Climate change

Air quality

Core Ideas/Crosscutting Concepts:

Atmosphere and Climate

Big Ideas:

Composition and construction of the atmosphere

Weather maps

Pressure Gradient Force and the Coriolis Force

Jet Stream

Factors that determine climate

Changes in climate:
Sun spots, Milankovitch Cycle
El Nino and La Nina
Hurricanes

Changes in climate through Geological history

Greenhouse Effect and Global Warming

Stratigraphic Ozone Layer

Essential Questions:

What is the composition of the atmosphere and how is it structured?

How does one identify weather patterns and how does one interpret weather maps?

What factors create air circulation?

What factors create climate?

What makes climate change?

How does El Nino and La Nina impact climate?

How has climate changed through geological history?

What is the Greenhouse Effect and how does human activity impact global temperatures?

What is the role of the Stratigraphic Ozone Layer and how does human activity impact it?

Learning Targets:

Earth Systems: Interconnected Spheres of Earth

Atmosphere

Atmospheric properties and currents

Hydrosphere

Oceanic currents and patterns (as they relate to climate)

Movement of matter and energy through the hydrosphere, lithosphere, atmosphere and biosphere

Energy transformations on global, regional and local scales

Climate and weather

Earth's Resources

Air and air pollution

Water and water pollution

Global Environmental Problems and Issues

Climate change

Core Ideas/Crosscutting Concepts:

Land Use

Big Ideas:

Current land use in the U.S.

Characteristics of urban areas and suburban sprawl

Land Use Planning

Fundamentals of Smarth Growth

Federal regulations:
CERCLA
SARA
NEPA
Brownfields

Characteristics and profiles of Soils

Desertification and salinization

The Green Revolution

Soil conservation practices

Genetically modified foods

Sustainable forestry

Mineral resources and mining

Government lands

Essential Questions:

How do we use land in the U.S.?

What are the traits of urban land and how did the U.S. develop suburban sprawl?

What are the alternatives to suburban sprawl?

How did federal regulations influence the development of suburban sprawl?

What are the basic characteristics of soil?

What is the relationship between soil and agricultural activities?

What is desertification and salinization and how do humans create these problems?

What is the Green Revolution and what are the consequences?

How can we save our soils?

What is Genetically Modified Food; what are the benefits and what are the risks?

How can we maintain our forests?

What environmental impacts result from mining?

How are our government lands being used?

Learning Targets:

Earth Systems: Interconnected Spheres of Earth

Biosphere

Biodiversity

Earth's Resources

Soil and land

Wildlife and wilderness

Global Environmental Problems and Issues

Sustainability

Species depletion and extinction

Food production and availability

Deforestation and loss of biodiversity

Core Ideas/Crosscutting Concepts:

Energy

Big Ideas:

History of energy use and energy consumption in the U.S.

Energy units and energy loss

Non-renewable resources:
Oil
Natural gas
Coal
Uranium

Renewable resources:
Biomass
Hydropower
Geothermal
Solar
Wind

Batteries (oxidation and reduction) and fuel cells

Essential Questions:

How is energy produced and how is it measured?

How much energy is consumed in the U.S. and how much is consumed globally?

Is energy lost through production and transmission?

What are non-renewable resources?

How is oil found, produced and how much is left?

What is natural gas and does it represent an alternative to oil use?

How much coal reserves does the U.S. possess and what are the environmental drawbacks to using coal?

What is nuclear energy?

What is the difference between fission and nuclear fusion?

What are renewable resources?

How can biomass, solar, wind and geothermal energy assist the U.S. in gaining energy independence?

How do batteries and fuel cells work?

What is the difference between hydrogen fuel cells and methanol fuel cells and what are their potential applications?

Learning Targets:

Movement of matter and energy through the hydrosphere, lithosphere, atmosphere and biosphere

Energy transformations on global, regional and local scales

Earth's Resources

Energy resources

Renewable and nonrenewable energy sources and efficiency

Alternate energy sources and efficiency

Resource availability

Mining and resource extraction

Global Environmental Problems and Issues

Climate change

Core Ideas/Crosscutting Concepts:

Populations

Big Ideas:

Population dynamics and population growth

Carrying capacity

Exponential and logistic growth

Doubling time

Population strategies:
r-select
K-select

Survivorship curves

Human impact on wildlife populations

Human population
Thomas Malthus
Fertility rates
Trends in birth rates
Mortality rates
Infant mortality
Human diseases and pandemics
Population age structure
Global carrying capacity

Essential Questions:

How do populations grow?

What is the concept of carrying capacity?

What is the difference between exponential growth and logistic growth?

How can populations influence the environment?

What are the different strategies organisms use to survive?

How does human activity impact wildlife populations?

What is the current human population how has it grown?

What impact does fertility rates, mortality and population age structure on human population?

What influence do diseases have on human population? What are pandemics?

What is the estimated carrying capacity for the human population?

Ethics and Economics
Economic forces and economic decisions

Different economic approaches

Measuring economics

Economic forces and economic models

Evolution of ethics and the Land Ethic

Environmental treaties and laws
GATT
NAFTA
CITES
Kyoto Accord

What are the economic forces that impact environmental issues?

What are the different types of economies?

How do you measure an economy?

How has economic forces determined the way we treat nature?

What are environmental impacts of selected treaties and laws?

Learning Targets:

Wildlife and wilderness

Global Environmental Problems and Issues

Human population

Sustainability

Species depletion and extinction

Food production and availability

Deforestation and loss of biodiversity

Core Ideas/Crosscutting Concepts:

Solid and Hazardous Waste

Big Ideas:

History of wastes

Classifying wastes, non-hazardous vs. hazardous waste

Federal regulations governing wastes
RCRA
CERLCA
SARA

Methods of solid waste disposal:
Landfill
Incineration
Recycling
Uncontrolled releases of hazardous wastes:
CAP
CERCLIS
NPL

Disposal and treatment options for hazardous waste
Incineration
Secure landfills
Above ground storage
Injection
Detoxification

Mercury-Containing and Rechargeable Battery Act

Nuclear wastes:

High and low levels
Health effects of radiation
Storage and disposal
Yucca Mountain

Essential Questions:

How are wastes different and how are they classified?

What is the difference between non-hazardous and hazardous wastes?

What are the federal regulations governing wastes and waste disposal?

What are the alternatives for the disposal of solid waste?

What happens when there is an uncontrolled release of hazardous waste?

What are the disposal and treatment options for hazardous waste?

How should rechargeable batteries be handled?

What is radioactive waste and how is it generated?

What are the long term health and storage concerns for radioactive waste?

Learning Targets:

Earth's Resources

Soil and land

Global Environmental Problems and Issues

Potable water quality, use and availability

Sustainability

Waste management (solid and hazardous)

Core Ideas/Crosscutting Concepts:

Biodiversity Through Time

Big Ideas:

Diversity and number of species

Estimating past diversity

Review of Geological Time

Mass extinctions and types of extinctions

Human causes of extinction

Lifespan of species

Extinction rates

Endangered species and ESA

Essential questions:

How many species exist today?

How many species have existed in the geological past?

What is the difference between background extinctions and mass extinctions?

What were the causes of mass extinctions?

How long does a species normally live?

What impact do humans have on extinctions?

What are endangered species and how are they protected?

Learning Targets:

Earth's Resources

Wildlife and wilderness

Global Environmental Problems and Issues

Sustainability

Species depletion and extinction

Food production and availability

Deforestation and loss of biodiversity