

CONSERVATION AND SUSTAINABILITY CURRICULUM



Grade Level(s): 11-12

Curriculum Author(s): Melissa Hodges

Course Description: Conservation and Sustainability is designed to cover topics such as fossil fuels, mining, alternative energy sources, climate change, air pollution and water pollution. The student will examine the complexities of solving current environmental problems at local, national and global levels and will provide practical knowledge of environmental issues that will help the student become an informed citizen and decision maker.

Year At A Glance

Unit Title	Overarching Essential Question	Overarching Enduring Understanding	<u>Vision of A Learner “I Can” Statements</u>
Science and the Environment (4 weeks)	What is the relationship between individuals, society, and the environment? How are they all connected?	The environment is a complex web of relationships that connects with us and the world we live in.	TCC2(9-12); TI1(9-12); AA2(9-12); CCE4(9-12)
Water (3 weeks) *Unit should be done when access to the Nonnwaug river is available*	Why is water essential to life on Earth?	Water is essential to all life on Earth.	TCC2(9-12); CCE4(9-12)
Weather and Climate (5 weeks)	What regulates weather and climate?	Climate is the long-term prevailing weather conditions at a particular place based on records taken and has been impacted by human activity.	TCC2(9-12); TI1(9-12); AA2(9-12); CCE1(9-12); CCE4(9-12)
Human Sustainability (6 weeks)	How can humans impact and improve the environment?	There are complex and significant interdependencies between humans and the rest of Earth’s systems through the impacts of natural hazards, our dependencies on natural resources, and the environmental impacts of human activities.	TCC2(9-12); TI1(9-12); AA2(9-12); CCE1(9-12); CCE4(9-12)



Unit 1 - Science and the Environment

Desired Results - Students will understand that the environment is a complex web of relationships that connects with us and the world we live in.

Established Goals:

Common Core State Standards:

RST.9-10.7 - Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words

RST.11-12.2 - Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes

NGSS Standards:

HS-LS2-6 - Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

HS-LS2-7 - Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

HS-ESS3-1 - Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

HS-ESS3-2 - Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

HS-ESS3-3 - Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

Vision of A Learner Attributes: Students will be able to independently use their learning to... (“I can” statements to be demonstrated)

- TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.
- TI1(9-12): I can implement a realistic plan and adapt when necessary to achieve my goals.
- AA2(9-12): I can assess my past successes and mistakes to change my approach.
- CCE4(9-12): I can communicate and express my understanding in an authentic, respectful and relevant way, using the most effective mode of expression.

Understandings: Students will understand that...

- Environmental science is an interdisciplinary study of human interactions with the living and nonliving world.
- Environmental change has occurred throughout Earth’s history.
- Hunter-gatherer societies cleared grassland by setting fires and

Essential Questions:

- Which period of history did humans alter their habitats?
- What effects did the Industrial revolution have on the environment?
- Which countries have a rapidly increasing population?

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<p>may have contributed to the extinction of some large mammals.</p> <ul style="list-style-type: none"> • The major environmental problems we face today are resource depletion, pollution, and loss of biodiversity • Environmental problems in developed countries tend to be related to consumption. In developing nations, the major environmental problems are related to population growth. • Describing how sustainability can be achieved is a primary goal of environmental science. 	<ul style="list-style-type: none"> • What is plastic? • What countries have large ecological footprints? • What time period did most of the environmental problems begin?
<p>Students will know...</p> <ul style="list-style-type: none"> • The Industrial Revolution caused rapid human population growth and the increased use of fossil fuels. Modern environmental problems began during the Industrial Revolution. • The agricultural revolution caused human population growth, habitat loss, soil erosion, and the domestication of plants and animals. • “The Tragedy of the Commons” was an influential essay that describes the relationship between the short-term interests of individuals and the long term interests of society. • The law of supply and demand states that when the demand for a product increases while the supply remains fixed, the cost of the product will increase. 	<p>Students will be able to...</p> <ul style="list-style-type: none"> • Define environmental science, and compare environmental science with ecology. • List the five major fields of study that contribute to environmental science. • Describe the major environmental effects of hunter-gatherers, the agricultural revolution, and the Industrial Revolution. • Distinguish between renewable and nonrenewable resources. • Classify environmental problems into three major categories • Describe “The Tragedy of the Commons.” • Explain the law of supply and demand. • Explain the differences between developed and developing countries. • Explain what sustainability is, and describe why it is a goal of environmental science.
<p>Key Vocabulary: environmental science, ecology, agriculture, natural resource, pollution, biodiversity, law of supply and demand, ecological footprint, sustainability, developing nation, resource depletion, microbiology, climatology, hydrology, sociology, botany, biochemistry, zoology, biodegradable, Spaceship Earth</p>	
<p>Assessment Evidence</p>	
<p>Performance Tasks:</p> <ul style="list-style-type: none"> • Design and Ecosystem Project • Ecology Quiz • Unit 1 Test 	<p>Other Evidence:</p> <ul style="list-style-type: none"> • Food web activity • Active reading textbook activities • Classifying Resources (renewable/nonrenewable)



- Public Service Announcement
- Giant Hogweed Discussion

- Food Chain Gizmo
- Examining Food Packaging
- Tidal Marsh activity
- Developing vs. developed activity

Learning Plan

THINK CRITICALLY AND CREATIVELY

TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.

- Giant Hogweed Discussion

TAKE INITIATIVE

TI1(9-12): I can implement a realistic plan and adapt when necessary to achieve my goals.

- Ecosystem Project research

ADAPT AND ADJUST

AA2(9-12): I can assess my past successes and mistakes to change my approach.

- Active reading activities

COLLABORATE AND COMMUNICATE EFFECTIVELY

CCE4(9-12): I can communicate and express my understanding in an authentic, respectful and relevant way, using the most effective mode of expression.

- Ecosystems Project Presentation
- Public Service Announcement

Teacher Resources:

- Environmental Science Textbook Chapter 3
- Explorelearning.com GIZMOs
- <https://www.earthsciweek.org/classroom-activities>



Unit 2 - Water

Desired Results - Students will understand that water is essential for all life on Earth.

Established Goals:

Common Core State Standards:

RST.9-10.7 - Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words

RST.11-12.2 - Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes

NGSS Standards:

HS-ESS3-1 - Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

HS-ESS3-3 - Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

HS-ESS2-5 - Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes

Vision of A Learner Attributes: Students will be able to independently use their learning to... (“I can” statements to be demonstrated)

- TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.
- CCE4(9-12): I can communicate and express my understanding in an authentic, respectful and relevant way, using the most effective mode of expression.

Understandings: Students will understand that...

- River systems drain in the land that makes up a watershed. The amount of water in a river system can vary in different seasons and from year to year.
- If the water in an aquifer is pumped out faster than it is replenished, the water table drops, which can affect humans and animals that depend on groundwater.
- Dams and water diversion projects are built to manage surface-water resources, but can have environmental and social consequences.

Essential Questions:

- Where is most of the freshwater located on Earth?
- Why is water considered a limited resource?
- Why does pollution in a watershed pose a potential threat to the river system that flows through it?
- How does water travel through rock?
- How do humans affect groundwater?
- How is water treated so that it is drinkable?
- What are the benefits and costs of dams and water diversion projects?

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<ul style="list-style-type: none"> • Water conservation is necessary to maintain an adequate supply of fresh water. Desalination and transporting water are options to supplement local water supplies. • Groundwater pollution is difficult to clean up because aquifers recharge slowly and because pollutants cling to the materials that make up an aquifer. 	<ul style="list-style-type: none"> • Why is point-source pollution easier to control than nonpoint-source pollution? • What are the major types of water pollution? • What are the unique problems to cleaning up groundwater pollution?
<p>Students will know...</p> <ul style="list-style-type: none"> • Only a small fraction of the Earth's water supply is freshwater. • Groundwater accumulates in underground formations called aquifers. Surface water enters an aquifer through the aquifers recharging zone. • There are three main types of water use; residential, industrial, and agricultural. Worldwide, most water use is agricultural. • Water can become polluted by chemical, physical, or biological agents. Most water pollution in the United States is caused by nonpoint-source pollutants. • Ocean pollution is mainly caused by coastal, nonpoint-source pollutants. • Government legislation, such as the Clean Water Act of 1972, has succeeded in reducing surface-water pollution. 	<p>Students will be able to...</p> <ul style="list-style-type: none"> • Describe the distribution of Earth's water resources. • Explain why fresh water is one of Earth's limited resources. • Describe the relationship between groundwater and surface water in a watershed. • Explain how water is treated so it can be used for drinking. • Identify how water is used in homes, in industry, and in agriculture. • Identify five ways that water can be conserved. • Compare point-source pollution and nonpoint source pollution. • Explain why groundwater pollution is difficult to clean. • Describe the major sources of ocean pollution, and explain the effects of pollution on ecosystems. • Describe a major law designed to improve water quality in the US.
<p>Key Vocabulary: surface water, river system, watershed, groundwater, aquifer, porosity, permeability, recharge zone, potable, pathogen, irrigation, dam, reservoir, desalination, water pollution, nonpoint-source pollution, wastewater, artificial eutrophication, thermal pollution, biomagnification</p>	
<p>Assessment Evidence</p>	
<p>Performance Tasks:</p> <ul style="list-style-type: none"> • Water, Water Everywhere Project • River study • Unit 2 test 	<p>Other Evidence:</p> <ul style="list-style-type: none"> • Watershed webquest
<p>Learning Plan</p>	



THINK CRITICALLY AND CREATIVELY

TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.

- Water, Water Everywhere research
- River study

COLLABORATE AND COMMUNICATE EFFECTIVELY

CCE4(9-12): I can communicate and express my understanding in an authentic, respectful and relevant way, using the most effective mode of expression.

- Water, Water Everywhere Project

Teacher Resources:

- Environmental Science Textbook Chapter 11
- Explorelearning.com GIZMOs
- <https://www.earthsciweek.org/classroom-activities>



Unit 3 - Weather and Climate

Desired Results - Students will understand that climate is the long-term prevailing weather conditions at a particular place based on records taken and has been impacted by human activity.

Established Goals:

Common Core State Standards:

RST.9-10.7 - Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words

RST.11-12.2 - Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes

NGSS Standards:

HS-ESS2-4 - Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.

HS-ESS3-5 - Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

Vision of A Learner Attributes: Students will be able to independently use their learning to... ("I can" statements to be demonstrated)

- TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.
- TI1(9-12): I can implement a realistic plan and adapt when necessary to achieve my goals.
- AA2(9-12): I can assess my past successes and mistakes to change my approach.
- CCE1(9-12): I can initiate discussions with my peers and teachers about a variety of topics, respecting differing viewpoints, actively listening to others, and responding thoughtfully with peer-reviewed evidence that is free of bias.
- CCE4(9-12): I can communicate and express my understanding in an authentic, respectful and relevant way, using the most effective mode of expression.

Understandings: Students will understand that...

- Most air pollution comes from vehicles and industry.
- Pollutants released in one geographical area may fall to the ground hundreds of kilometers away as acid precipitation.
- Factors that determine climate include latitude, atmospheric and oceanic circulation patterns, local geography, and solar and volcanic activity.
- Ozone levels measured over the polar regions have been decreasing over the past several decades.

Essential Questions:

- How is air pollution impacting the environment?
- What is currently being done to combat air pollution?
- How does acid precipitation form?
- What impacts is acid precipitation having on the environment?
- How is human activity affecting the climate?
- Why do different parts of the Earth have different climates?
- Why is the ozone layer important?
- What is climate change and how do scientists believe humans

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<ul style="list-style-type: none"> • The thinning of the ozone layer may increase the harmful effects of UV light that reaches the Earth's surface. • The predicted increase in global temperature occurs as a result of increasing greenhouse gasses (water vapor, carbon dioxide, CFCs, methane, and nitrous oxide). • Because climate patterns are complex, scientists continue to use computer models to attempt to predict the rate of global warming. • Global warming could produce a number of potentially serious environmental problems. 	<ul style="list-style-type: none"> • are impacting the climate? • What are the consequences of a warmer Earth?
<p>Students will know...</p> <ul style="list-style-type: none"> • Primary pollutants are pollutants put directly in the air by human activity while secondary pollutants are formed when a primary pollutant comes into contact with other primary pollutants or naturally occurring substances, and a chemical reaction takes place. • Pollution can be trapped near the surface of the Earth by a condition known as temperature inversion. • Acid shock occurs when a sudden influx of acidic water enters a lake or stream and causes a rapid change in pH that harms aquatic life. • Climate represents the long-term prevailing conditions at a particular place based on records taken. • The angle at which the sun's rays strike the Earth changes as the Earth moves around this sun. This change in angle is what causes the seasons to change. • The ozone layer in the Earth's stratosphere absorbs most of the UV light from the sun. • Chlorofluorocarbons are man made chemicals that destroy ozone molecules. Use of these chemicals has decreased. 	<p>Students will be able to...</p> <ul style="list-style-type: none"> • Name primary air pollutants, and give sources for each. • Name major sources of air pollution in urban areas. • Describe how smog forms. • Explain how thermal inversion traps heat. • Explain what causes acid precipitation. • Explain how acid precipitation affects plants, soils and aquatic ecosystems. • Describe how acid precipitation affects humans. • Describe ways that countries are working together to solve the problem of acid precipitation. • Explain the difference between weather and climate. • Identify the factors that determine climate. • Explain why different parts of the Earth have different climates. • Explain what causes the seasons. • Explain how the ozone layer shields the Earth from much of the sun's harmful radiation. • Explain the damage to the ozone layer and how it formed. • Explain the greenhouse effect. • Explain why scientists believe our climate is changing.
<p>Key Vocabulary: air pollution, primary pollutant, secondary pollutant, smog, temperature inversion, acid precipitation, pH, acid shock, climate, El Niño, La Niña, ozone layer, chlorofluorocarbons (CFCs), ozone hole, polar stratospheric clouds, greenhouse gasses, global warming</p>	
<p>Assessment Evidence</p>	



<p>Performance Tasks:</p> <ul style="list-style-type: none"> • The Acid Test lab • Climate Change Project • Unit 3 test 	<p>Other Evidence:</p> <ul style="list-style-type: none"> • Ice Cores: Reconstructing Past Climates • Climate change venn diagram • Graphing Temperature data
<p>Learning Plan</p>	
<p>THINK CRITICALLY AND CREATIVELY TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.</p> <ul style="list-style-type: none"> • The Acid Test Lab <p>TAKE INITIATIVE TI1(9-12): I can implement a realistic plan and adapt when necessary to achieve my goals.</p> <ul style="list-style-type: none"> • Climate change research <p>ADAPT AND ADJUST AA2(9-12): I can assess my past successes and mistakes to change my approach.</p> <ul style="list-style-type: none"> • Graphing temperature data <p>COLLABORATE AND COMMUNICATE EFFECTIVELY CCE1(9-12): I can initiate discussions with my peers and teachers about a variety of topics, respecting differing viewpoints, actively listening to others, and responding thoughtfully with peer-reviewed evidence that is free of bias.</p> <ul style="list-style-type: none"> • Climate change project class discussions <p>CCE4(9-12): I can communicate and express my understanding in an authentic, respectful and relevant way, using the most effective mode of expression.</p> <ul style="list-style-type: none"> • Climate change project 	
<p>Teacher Resources:</p> <ul style="list-style-type: none"> • Environmental Science Textbook Chapters 12 + 13 • Explorelearning.com GIZMOs • https://www.earthsciweek.org/classroom-activities • https://www-tc.pbs.org/ 	

Unit 4 - Human Sustainability



Desired Results - Students will understand there are complex and significant interdependencies between humans and the rest of Earth's systems through the impacts of natural hazards, our dependencies on natural resources, and the environmental impacts of human activities.

Established Goals:

Common Core State Standards:

RST.9-10.7 - Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words

RST.11-12.2 - Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes

NGSS Standards:

HS-ESS3-1 - Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

HS-ESS3-2 - Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

HS-ESS3-4 - Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

HS-ESS3-6 - Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

Vision of A Learner Attributes: Students will be able to independently use their learning to... ("I can" statements to be demonstrated)

- TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.
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- CCE1(9-12): I can initiate discussions with my peers and teachers about a variety of topics, respecting differing viewpoints, actively listening to others, and responding thoughtfully with peer-reviewed evidence that is free of bias.
- CCE4(9-12): I can communicate and express my understanding in an authentic, respectful and relevant way, using the most effective mode of expression.

Understandings: Students will understand that...

- Some environmental consequences of mining may include air and noise pollution, water contamination, displacement of wildlife, erosion and sedimentation, soil degradation, subsidence, and underground mine fires.
- The extraction, transportation and use of fossil fuels cause many environmental problems, including air and water pollution,

Essential Questions:

- How does mining for minerals affect the environment?
- What are the advantages and disadvantages to all energy sources?
- What makes a substance, non recyclable, recyclable or biodegradable?
- Why should we recycle?



<p>habitat destruction, and are thought to be a major contributor to climate change.</p> <ul style="list-style-type: none"> • Nuclear power is a fuel that is compact and the power stations generally do not pollute, however it produces waste that is radioactive. 	
<p>Students will know...</p> <ul style="list-style-type: none"> • Ore minerals are naturally occurring substances with high economic value that form from the cooling of magma, the circulation of hot-water solutions through rocks, and the evaporation of water that contains salts. • Most of the world's energy needs are met by fossil fuels, which are nonrenewable resources. • Nuclear energy is created by bombarding Uranium nuclei with neutrons, which causes fission, releasing large amounts of energy. • Renewable energy sources are forms of energy that are constantly being formed from the sun's energy. • Materials that are biodegradable can be broken down by biological processes. Materials that are not biodegradable, such as plastics, are a major source of disposal problems. • Recycling is the process of reusing materials or recovering valuable materials from waste or scrap. 	<p>Students will be able to...</p> <ul style="list-style-type: none"> • Explain how ore minerals form and why they are important. • Explain the various mineral mining processes. • Explain how fuels are used to generate electricity at a power plant. • Identify patterns of energy consumption and production in the world and in the United States. • Explain how fossil fuels form and how they are used. • Compare the advantages and disadvantages to using all sources of energy (fossil fuels, coal, natural gas, nuclear power, solar energy, wind farms, biomass, geothermal, hydroelectric, tidal power) • Explain how a modern landfill works.
<p>Key Vocabulary: nonrenewable energy, renewable energy, mineral, ore mineral, surface mining, subsurface mining, placer deposit, smelting, subsidence, fossil fuels, petroleum, oil reserves, nuclear energy, nuclear fission, methane (natural gas) nuclear fusion, solar energy, biomass fuel, hydroelectric energy, geothermal energy, wind farm, tidal power, energy efficiency, energy conservation, hydrogen, solid waste, biodegradable, compost</p>	
<p>Assessment Evidence</p>	
<p>Performance Tasks:</p> <ul style="list-style-type: none"> • Your Household Energy Consumption • Energy research project 	<p>Other Evidence:</p> <ul style="list-style-type: none"> • Maps in Action: Mineral Production in the United States • Case study: Paper or Plastic?



- Unit 4 test

Learning Plan

THINK CRITICALLY AND CREATIVELY

TCC2(9-12): I can evaluate evidence from multiple perspectives, and recognize their limitations and implications, in order to justify new conclusions.

- Energy resource research

TAKE INITIATIVE

TI1(9-12): I can implement a realistic plan and adapt when necessary to achieve my goals.

- Energy resource project

ADAPT AND ADJUST

AA2(9-12): I can assess my past successes and mistakes to change my approach.

- Your Household Energy Consumption

COLLABORATE AND COMMUNICATE EFFECTIVELY

CCE1(9-12): I can initiate discussions with my peers and teachers about a variety of topics, respecting differing viewpoints, actively listening to others, and responding thoughtfully with peer-reviewed evidence that is free of bias.

- Energy resource class discussions

CCE4(9-12): I can communicate and express my understanding in an authentic, respectful and relevant way, using the most effective mode of expression.

- Energy resource project presentation

Teacher Resources:

- Environmental Science Textbook Chapters 16-19
- Explorelearning.com GIZMOs
- <https://www.earthsciweek.org/classroom-activities>
- [Energy research projects](#)

