Environmental Science

11 & 12

Course/Subject:	Grade:		Suggested Timeline:
Environmental Science	11 & 12		2-3 weeks

Course Summary	Environmental Science is a multidisciplinary field that draws from all the sciences, as well as other fields, to help us better understand how the world works, as well as the relationship between humans and the world in which we live. Much of Environmental Science is applied science. It applies the principles of pure sciences, such as Earth & Space science and Biology, to help achieve practical goals. Applied environmental science focuses on three main areas: 1) environmental research, 2) conservation and protection of natural resources, and 3) environmental education and communication.
Course Units	1. **Introduction to Environmental Science & Sustainability** 2. Ecosystems: Energy, Patterns, and Disturbance 3. The Human Population 4. Water: The Hydrologic Cycle, Human Use, and Pollution 5. Sustaining Terrestrial and Aquatic Resources 6. Mineral and Energy Resources 7. Environmental Health, Risk, and Toxicology

Unit Title	Introduction to Environmental Science & Sustainability
Unit Summary	Environmental Science is an interdisciplinary study of human interactions with the biotic and abiotic factors of the world. The major environmental problems we face today are resource depletion, pollution, and loss of biodiversity. Describing how sustainability can be achieved is the primary goal of Environmental Science. Sustainability will require cooperation and communication at many levels of society amongst people with varying worldviews.

Unit Essential Question:

1. How do science and values help address environmental issues?

Lesson Essential Questions:

1. What is Environmental Science and how does it address human impact?
2. What is sustainability and how can it help us address environmental problems?
3. How people's personal views and ethics affect how they value the environment?
4. In what ways is environmental impact by humans a global issue?

Key Understandings:

1. Environmental Science includes three goals: to learn how life on Earth has survived and thrived, to understand how humans interact with the environment, to find ways to deal with environmental problems and live more sustainably.
2. Sustainability is comprised of the following factors: solar energy, biodiversity, nutrient cycling, economics, political science, and ethics.
3. Natural capital is comprised of natural resources and ecosystem services. Whether or not sustainability is achieved depends on how humans use natural capital.
4. Humans are living unsustainably by causing natural capital degradation.
5. Every person or group of people produces an ecological footprint, which is equivalent to the land and water needed to produce the natural resources consumed by a person or population and to absorb their wastes.

	6. Major environmental problems are population growth, wasteful and unsustainable resource use, poverty, avoidance of full-cost pricing, increasing isolation from nature, and conflicting environmental worldviews. 7. Living sustainably means living off Earth's natural income without depleting or degrading the natural capital that supplies it.

Focus Standards Addressed in the Unit:	
Standard Number	*Standard Description*
4.1.12.B	Research solutions to problems caused by interrupting natural cycles.
4.1.12.E	Research solutions addressing human impacts on ecosystems overtime.
4.3.12.B	Analyze factors that influence the local, regional, national, and global availability of natural resources.

Important Standards Addressed in the Unit:	
	Reading in Science and Technical Subjects
CC.3.5.11-12.A	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
CC.3.5.11-12.B	Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
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CC.3.5.11-12.G	Integrate and evaluate multiple sources of information presented in diverse formats and media in order to address a question or solve a problem.
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CC.3.5.11-12.I	Synthesize information from a range of sources into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
	Writing in Science and Technical Subjects
CC.3.6.11-12.A	Write arguments focused on *discipline-specific content.*
CC.3.6.11-12.F	Conduct short as well as more sustained research projects to answer a question or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
CC.3.6.11-12.G	Gather relevant information from multiple authoritative print and digital sources; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and over-reliance on any one source and following a standard format for citation.
CC.3.6.11-12.H	Draw evidence from informational texts to support analysis, reflection, and research.
CC.3.6.11-12.I	Write routinely over extended time frames and shorter time frames for a range of discipline-specific tasks, purposes, and audiences.

Misconceptions:	Proper Conceptions:
1. Students may think that the human population will continue to grow at the same rate as it has in recent years. 2. Many students confuse hypotheses with predictions. 3. All information they find on the Internet is factual. 4. There is only one scientific method. 5. Possibility and probability have the same meaning.	1. There is a wide range of estimates of population growth. Students should be aware that population growth estimates are averages of different population growth rates from different regions (some are positive and some are negative). Students should consider, however, that both the number of people and how many resources each person uses affect environmental impacts. Some scientists think the world population is already larger than can be sustained at a high quality of life. 2. A hypothesis is a general statement that offers an explanation of a problem that has been observed. Hypotheses can be supported or contradicted by experimentation. A prediction is based on a hypothesis that is meant to describe what will happen in a scientific situation, such as an experiment. 3. While the Internet is an increasingly important means not only for disseminating scientific results and studies but also for linking relevant studies together, it also offers a lot of misinformation and bias. 4. There is no single "scientific method". Scientist approach problems from a variety of viewpoints. They conduct their research using available tools, data, time, and people. Research often leads scientists to develop new tools and techniques, but the basic *methods* remain unchanged. 5. When something is possible, it can occur. Mathematical probability refers to the likelihood of possible events. For example, it is possible for a tornado to sweep up a winning lottery ticket and drop it gently at your door on your birthday, but it is not probable.

Knowledge & Concepts	Skills & Competencies	Dispositions & Practices
● Understand the link between ecosystem services and natural resources. ● Have knowledge of the content of Earth & Space Science and Biology and begin to understand how that content applies to personal, local, state, federal, and global decisions about society, economics, and the environment.	● Discuss the study of environmental science and its goals. ● Describe the concept of sustainability and its significance to environmental science. ● Discuss the major causes of environmental problems. ● Explain how one's environmental worldview affects one's attitude toward living sustainably. ● Explain the basic difference between preservation and conservation. ● Discuss how people can achieve an environmentally sustainable society.	● Encouraging Inquiry and Curiosity: Modeling, developing, and encouraging students to begin asking and answering questions about their own interactions with the environment.

Academic Vocabulary:		
● Natural capital ● Natural resource	● Environmental degradation ● Environmentalism ● Pollution ● Sustainability	● Bias ● Conflict of interest ● Environmental ethics (preservation and conservation)

		Supplemental Vocabulary ● Anthropocentric (human-centered) worldview ● Biocentric (life-centered) worldview ● Ecocentric (Earth-centered) worldview ● Environmental worldview ● Law of Supply and Demand ● Risk management

Evidence: Assessments and Performance Task(s)

- Various formative assessments including but not limited to:
    - Critical thinking questions/reflections
    - Brief content-specific quizzes throughout the unit
    - Teacher-student "check-ins" on various projects/assignments/laboratory exercises
- Various summative assessments including but not limited to:
    - Section quizzes throughout the unit
    - Laboratory Exercises
    - Case Studies
    - Research, Creative-Design, and Problem-Solving focused projects
    - Unit tests

Interdisciplinary Connections:

- Economics, Political Science, Sociology, Ethics, Biology, Earth and Space Science, Chemistry, Physics

Additional Resources:

- Houghton Mifflin Harcourt Environmental Science and related resources
- National Geographic Learning Environmental Science: Sustaining Your World and related resources
- Macmillan Environment Science: Issues, and Solutions and related resources
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- Globe Fearon Exercise Books: Environmental Science
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- Various models and posters
- Various laboratory equipment
- Community professionals that would be available to present information

Created By:

Nicole Gutacker and Jennifer Isaac

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Course/Subject: Environmental Science	**Grade:** 11 & 12		**Suggested Timeline:** 6-7 weeks

Course Summary	Environmental Science is a multidisciplinary field that draws from all the sciences, as well as other fields, to help us better understand how the world works, as well as the relationship between humans and the world in which we live. Much of Environmental Science is applied science. It applies the principles of pure sciences, such as Earth & Space science and Biology, to help achieve practical goals. Applied environmental science focuses on three main areas: 1) environmental research, 2) conservation and protection of natural resources, and 3) environmental education and communication.
Course Units	1. Introduction to Environmental Science & Sustainability **2. Ecosystems: Energy, Patterns, and Disturbance** 3. The Human Population 4. Water: The Hydrologic Cycle, Human Use, and Pollution 5. Sustaining Terrestrial and Aquatic Resources 6. Mineral and Energy Resources 7. Environmental Health, Risk, and Toxicology

Unit Title	Ecosystems: Energy, Patterns, and Disturbance
Unit Summary	To understand the goals of conservation, we need to take a step back and understand what it is that we are conserving. Reducing environmental impact involves work across many areas, including science, politics, law, and economics. The solutions to protecting Earth's diverse ecosystems can be addressed in our daily lives in many significant ways that collectively make a very big difference.

Unit Essential Question:

1. How can linking ecology and economics help reduce societies' environmental impacts and protect Earth's diverse ecosystems?

Lesson Essential Questions:

1. How do matter and energy move through ecosystems?
2. How do populations grow and how are they regulated?
3. What is the significance of diversity within ecosystems?
4. What types of species have especially great influences on biodiversity?
5. How does biodiversity change during ecological succession?
6. What is the Tragedy of the Commons and the HIPPO Dilemma and how do they impact the environment?
7. Why is biodiversity important and what are some alternative economic approaches to sustainability?

Key Understandings:

1. Matter can undergo physical or chemical changes. The Law of Conservation of Matter states that whenever matter undergoes a physical or chemical change, no atoms are created or destroyed
2. When energy is converted from one form to another in physical or chemical change, no energy is created or destroyed.
3. The flow of energy drives the cycling of matter within Earth's biosphere, geosphere, hydrosphere, and atmosphere.
4. Ecology is the study of how organisms interact with one another and their nonliving environment of matter and energy.
5. A rapidly growing population of any species eventually reaches some size limit imposed by limiting factors such as sunlight, water, temperature, space, nutrients, or exposure to predators or infectious diseases.

	6. Biodiversity is the variety of life on Earth. It provides natural resources and ecosystem services that help build natural capital. 7. Keystone species play critical roles in sustaining ecosystems. Their loss can lead to population crashes and extinctions of other species. Indicator species are those whose presence or absence indicates the quality of certain environmental conditions. 8. Ecological succession occurs when the composition of a community or ecosystem changes in response to changing environmental conditions. 9. Human-related activities that hasten extinction include: habitat destruction, degradation, and fragmentation; spread of invasive species; population growth; pollution; and overexploitation. 10. One key to protecting wild species and biodiversity is protecting areas where they live.

Focus Standards Addressed in the Unit:	
Standard Number	*Standard Description*
4.1.12.A	Analyze the significance of biological diversity in an ecosystem. Explain how species adapt to limiting factors in an ecosystem. Analyze the differences between natural causes and human causes of extinction. Research wildlife management laws and their effects on biodiversity.
4.1.10.B	Explain the consequences of interrupting natural cycles.
4.1.12.C	Research how humans affect energy flow within an ecosystem. Describe the impact of industrial, agricultural, and commercial enterprises on an ecosystem.
4.5.10.D	Research practices that impact biodiversity in specific ecosystems. Analyze the relationship between habitat changes to plant and animal population fluctuations.
4.1.10.E	Analyze how humans influence the pattern of natural changes in ecosystems over time.

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Misconceptions:	**Proper Conceptions:**
1. "Survival of the Fittest" means that when two organisms fight each other to survive, the 'fittest' one will win the contest. 2. "Biome" and "ecosystem" are synonyms. 3. Populations are difficult to contain. 4. Population change includes migration. 5. "Niche" and "habitat" are synonyms. 6. Scientists know how many species we have on Earth. 7. "Keystone" and "flagship species" are synonyms.	1. The 'fittest' individual (the one that survives to pass on the greatest number of genes) is the one most adapted to its current or changing environment. 2. A biome and ecosystem are defined by the abiotic and biotic factors and by the types of interactions among organisms that live in each. The biosphere is divided into biomes, which are divided into smaller and more specific ecosystems. 3. A population is only those members of a species that actually are capable of interbreeding. Because they are in constant flux (as individuals reproduce, die, or migrate in or out of a given area), population refers to the number of species within a defined area at a given time. 4. Populations increase by births or through immigration and decrease by deaths or emigration. 5. Scientists define niches based on the ecological role of a species or the interactions (primarily feeding interactions) it has with other organisms. 6. There is no reasonable way to count all of the species on Earth, but scientists have developed systems for making educated guesses. The most recent estimates are that there are around 9 million species of eukaryotes. The number of prokaryotes has yet to be well-defined. 7. A keystone species is one whose effect on its ecosystem is greater than you would assume given its mass or abundance. A flagship species, such as the panda bear, is one that is well-known and popular.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**
● Understand how nutrients cycle and energy flows through ecosystems. ● Understand how the species composition of a community or ecosystem can change. ● Understand how biodiversity relates to natural capital.	● Identify the different ways in which energy and matter are transformed in an ecosystem. ● Explain how human activities impact nutrient cycles in ecosystems. ● Explain how species compete with one another for certain resources.	● Encouraging Inquiry and Curiosity: Modeling, developing, and encouraging students to begin asking and answering questions about their own interactions with the environment.

● Understand how threats to keystone species and indicator species in turn threaten the ecosystem they inhabit. ● Understand how invasive species disrupt ecosystems.	● Explain how biodiversity leads to more resilient ecosystems. ● Discuss how human population growth and activities lead to habitat fragmentation and increase wild species extinctions.	

Academic Vocabulary:

● Biogeochemical cycle ● Bioaccumulation ● Biomagnification ● Nitrogen-fixing bacteria *Review Vocabulary:* ● Autotroph ● Conversation of Matter ● Heterotroph ● Trophic level	● Ecosystem diversity ● Genetic diversity ● K-selected species ● r-selected species ● Species diversity *Review Vocabulary:* ● Biodiversity ● Carrying capacity ● Limiting Factor	● Generalist species ● Indicator species ● Keystone species ● Native species ● Nonnative species ● Specialist species *Review Vocabulary:* ● Ecological succession ● Primary succession ● Secondary succession	● Ecotourism ● Endangered Species ● Extinct Species ● Invasive species ● Overexploitation ● Pollution *Supplemental Vocabulary* ● Gross primary productivity (GPP) ● Interspecific competition ● Intraspecific competition ● Net primary productivity (NPP) ● Range of tolerance ● Resource partitioning

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Unit Title	The Human Population
Unit Summary	This unit builds on basic concepts of population ecology, extending into the more complicated human context. Predicting and managing human population growth has become more challenging in recent centuries. However, some patterns can be seen in the economic and political development of different countries.

Unit Essential Questions:

1. How can we achieve sustainable human populations?

Lesson Essential Questions:

1. How does the human population change?
2. What is the general relationship between the human population, societal development, and **environmental impact**?
3. How do we transition to sustainable human populations?

Key Understandings:

1. Population change is the total number of people entering an area during a specific time (fertility/natality or immigration) subtracted by the number of people leaving it during that time (mortality or emigration).
2. Three trends related to human population growth are: the growth rate has slowed since 1960; the growth is distributed unevenly; and large numbers of people have moved from rural to urban areas.
3. A population's age structure is based on the percentages or numbers of males and females in the total population by age. Age structure affects how fast a population grows or declines, and it differs between more- and less-developed countries.
4. Population growth can be slowed by promoting economic development (reducing poverty), empowering women, and promoting family planning.
5. Trends related to urban populations include: the percentage of the global population living in urban areas has grown sharply,

	and growth is expected to continue; the number of urban areas is growing; and poverty is becoming increasingly urbanized. 6. While urbanization has economic and environmental advantages, it also has disadvantages. Most cities are unsustainable because of high levels of resource use, waste, pollution, and poverty. 7. Eco-friendly cities (eco-cities) enable people to choose walking, biking, or mass transit for most transportation needs. Eco-cities recycle or reuse most of their wastes, grow most of their food, and protect biodiversity by preserving surrounding land.

Focus Standards Addressed in the Unit:	
Standard Number	*Standard Description*
4.1.12.C	Research how humans affect energy flow within an ecosystem. Describe the impact of industrial, agricultural, and commercial enterprises on an ecosystem.
4.1.10.E	Analyze how humans influence the pattern of natural changes in ecosystems over time.
4.3.12.A	Explain how consumption rate affects the sustainability of resource use.
4.3.12.B	Analyze factors that influence local, regional, national, and global availability of natural resources. Compare the use of natural resources in different countries. Analyze the social, economic, and political factors that affect the distribution of natural resources.
4.5.12.A	Research how technology influences the sustainable use of natural resources.

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Misconceptions:	**Proper Conceptions:**
1. A population should stop growing when total fertility rates are declining or low. 2. All developing regions have high population densities because they have high fertility rates. 3. The concepts "population size", "population growth rates", and "population density" are the same. 4. Fertility is said to be at "replacement-level" when couples have just enough children to replace the adults in the population.	1. There is a delay of approximately twenty years (one generation) before a group of kids grows up and begins having their own children (and thus contributing to the fertility rate). 2. Some of the least developed countries have the lowest population densities, partially due to high death rates and unproductive land. Africa has an average population density of 66 people per square mile, while the UK has a population density of 634 people per square mile. 3. Large populations-as well as small ones-may have a high growth rate, a low growth rate, or a zero growth rate. The growth rate is not necessarily dependent on the size of the population, unless the population has reached the carrying capacity of the environment. Population density is measured over a defined area so that one can compare the population size and densities of different countries. 4. Replacement-level is higher than two children because not all females survive through their childbearing years and because there are slightly more males than females born. In the more-developed countries, where infant and child mortality are low, replacement level is about 2.1 children per couple. In countries with higher mortality rates, more children are needed to "replace" the population.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**
● Recognize the plight of poor people in urban areas.	● Identify trends in human population growth. ● Calculate population change. ● Identify total fertility rate as a key factor affecting human population growth or decline. ● Describe the effect of age structure on a population's growth rate. ● Discuss ways to slow human population growth. ● Describe trends in urbanization and the effects of urban sprawl. ● Explain the advantages and disadvantages of urbanization. ● Describe the eco-city concept.	● Encouraging Inquiry and Curiosity: Modeling, developing, and encouraging students to begin asking and answering questions about their own interactions with the environment.

Academic Vocabulary:

- Demography
- Emigration
- Endemic
- Epidemic
- Fertility rate
- Immigration
- Migration
- Pandemic
- Affluence
- Age structure
- Ecological footprint
- Infrastructure
- Longevity
- Megaregion
- Mortality
- Natality
- Urbanization
- Urban sprawl
- Demographic transition
- Eco-city
- Smart growth

Supplemental Vocabulary:

- IPAT equation

Evidence: Assessments and Performance Task(s)

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Unit Title	Water: The Hydrologic Cycle, Human Use, and Pollution
Unit Summary	Although there is an abundance of water on Earth, only a small percentage is freshwater suitable for human use. Pollution and misuse has caused fresh water to become one of our most threatened resources. Many of the world's rivers, lakes, oceans, and aquifers are contaminated with industrial chemicals, agricultural runoff, and sewage. Damage to a water ecosystem can be immediate and widespread, and attempts to clean up water pollution make take a very long time to succeed.

Unit Essential Questions:

1. How can we meet human needs for freshwater while avoiding or reducing environmental impact?

Lesson Essential Questions:

1. How does the hydrologic cycle move water around Earth?
2. What is the current state of groundwater and what affects its availability?
3. How do humans use water and what are factors that affect water's availability?
4. What are some water conservation approaches and how do they affect water availability?

Key Understandings:

1. Humans and other species need fresh water to survive. The availability of freshwater is not only an environmentals issue; it also affects global health, economics, and security.
2. Supplies of freshwater are not evenly distributed, and many people lack access to clean water. Even where large freshwater supplies exist, they are often poorly managed.
3. Because they flow, streams and rivers can recover from pollutants more easily than stationary lakes and reservoirs.
4. Because groundwater takes so long to cleanse itself and is so costly to clean, prevention of pollution is the only feasible way to deal with groundwater contamination.
5. Sustainable ways to reduce water pollution include reducing soil erosion from farms and using organic farming methods, government regulation of polluters and policies that promote pollution prevention or reduction, sewage treatment, and individual efforts.

Focus Standards Addressed in the Unit:	
Standard Number	*Standard Description*
4.1.12.B	Research solutions to problems caused by interrupting natural cycles.
4.1.12.C	Describe the impact of industrial, agricultural, and commercial enterprises on an ecosystem.
4.1.12.E	Research solutions addressing human impacts on ecosystems over time.
4.2.12.A	Examine environmental laws related to land use management and its impact on the water quality and flow within a watershed.
4.2.12.C	Analyze the effects of policies and regulations at various governmental levels on water quality. Assess the intended and unintended effects of public policies and regulations relating to water quality.
4.5.12.C	Analyze the costs and benefits of means to control pollution. Analyze the role of technology in the reduction of pollution. Research and analyze the local, state, and national laws that deal with point and non-point source pollution.

Important Standards Addressed in the Unit:	
	Reading in Science and Technical Subjects
CC.3.5.11-12.A	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
CC.3.5.11-12.B	Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
CC.3.5.11-12.C	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
CC.3.5.11-12.F	Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.
CC.3.5.11-12.G	Integrate and evaluate multiple sources of information presented in diverse formats and media in order to address a question or solve a problem.
CC.3.5.11-12.H	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
CC.3.5.11-12.I	Synthesize information from a range of sources into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
	Writing in Science and Technical Subjects
CC.3.6.11-12.A	Write arguments focused on *discipline-specific content.*
CC.3.6.11-12.F	Conduct short as well as more sustained research projects to answer a question or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
CC.3.6.11-12.G	Gather relevant information from multiple authoritative print and digital sources; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and over-reliance on any one source and following a standard format for citation.
CC.3.6.11-12.H	Draw evidence from informational texts to support analysis, reflection, and research.
CC.3.6.11-12.I	Write routinely over extended time frames and shorter time frames for a range of discipline-specific tasks, purposes, and audiences.

Misconceptions:	Proper Conceptions:
1. The water cycle only involves the transformation of water through its phases. 2. "Consumption" and "withdrawal" describe the same process. 3. Waterborne diseases are only a problem in developing countries.	1. Plants and soil are also part of the water cycle. Plants move water through the water cycle as they draw liquid water from the ground and transpire, or release water vapor through leaf pores. Water also evaporates from the plants after transpiration. 2. All water that is used by humans is withdrawn. What that has been withdrawn and is no longer available for reuse- because it has been evaporated or used by people, animals, or plants- has been consumed. 3. Despite elaborate wastewater purification systems, outbreaks still occur in developed countries. In 1993, there was a *Cryptosporidium* outbreak in Milwaukee, which affected over 400,000 people.

Knowledge & Concepts	Skills & Competencies	Dispositions & Practices
● Understand the benefits and problems associated with dams and reservoirs.	● Explain the importance of fresh water. ● Explain the causes and effects of freshwater scarcity. ● Explain the harmful effects of aquifer depletion. ● Discuss the problems associated with water transfer and desalination. ● Describe ways to reduce freshwater losses. ● Compare and contrast point and nonpoint sources of water pollution and their effects on the environment. ● Discuss sustainable ways to reduce or eliminate water pollution.	● Encouraging Inquiry and Curiosity: Modeling, developing, and encouraging students to begin asking and answering questions about their own interactions with the environment.

Academic Vocabulary:

● Aquifer ● Permeability ● Porosity ● Recharge zone ● River system ● Watershed ● Water table ● Zone of saturation *Review Vocabulary:* ● Groundwater ● Hydrologic cycle ● Surface water	● Aqueducts ● Dam ● Desalination ● Pathogen ● Potable ● Reservoir ● Subsidence ● Wastewater (nonpotable) ● Wastewater Treatment	● Artificial eutrophication ● Drip irrigation ● Flood irrigation ● Gray water ● Nonpoint-source pollution ● Point-source pollution ● Thermal pollution ● Water pollution *Review Vocabulary:* ● Biomagnification

Evidence: Assessments and Performance Task(s)

- Various formative assessments including but not limited to:

    - Critical thinking questions/reflections
    - Brief content-specific quizzes throughout unit
    - Teacher-student “check-ins” on various projects/assignments/laboratory exercises
- Various summative assessments including but not limited to:
    - Section quizzes throughout the unit
    - Laboratory Exercises
    - Case Studies
    - Research, Creative-Design, and Problem-Solving focused projects
    - Unit Tests

Interdisciplinary Connections:

- Economics, Political Science, Sociology, Ethics, Biology, Earth and Space Science, Chemistry, Physics

Additional Resources:

- Houghton Mifflin Harcourt Environmental Science and related resources
- National Geographic Learning Environmental Science: Sustaining Your World and related resources
- Macmillan Environment Science: Issues, and Solutions and related resources
- Facing the Future: Big World, Small Planet and related resources
- Globe Fearon Exercise Books: Environmental Science
- Globe Fearon Environment and Ecology for Pennsylvania and related resources
- Various models and posters
- Various laboratory equipment
- Community professionals that would be available to present information

Created By:

Nicole Gutacker and Jennifer Isaac

			Environmental Science **11 & 12**
Course/Subject: Environmental Science	**Grade:** 11 & 12		**Suggested Timeline:** 4-5 weeks

Course Summary	Environmental Science is a multidisciplinary field that draws from all the sciences, as well as other fields, to help us better understand how the world works, as well as the relationship between humans and the world in which we live. Much of Environmental Science is applied science. It applies the principles of pure sciences, such as Earth & Space science and Biology, to help achieve practical goals. Applied environmental science focuses on three main areas: 1) environmental research, 2) conservation and protection of natural resources, and 3) environmental education and communication.
Course Units	1. Introduction to Environmental Science & Sustainability 2. Ecosystems: Energy, Patterns, and Disturbance 3. The Human Population 4. Water: The Hydrologic Cycle, Human Use, and Pollution **5. Sustaining Terrestrial and Aquatic Resources** 6. Mineral and Energy Resources 7. Environmental Health, Risk, and Toxicology

Unit Title	Sustaining Terrestrial and Aquatic Resources
Unit Summary	Humans use land for many purposes, including farmland to grow crops, rangeland to feed livestock, forest land for wood, cities to live and conduct business, and parks for recreational enjoyment. Understanding these uses and their implications can make us better stewards of our environment. Fisheries and aquaculture products are a major part of the diets of people around the world. Demand for them continues to increase, creating even more pressures on marine and freshwater environments already threatened by overexploitation. One way that each of us can help foster more sustainable use of these resources is by making informed choices.

Unit Essential Questions:
1. How can we produce food and forest products while minimizing environmental impact?
2. Can we sustainably manage fisheries and aquaculture?

Lesson Essential Questions
1. How do we currently use land to produce products and how can we change this to use Earth's resources more sustainably?
2. How can sustainable farming, forestry, and ranching practices reduce soil losses and improve soil fertility?
3. What is Integrated Pest Management and what are its benefits?

Key Understandings:
1. Obstacles to providing enough nutritious food for the world's growing population include lack of nutrition information, poverty, war, bad weather, climate change, and the harmful effects of industrialized food production.
2. The three agricultural systems that provide most of the world's food are (1) croplands, (2) rangelands, and (3) fisheries and aquaculture.
3. Environmental problems from food production include soil erosion, biodiversity loss, air pollution, water pollution, and threats to human health.
4. To create and maintain food security, society must manage pests. This includes the use of natural and synthetic pesticides

4. In what ways does aquaculture affect the aquatic environment and wild fish populations? 5. What management strategies and tactics are being used to make harvests of aquatic resources more sustainable and reduce environmental impacts?	and managing the environmental and health impacts of using such chemicals. 5. More sustainable food production can be achieved with Integrated Pest Management. 6. To make food production more sustainable, society must reduce erosion, increase soil fertility, maintain integrity of aquatic ecosystems, and improve the production of animal products. Other measures are to train farmers in sustainable practices, establish enforceable laws and guidelines to govern food production, and educate consumers about how food is produced and how it can be produced more sustainably.

Focus Standards Addressed in the Unit:	
Standard Number	*Standard Description*
4.1.12.B	Research solutions to problems caused by interrupting natural cycles.
4.1.12.C	Describe the impact of industrial, agricultural, and commercial enterprises on an ecosystem.
4.4.12.A	Research and analyze the social, political, economic, and environmental factors that affect agricultural systems.
4.4.10.C	Analyze how agricultural sciences and technologies strive to increase efficiency while balancing the needs of society with the conservation of our natural resources.
4.4.10.D	Evaluate the use of technologies to increase plant and animal productivity.
4.5.10.B	Describe the impact of Integrated Pest Management practices on the environment.

Important Standards Addressed in the Unit:	
	Reading in Science and Technical Subjects
CC.3.5.11-12.A	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
CC.3.5.11-12.B	Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
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CC.3.5.11-12.F	Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.
CC.3.5.11-12.G	Integrate and evaluate multiple sources of information presented in diverse formats and media in order to address a question or solve a problem.
CC.3.5.11-12.H	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
CC.3.5.11-12.I	Synthesize information from a range of sources into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
	Writing in Science and Technical Subjects
CC.3.6.11-12.A	Write arguments focused on *discipline-specific content.*
CC.3.6.11-12.F	Conduct short as well as more sustained research projects to answer a question or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

CC.3.6.11-12.G	Gather relevant information from multiple authoritative print and digital sources; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and over-reliance on any one source and following a standard format for citation.
CC.3.6.11-12.H	Draw evidence from informational texts to support analysis, reflection, and research.
CC.3.6.11-12.I	Write routinely over extended time frames and shorter time frames for a range of discipline-specific tasks, purposes, and audiences.

Misconceptions:	**Proper Conceptions:**
1. Agriculture = Agribusiness 2. Genetically modified (GM) crops are only used for grocery foods.	1. There were more than six million farms in the U.S. at the end of World War II. Today, there are less than two million farms, and it has been largely small farms that have been replaced by large-scale agribusinesses. Agribusinesses combine all of the functions that the term agriculture has traditionally denoted, and can be defined as including all of the activities that take place in the production, distribution, wholesale and retail sales of a commodity. In agribusiness farming, an owner or company will purchase a row of "suitcase" farms and send large machinery and crews of migrant farmers from one farm to the next. A major downside of agribusiness is their heavy reliance on pesticides and large machines that run fossil fuels. 2. GM crops are used as ingredients for medicines and industrial products, such as cosmetics, personal health care, biodegradable plastics, and biofuels. Animal and microbial genes are being spliced into plants, and vice versa. GM pets and livestock are also being researched.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**
● Understand the pros and cons of crossbreeding and genetic engineering in food production. ● Understand how environmental issues impact food production and, therefore, food security. ● Understand why pests need to be managed to ensure food security. ● Recognize that sustainable solutions to agriculture must conserve soil, water, and energy.	● Identify the major systems used to produce food. ● Describe how food production contributes to environmental issues. ● Discuss the trade-offs of synthetic pesticides. ● Explore alternative, more sustainable ways to manage agricultural pests. ● Identify a variety of solutions to produce crops and animal products sustainably.	● Encouraging Inquiry and Curiosity: Modeling, developing, and encouraging students to begin asking and answering questions about their own interactions with the environment.

Academic Vocabulary:

● Deforestation ● Ecosystem services ● Geographic Information System (GIS) ● Land-use planning ● Reforestation ● Overgrazing	● Agriculture ● Desertification ● Famine ● Integrated Pest Management ● Malnutrition ● Overharvesting ● Pesticide	● Aquaculture ● Bycatch ● Commercial fishing ● Ecosystem-based management ● Maximum sustainable yield (MSY) ● Subsistence fishing

	● Salinization	

Evidence: Assessments and Performance Task(s)

- Various formative assessments including but not limited to:
  - Critical thinking questions/reflections
  - Brief content-specific quizzes throughout unit
  - Teacher-student "check-ins" on various projects/assignments/laboratory exercises
- Various summative assessments including but not limited to:
  - Section quizzes throughout the unit
  - Laboratory Exercises
  - Case Studies
  - Research, Creative-Design, and Problem-Solving focused projects
  - Unit Tests

Interdisciplinary Connections:

- Economics, Political Science, Sociology, Ethics, Biology, Earth and Space Science, Chemistry, Physics

Additional Resources:

- Houghton Mifflin Harcourt Environmental Science and related resources
- National Geographic Learning Environmental Science: Sustaining Your World and related resources
- Macmillan Environment Science: Issues, and Solutions and related resources
- Facing the Future: Big World, Small Planet and related resources
- Globe Fearon Exercise Books: Environmental Science
- Globe Fearon Environment and Ecology for Pennsylvania and related resources
- Various models and posters
- Various laboratory equipment
- Community professionals that would be available to present information

Created By:
Nicole Gutacker and Jennifer Isaac

			Environmental Science **11 & 12**
Course/Subject: Environmental Science	**Grade:** 11 & 12		**Suggested Timeline:** 6-7 weeks

Course Summary	Environmental Science is a multidisciplinary field that draws from all the sciences, as well as other fields, to help us better understand how the world works, as well as the relationship between humans and the world in which we live. Much of Environmental Science is applied science. It applies the principles of pure sciences, such as Earth & Space science and Biology, to help achieve practical goals. Applied environmental science focuses on three main areas: 1) environmental research, 2) conservation and protection of natural resources, and 3) environmental education and communication.
Course Units	1. Introduction to Environmental Science & Sustainability 2. Ecosystems: Energy, Patterns, and Disturbance 3. The Human Population 4. Water: The Hydrologic Cycle, Human Use, and Pollution 5. Sustaining Terrestrial and Aquatic Resources **6. Mineral and Energy Resources** 7. Environmental Health, Risk, and Toxicology

Unit Title	Mineral and Energy Resources
Unit Summary	Minerals that are economically valuable are mined through surface and subsurface mining techniques. In the United States, product and energy consumption patterns produce a great demand for minerals and fuels in the transportation, industrial, residential, and commercial sectors. Our choice of fuels and our dependence on them has economic, environmental, and political consequences. Renewable energy resources can reduce our dependence on nonrenewable resources.

Unit Essential Questions:

1. How can we manage nonrenewable energy resources in a way that reduces environmental harm and can we develop renewable energy resources to help sustain a thriving economy without adversely affecting the environment?

Lesson Essential Questions:

1. How do geological processes relate to society and the environment?
2. How can society use mineral resources sustainably?
3. What is the nature of global energy consumption?
4. What are the advantages and disadvantages of using fossil fuels?
5. What are the advantages and disadvantages of using nuclear power?
6. What are the environmental and societal impacts of renewable energy?

Key Understandings:

1. Mineral resources exist in finite amounts and can be economically depleted when it costs more than they are worth to find, extract, and process them. There are several ways to extend supplies of mineral resources, but each are limited by economic and environmental factors.
2. Extracting minerals from Earth's crust and converting them to useful products disturbs the land, erodes soils, produces large amounts of solid waste, and may pollute the air, water, and soil.
3. Reducing or ending mining subsidies and increasing subsidies for reuse, recycling, and finding substitutes can enhance sustainability of mineral resources.
4. About 90% of the world's commercial energy comes from nonrenewable resources- 86% from carbon-containing fossil fuels and 4% from nuclear power.

	5. There are economical and environmental advantages and disadvantages to using oil, natural gas, coal, and nuclear power. 6. Renewable energy resources- solar, wind, hydropower, geothermal heat, biomass, biofuel, and hydrogen fuel- reduce dependence on fossil fuels and reduce harmful environmental impacts. 7. Making the transition to a more sustainable energy future will require greatly improving energy efficiency, using a mix of renewable energy resources, and including the environmental and health costs of energy market prices. Decarbonization, or a shift away from fossil fuel use, is key to stabilizing Earth's climate.

Focus Standards Addressed in the Unit:	
Standard Number	*Standard Description*
4.3.12.A	Evaluate the advantages and disadvantages of using renewable and nonrenewable resources. Explain how consumption rate affects the sustainability of resource use. Evaluate the advantages and disadvantages of using renewable resources such as solar power, wind power, and biofuels.
4.3.12.B	Analyze factors that influence the local, regional, national, and global availability of natural resources. Compare the use of natural resources in different countries. Analyze the social, economic, and political factors that affect the distribution of natural resources (i.e. wars, political systems, classism, racism).
4.5.12.A	Research how technology influences the sustainable use of natural resources. Analyze how consumer demands drive the development of technology enabling the sustainable use of natural resources.

Important Standards Addressed in the Unit:	
	Reading in Science and Technical Subjects
CC.3.5.11-12.A	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
CC.3.5.11-12.B	Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
CC.3.5.11-12.C	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
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CC.3.5.11-12.G	Integrate and evaluate multiple sources of information presented in diverse formats and media in order to address a question or solve a problem.
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CC.3.5.11-12.I	Synthesize information from a range of sources into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
	Writing in Science and Technical Subjects
CC.3.6.11-12.A	Write arguments focused on *discipline-specific content.*

CC.3.6.11-12.F	Conduct short as well as more sustained research projects to answer a question or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
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CC.3.6.11-12.H	Draw evidence from informational texts to support analysis, reflection, and research.
CC.3.6.11-12.I	Write routinely over extended time frames and shorter time frames for a range of discipline-specific tasks, purposes, and audiences.

Misconceptions:	**Proper Conceptions:**
1. The United States only imports oil. 2. Most imported oil comes from the Middle East or the Persian Gulf. 3. Oil exists underground in large lakes or pools. 4. A nuclear power plant will explode like an atomic bomb if the reaction is uncontrolled. 5. The byproducts of nuclear fission do not remain radioactive forever. 6. Renewable energy does not harm the environment. 7. Increasing fossil fuel production is the only way to meet growing energy needs. 8. Making a home energy efficient is expensive.	1. The U.S. relies on imported oil for about half of its oil consumption. Oil moves freely across the globe so the U.S. exports as well as imports oil. This means that oil prices are most influenced by total, global production. Speculation and refining capacity also influence the price of fuel. 2. Canada is the largest single exporter of oil to the U.S., providing 25% of total U.S. oil imports in 2011. After Canada, the largest oil exporters to the U.S. were Saudi Arabia, Mexico, and Venezuela. The oil from these countries accounted for 38% of U.S. oil imports. 3. Most oil is trapped inside the rock in tiny spaces, called pores. The word *petroleum* literally means "rock oil" in Latin. 4. Atomic bombs use different fuel from that used in power plants. Weapons-grade uranium is over 90% pure uranium compared to 3.5% pure uranium in commercial fuel rods. The uranium fuels rods may melt, but they cannot explode. 5. After the fission reaction, the waste products give off thermal energy and radioactivity, cooling down and gradually becoming less hazardous. The amount of time this takes varies from minutes to thousands of years depending on the element. 6. There are environmental consequences associated with any form of energy. For example, toxic substances are used in the manufacture of photovoltaic cells, and the battery systems that store the energy use toxic heavy metals such as lead. 7. Small improvements in energy efficiency can lead to huge decreases in fuel use. For example, the Rocky Mountain Institute estimates the proposed extraction of 3.2 billion barrels of oil from the Arctic National Wildlife Refuge in Alaska would be unneccessary if cars and light trucks driven in the U.S. were 0.4% miles per gallon more efficient. 8. Although some measures, such as the purchase of new appliances, are expensive, many are free or inexpensive. It costs nothing to turn off unused lights, clean refrigerator coils, or air-dry clothes.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**

● Understand that Earth's dynamic processes produce important benefits as well as potential threats. ● Have knowledge of the difference between minerals and rocks and how they are formed during the rock cycle. ● Understand the advantages and disadvantages of using fossil fuels for energy. ● Understand how a nuclear fission reaction works, and describe the nuclear fuel cell. ● Understand the advantages and disadvantages of each source of renewable energy.	● Describe how mineral resources can become economically depleted. ● Explain how market prices affect mineral supplies. ● Describe the major types of mining and their harmful environmental effects. ● Explain how mineral resources can be used more sustainably. ● Identify the types of nonrenewable energy resources. ● Discuss oil, natural gas, and coal as commercial energy sources. ● Explain the advantages and disadvantages of using nuclear power. ● Define energy efficiency and explain what makes a device energy efficient. ● Describe ways to improve energy efficiency with regard to industry, transportation, and home building. ● Explain why renewable energy resources have not been more widely adopted. ● Identify the challenges associated with transitioning to a more sustainable energy future.	● Encouraging Inquiry and Curiosity: Modeling, developing, and encouraging students to begin asking and answering questions about their own interactions with the environment.

Academic Vocabulary:

● Materials revolution ● Placer deposit ● Reclamation ● Reserve ● Smelting ● Strip mining ● Subsidence ● Subsurface mining ● Surface mining *Review Vocabulary:* ● Ore mineral	● Crude oil ● Fossil fuels ● Hydraulic fracturing ● Natural gas ● Net energy ● Nonrenewable energy/resource ● Oil reserves ● Petrochemical *Review Vocabulary:* ● Nuclear fission ● Nuclear fusion	● Active solar heating ● Alternative energy ● Biofuel ● Biomass ● Decarbonization ● Energy conservation ● Energy efficiency ● Hydroelectric energy ● Hydrogen fuel cell ● Geothermal energy ● Renewable energy/resource ● Passive solar heating *Supplemental Vocabulary:* ● Nanotechnology

Evidence: Assessments and Performance Task(s)

- Various formative assessments including but not limited to:
  - Critical thinking questions/reflections
  - Brief content-specific quizzes throughout unit
  - Teacher-student "check-ins" on various projects/assignments/laboratory exercises
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- Research, Creative-Design, and Problem-Solving focused projects
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Interdisciplinary Connections:

- Economics, Political Science, Sociology, Ethics, Biology, Earth and Space Science, Chemistry, Physics

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- Globe Fearon Exercise Books: Environmental Science
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- Various models and posters
- Various laboratory equipment
- Community professionals that would be available to present information

Created By:

Nicole Gutacker and Jennifer Isaac

			Environmental Science **11 & 12**
Course/Subject: Environmental Science	**Grade:** 11 & 12		**Suggested Timeline:** 6-7 weeks

Course Summary	Environmental Science is a multidisciplinary field that draws from all the sciences, as well as other fields, to help us better understand how the world works, as well as the relationship between humans and the world in which we live. Much of Environmental Science is applied science. It applies the principles of pure sciences, such as Earth & Space science and Biology, to help achieve practical goals. Applied environmental science focuses on three main areas: 1) environmental research, 2) conservation and protection of natural resources, and 3) environmental education and communication.
Course Units	1. Introduction to Environmental Science & Sustainability 2. Ecosystems: Energy, Patterns, and Disturbance 3. The Human Population 4. Water: The Hydrologic Cycle, Human Use, and Pollution 5. Sustaining Terrestrial and Aquatic Resources 6. Mineral and Energy Resources **7. Environmental Health, Risk, and Toxicology**

Unit Title	Environmental Health, Risk, and Toxicology
Unit Summary	Society produces many different kinds of solid wastes, and theses wastes must be disposed of properly. Producing less waste, recycling, buying recycled products, composting, and changing the types of materials we use can help alleviate the waste problem. Human health is affected by environmental conditions. Some human health problems are directly related to natural and human-produced pollution caused by the improper disposal of waste. Environmental decision-making occurs at the level of the individual, the community, state or national government, or internationally.

Unit Essential Questions:

1. What is the relationship between the environment and human health and how can we manage that relationship?

Lesson Essential Questions:

1. How does "waste" generated by economic systems compare to waste in natural systems?
2. What is the focus of modern waste management?
3. What are the main sources of pollutants and how do they move around the planet?
4. What are the impacts of pollution on health and economies?
5. What impact have environmental regulation and international treaties has for reducing pollution in North America?

Key Understandings:

1. The United States is the world's largest generator of industrial solid waste, municipal solid waste, e-waste, and hazardous waste.
2. Plastic marine debris is a serious problem for the world's oceans, especially where it is concentrated in areas called garbage patches.
3. The major types of outdoor air pollution include carbon dioxide, nitrogen oxides and nitric acid, sulfur dioxide and sulfuric acid, particulates, ozone, and VOCs. Sulfur compounds and suspended particles in the air combine to form industrial smog. Primary and secondary pollutants react with UV radiation to form photochemical smog. Acid deposition occurs when acidic pollutants in the atmosphere fall to Earth's surface.

6. What can you do as a citizen to decrease your ecological footprint and help to preserve the environment for future generations?	4. Indoor air pollution is more concentrated than outside air pollution and affects more people, especially those in less-developed countries. 5. Hazardous and toxic waste is defined as any discarded material or substance that threatens human health or the environment because it is poisonous, dangerously chemically reactive, corrosive, or flammable. 6. The greatest risks to human health are connected to poverty, sex, and lifestyle choices. 7. Pollution prevention is the safest way to introduce the use of chemicals and prevent them from entering the environment. 8. The precautionary principle states that until society understand how harmful a toxin is, it should be avoided, used sparingly, or heavily regulated. 9. Solid waste can be reduced using the "Four Rs" strategy: refuse, reduce, reuse, and recycle. Integrated waste management is a coordinated strategy for waste disposal and reduction. 10. The United States government has passed legislation that deals with hazardous waste: the Resource Conservation and Recovery Act (RCRA), the Toxic Substance Control Act (TSCA), and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (also known as the Superfund Act). 11. Becoming environmentally literate, learning from nature, and living more simply can lead to more sustainability. Working together, individuals can bring about a sustainability revolution to shift to a more sustainable way of living.

Focus Standards Addressed in the Unit:	
Standard Number	*Standard Description*
4.5.12.A	Research how technology influences the sustainable use of natural resources.
4.5.12.C	Analyze the costs and benefits of means to control pollution. Analyze the role of technology in the reduction of pollution.
4.3.12.D	Evaluate waste management practices. Analyze current solid waste regulations. Research the impact of new and emerging technologies in the use, reuse, recycling, and disposal of materials. Evaluate ways that waste could be reduced during the production of specific product.
4.5.10.E	Describe the impact of occupational exposure to pollutants. Analyze laws and regulations designed to protect human health. Analyze efforts to prevent, control, and/or reduce pollution through cost and benefit analysis and risk management.

Important Standards Addressed in the Unit:	
	Reading in Science and Technical Subjects
CC.3.5.11-12.A	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
CC.3.5.11-12.B	Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

CC.3.5.11-12.C	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
CC.3.5.11-12.F	Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.
CC.3.5.11-12.G	Integrate and evaluate multiple sources of information presented in diverse formats and media in order to address a question or solve a problem.
CC.3.5.11-12.H	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
CC.3.5.11-12.I	Synthesize information from a range of sources into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
	Writing in Science and Technical Subjects
CC.3.6.11-12.A	Write arguments focused on *discipline-specific content.*
CC.3.6.11-12.F	Conduct short as well as more sustained research projects to answer a question or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
CC.3.6.11-12.G	Gather relevant information from multiple authoritative print and digital sources; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and over-reliance on any one source and following a standard format for citation.
CC.3.6.11-12.H	Draw evidence from informational texts to support analysis, reflection, and research.
CC.3.6.11-12.I	Write routinely over extended time frames and shorter time frames for a range of discipline-specific tasks, purposes, and audiences.

Misconceptions:	**Proper Conceptions:**
1. A landfill is a giant compost pile where waste decomposes. 2. The best thing to do to reduce waste is to recycle. 3. If you see the "recycling" symbol, then you can recycle the plastic item. 4. There is nothing wrong with disposing of hazardous materials, such as oil-based stains and varnishes, or motor oil, by pouring them down storm drains along the street.	1. Decomposition usually cannot occur very quickly because the waste is kept carefully isolated from surrounding soil and water to prevent contamination, and the daily layer of soil on top keeps air out. Without air and water, very little decomposition takes place, even the decomposition of food. 2. Recycling should be a last resort. Reducing your waste production has the greatest impact. The next best thing is to reuse items, which decreases the rate at which natural resources are consumed. 3. The "chasing arrow" symbol on the bottom of plastic containers does not mean that the plastic is recyclable. It is merely intended to highlight the number inside, which indicates the general type of resin that the plastic was made from. 4. Storm-drain water is not treated at a wastewater plant; it goes directly to local streams, rivers, and lakes. Hazardous substances should never be poured into gutters.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**
● Understand how waste management, waste reduction, and integrated waste management differ in their approaches to dealing with solid waste.	● Define and give examples of solid waste. ● Explain what happens to solid waste after its disposal.	● Encouraging Inquiry and Curiosity: Modeling, developing, and encouraging students to begin asking and answering questions about their

● Understand the types of risks people encounter. ● Understand how chemicals in the environment can harm the human body. ● Revisit the concept of environmental worldviews.	● Describe the advantages and disadvantages of recycling, treating, and storing hazardous waste. ● Explain the precautionary principle and how it can be applied. ● Recognize that while some hazards are unavoidable, others can be reduced through lifestyles and choices. ● Explain the causes and effects of different types of pollution. ● Identify actions that people and governments can take to reduce air pollution. ● Define the "Four Rs" approach to dealing with solid waste and identify ways individuals, industries, and communities can use this approach to limit waste and pollution. ● Identify ways in which society can use resources more sustainably.	own interactions with the environment.

Academic Vocabulary:

● Biodegradable ● Demanufacturing ● Electronic waste (e-waste) ● Hazardous waste ● Integrated waste management ● Life cycle assessment ● Landfill ● Leachate ● Municipal solid waste (MSW) ● Non-biodegradable ● Source reduction	● Air pollution ● Airshed ● Carcinogen ● Light pollution ● Mitigation ● Neurotoxin ● Noise pollution ● Ozone ● Radon ● Transboundary pollution ● Volatile organic compounds (VOCs)	● Bioremediation ● Ecological (carbon) footprint ● Precautionary principle ● Superfund ● Sustainability

Evidence: Assessments and Performance Task(s)

- Various formative assessments including but not limited to:
  - Critical thinking questions/reflections
  - Brief content-specific quizzes throughout the unit
  - Teacher-student "check-ins" on various projects/assignments/laboratory exercises
- Various summative assessments including but not limited to:
  - Section quizzes throughout the unit
  - Laboratory Exercises
  - Case Studies
  - Research, Creative-Design, and Problem-Solving focused projects
  - Unit tests

Interdisciplinary Connections:

- Economics, Political Science, Sociology, Ethics, Biology, Earth and Space Science, Chemistry, Physics

Additional Resources:

- Houghton Mifflin Harcourt Environmental Science and related resources
- National Geographic Learning Environmental Science: Sustaining Your World and related resources

- Macmillan Environment Science: Issues, and Solutions and related resources
- Facing the Future: Big World, Small Planet and related resources
- Globe Fearon Exercise Books: Environmental Science
- Globe Fearon Environment and Ecology for Pennsylvania and related resources
- Various models and posters
- Various laboratory equipment
- Community professionals that would be available to present information

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