Essential Outcomes Environmental Science

1) Environmental systems are constantly changing due to physical, biological, and chemical factors. Nutrients cycle through ecosystems and humans greatly impact the biomes of the world.

Learning Goals:

a) Students will understand and explain how ecosystems can be relatively stable for long periods of time but can be disturbed by both natural and human causes and under the right conditions may eventually recover in stages. (Env 1.1, 1.2, 1.4, 1.6, 1.8, 1.12)
b) Students will understand that ecosystems fluctuate. (Env 1.3)
c) Students will understand that present matter has arisen from past processes and evolutionary change and nutrient cycles are constantly recycling matter in different forms. (Env 1.7, 1.9)
d) Students will understand and explain the differences between abiotic and biotic factors, as well as biological, physical, and chemical factors in the environment. (Env 1.10, 1.11)
e) Students will understand that both primary and secondary succession impact ecosystems. (Env 1.12)

2) The flow of matter and energy are essential to life.

Learning Goals:

a) Students will analyze how limiting factors in the environment determine how much life can be supported in any area. (Env 1.14)
b) Students will recognize and investigate trophic levels within food chains and food webs and how chemical elements and energy are both passed through each step. (Env 1.15, 1.18)
c) Students will understand the different biomes of the Earth and how the flow of energy, matter, and food webs occur within them. (Env 1.11)

3) Growth rates of populations are affected by many factors.

Learning Goals:

a) Students will assess how factors such as birth rate, death rate, immigration, migration, and available resources affect the growth rate of populations. (Env 1.19, 1.20)
b) Students will explain how the size and rate of growth of human populations are influenced by many factors both environmental and non-environmental. (Env 1.5)

4) Natural resources around the world are used greatly by humans but it is also essential to protect and revitalize them so that they are not depleted beyond repair. Matter in the form of fossil fuels is being used by humans with an ever increasing demand which has led to their depletion as well as environmental risks.

Learning Goals:

a) Students will explain and understand the difference between renewable and nonrenewable resources as well as the importance of natural resource management. (Env 1.21, 1.26, 1.27)
b) Students will understand and explain how all fuel sources have advantages and disadvantages economically and environmentally. The burning of fossil fuels contributes greatly to the large amounts of carbon dioxide released into the atmosphere. (Env 1.13, 1.16)
c) Students will comprehend and describe what parts of the United States are responsible for different types of natural resources and how they are used to produce raw materials. (Env 1.22, 1.23)
d) Students will differentiate and explain how energy is harnessed from fossil fuels as well as nuclear power plants. (Env 1.24)
e) Students will recognize and explain the importance of recycling and environmental legislation in the endeavor to conserve natural resources. (Env 1.28)
f) Students will identify and comprehend important environmental legislation and the environmental policy process. (Env 1.29)

5) Alternative energy must be explored through using renewable energy sources to lessen the negative effects of burning fossil fuels.

Learning Goals:

a) Students will explain how energy is harnessed alternatively from the water, atmosphere, and the sun. (Env 1.25)
b) Technological innovations are being made to slow down the loss of fossil fuels. (Env 1.17)

6) Environmental hazards are caused by human's increasing needs for energy, an abundance of waste products, as well as natural disasters and natural pollution.

Learning Goals:

a) Students will understand and describe how technological advances in agriculture have led to increased production but also increased damage to the environment for example the effects of herbicides and pesticides on plants and animals. (Env 1.30, 1.35)
b) Students will analyze and take into consideration the political, economic, and technical aspects of waste management. Students will also distinguish between human made pollution and natural pollution. (Env 1.31, 1.34)
c) Students will identify the short and long term effects that natural disasters have on the Earth's environment and human populations. (Env 1.33)
d) Students will describe and comprehend how nuclear energy reduces the amount of by-products released into the atmosphere compared to the burning of fossil fuels but must also recognize the possible dangerous effects on the environment and humans from nuclear by-products and radiation. (Env 1.32)

7) The work of Rachael Carson has influenced the use of pesticides, especially DDT, in the US and around the world and Henry Cowles' research at the Indiana Dunes and Lake Michigan lakeshore helped establish it as an important resource for succession research.

Learning Goals:

a) Students will understand how the book *Silent Spring* showed how pesticides, in particular, DDT were causing pollution and poisoning many natural habitats, plants, and animals. (Env 2.1)
b) Students will analyze how Henry Cowles' research in the Indiana Dunes and along the Lake Michigan lakeshore led to the development of important principles in plant succession. (Env 2.2)

Environmental Science Bundle #1- Environmental Systems

Standard Indicator: Environmental Systems

Essential Outcome: Environmental systems are constantly changing due to physical, biological, and chemical factors. Nutrients cycle through ecosystems and humans greatly impact the biomes of the world.

Learning Goals:

a) Students will understand and explain how ecosystems can be relatively stable for long periods of time but can be disturbed by both natural and human causes and under the right conditions may eventually recover in stages. (Env 1.1, 1.2, 1.4, 1.6, 1.8, 1.12)
b) Students will understand that ecosystems fluctuate (Env 1.3)
c) Students will understand that present matter has arisen from past processes and evolutionary change and nutrient cycles are constantly recycling matter in different forms. (Env 1.7, 1.9)
d) Students will understand and explain the differences between abiotic and biotic factors, as well as biological, physical, and chemical factors in the environment. (Env 1.10, 1.11)
e) Students will understand that both primary and secondary succession impact ecosystems (Env 1.12)

Declarative Knowledge				Procedural Knowledge	
Concepts	1. Ecosystems recover from disasters in stages. 2. Human population growth and environmental factors are linked. 3. Nutrient cycles change matter into different forms, constantly recycling them. 4. Biomes and their biotic/abiotic factors are linked with other factors in the environment.			Processes	1. Scientific Method 2. Reading Process 3. Writing Process
Organizing Ideas	1. Primary succession builds ecosystems. 2. Secondary succession re-builds ecosystems after disasters. 3. Environmental factors affect how fast and how large human populations grow. 4. Non-environmental factors such as government and economics affect how fast and how large human populations grow. 5. The water cycle, carbon cycle, nitrogen cycle, and phosphorus cycles are essential to all life on Earth. 6. Similar biomes are spread throughout the world. 7. Organisms are adapted to their specific biome. 8. Human impact can negatively impact ecosystems and the development of organisms.				
Details	1. Primary succession builds on barren land. 2. Secondary succession rebuilds an ecosystem that has been damaged. 3. Identify stages of succession. 4. The state of the environment impacts human population growth. 5. Water cycles through the Earth from the atmosphere through bodies of water, plants, animals, and underground. 6. Carbon cycles through the Earth from food organisms eat to the burning of fossil fuels. 7. Nitrogen cycles through the Earth from food organisms eat to nitrogen fixing bacteria and agriculture. 8. Phosphorus cycles through the Earth from food organisms eat and agriculture. 9. The make up of a Biome determines what organisms are located there and each organism has specific adaptations to help it be successful.			Skills	1. Analyze steps of succession 2. Compare Biomes 3. Diagram cycles
Vocabulary	Ecology Species Succession Ecosystem Environment Biodiversity Invasive Species	Biome Community Population Biosphere Biotic Abiotic	Water Cycle Carbon Cycle Nitrogen Cycle Phosphorus Cycle Feed back Loop		

Environmental Science Bundle #2- Matter and Energy Flow

Standard Indicator: Flow of Matter and Energy

Essential Outcome: The flow of matter and energy are essential to life.

Learning Goals:

a) Students will analyze how limiting factors in the environment determine how much life can be supported in any area. (Env 1.14)
b) Students will recognize and investigate trophic levels within food chains and food webs and how chemical elements and energy are both passed through each step. (Env 1.15, 1.18)
c) Students will understand the different biomes of the Earth and how the flow of energy, matter, and food webs occur within them. (Env 1.11)

Declarative Knowledge				Procedural Knowledge	
Concepts	1. An ecosystem can only contain so much life. 2. There are many different types of fuel sources available to humans. 3. Burning fossil fuels affects the flow of nutrients in the environment.			Processes	1. Reading Processes 2. Writing Processes 3. Critical Thinking
Organizing Ideas	1. Limiting factors in an ecosystem determines how much life will be there. 2. Different fuel sources for humans include coal, oil, natural gas. 3. Large amounts of carbon dioxide are released into Earth's atmosphere from the burning of fossil fuels.				
Details	1. Each ecosystem has a different set of limiting factors that will determine what organisms and how many will live there. Organisms have adaptations to help them live in an area. 2. Food, water, and area are all examples of limiting factors.			Skills	
Vocabulary	Limiting factor Trophic Level Food Chain Food Web Biomass Keystone Species				

Environmental Science Bundle #3- Populations

<table>
<tr><td colspan="5">Standard Indicator: Populations</td></tr>
<tr><td colspan="5">Essential Outcome: Growth rates of populations are affected by many factors.</td></tr>
<tr><td colspan="5">Learning Goals:
a) Students will asses how factors such as birth rate, death rate, immigration, migration, and available resources affect the growth rate of populations. (Env 1.19, 1.20)
b) Students will explain how the size and rate of growth of human populations are influenced by many factors both environmentaland non-environmental. (Env 1.5)</td></tr>
<tr><td colspan="3">Declarative Knowledge</td><td colspan="2">Procedural Knowledge</td></tr>
<tr><td>Concepts</td><td colspan="2">1. Many different factors influence the growth rate of populations.</td><td>Processes</td><td>1. Reading Processes
2. Writing Processes</td></tr>
<tr><td>Organizing Ideas</td><td colspan="2">1. Plant and animal populations are affected in various ways.
2. Human populations are also affected by similar factors, however humans have unique factors affecting their population growth.</td><td rowspan="3"></td><td rowspan="3"></td></tr>
<tr><td>Details</td><td colspan="2">1. When monitoring and predicting population growth ,birth rate and death rate must be used.
2. Immigration and migration affect population growth.
3. The available resources within an ecosystem greatly affect the growth rate of populations just as much as other factors.</td></tr>
<tr><td>Vocabulary</td><td>Population Size
Population Density
Population Distribution
Age Structure Diagram
Sex Ratio</td><td>Exponential Growth
Logistic Growth
Density-Dependent Factor
Density- Independent Factor
Biotic Potential</td><td>Survivorship Curve
Immigration
Emigration
Migration
Birth Rate
Death Rate</td></tr>
<tr><td>Skills</td><td colspan="2">1. Graphing Skills
2. Interpreting Data Skills</td></tr>
</table>

Environmental Science Bundle #4- Fossil Fuels

Standard Indicator: Natural Resources

Essential Outcome: Natural resources around the world are used greatly by humans but it is also essential to protect and revitalize them so that they are not depleted beyond repair. Matter in the form of fossil fuels is being used by humans with an ever increasing demand which has led to their depletion as well as environmental risks.

Learning Goals:

a) Students will explain and understand the difference between renewable and nonrenewable resources as well as the importance of natural resource management. (Env 1.21, 1.26, 1.27)
b) Students will comprehend and describe what parts of the United States are responsible for different types of natural resources and how they are used to produce raw materials. (Env 1.22, 1.23)
c) Students will differentiate and explain how energy is harnessed from fossil fuels as well as nuclear power plants. (Env 1.24, 1.32)
d) Students will recognize and explain the importance of recycling and environmental legislation in the endeavor to conserve natural resources.
e) Students will understand and explain how all fuel sources have advantages and disadvantages economically and environmentally. The burning of fossil fuels contributes greatly to the large amounts of carbon dioxide released into the atmosphere and the depletion of energy sources on Earth is leading to technological innovations to slow the loss down. (Env 1.13, 1.16, 1.17)
f) Students will identify and comprehend important environmental legislation and the environmental policy process. (Env 1.29)

Declarative Knowledge				Procedural Knowledge	
Concepts	1. Natural resources are being depleted by humans. 2. Natural resources should be protected. 3. Natural resources should be replenished. 4. Fossil fuel burning should be lessened and alternative energy should be explored. 5. Local, state, national, and international laws and treaties exist to protect the environment.			Processes	1. Reading Processes 2. Writing Processes
Organizing Ideas	1. Natural resources should be monitored. 2. Laws and legislation should be established to protect our natural resources. 3. Environmental laws and policies are essential to protecting and preserving resources. 3. The release of carbon dioxide gas from the burning of fossil fuels is contributing to global warming. 4. The over demand of energy and fuel sources by humans on Earth are depleting the amount available to use.				
Details	1. Natural resources such as coal, oil, and natural gas are being used at alarming rates by humans- these are all non-renewable resources. 2. How or who should be monitoring the use of natural resources and when will it be regulated better? 3. How should natural resources be protected? 4. Various governmental and private organizations have been set up in order to protect natural resources. 5. Investigate the local agencies in and around Michigan City that protect the environment. 6. Investigate how agencies restore natural areas that have been damaged or depleted due to human use. 7. Laws, policies, and treaties such as the Kyoto Protocol, the Montreal Protocol, and CITES are essential for countries to communicate about and work on together to ensure the preservation of environmental resources throughout the world.			Skills	
Vocabulary	Resource Management Maximum Sustainable Yield (MSY) Ecosystem-Based Management Adaptive Management Even-Aged Uneven-Aged Clear-Cutting Seed-Tree Approach Shelterwood Approach Selection System Deforestation	Old-Growth Forest Renewable Non-renewable	Montreal Protocol Kyoto Protocol CITES Clean Air Act Clean Water Act		

Environmental Science Bundle #5- Alternative Energy

<table>
<tr><td colspan="5">Standard Indicator: Natural Resources</td></tr>
<tr><td colspan="5">Essential Outcome: Alternative energy must be explored through using renewable energy sources to lessen the negative effects of burning fossil fuels.</td></tr>
<tr><td colspan="5">Learning Goals:
a) Students will explain how energy is harnessed alternatively from the water, atmosphere, and the sun. (Env 1.25)
b) Technological innovations are being made to slow down the loss of fossil fuels. (Env 1.17)</td></tr>
<tr><td colspan="3">Declarative Knowledge</td><td colspan="2">Procedural Knowledge</td></tr>
<tr><td>Concepts</td><td colspan="2">1. Natural resources are being depleted by humans.
2. Fossil fuel burning should be lessened and alternative energy should be explored.
3. Technology is exploring new types of energy and lowering alternative energy costs.</td><td>Processes</td><td>1. Reading Processes
2. Writing Processes</td></tr>
<tr><td>Organizing Ideas</td><td colspan="2">1. Advancements in technology should be made to restore areas where natural resources have been abused.
2. New alternative energy sources are being developed to help slow the burning of fossil fuels.
3. How do countries around the world differ in their strive for alternative energy sources?</td><td></td><td></td></tr>
<tr><td>Details</td><td colspan="2">1. Alternative energy sources are a more Earth-friendly path.
2. Renewable energy such as solar, wind, water, and geochemical are viable alternatives to fossil fuel energy.</td><td>Skills</td><td></td></tr>
<tr><td>Vocabulary</td><td>Resource Management</td><td>Renewable
Non-renewable
Biomass Energy
Biofuel
Biopower
Geothermal Energy
Hydropower
Tidal Energy
Ocean Thermal Energy Conversion (OTEC)
Sustainability</td><td>Sustainable Forestry Certification
Alternative Energy
Passive Solar Heating
Active Solar Heating
Flat-Plate Solar Collector
Photovoltaic (PV) Cell
Concentrating Solar Power (CSP)
Wind Turbine
Wind Farm</td><td></td></tr>
</table>

Environmental Science Bundle #6- Hazards in the Environment

Standard Indicator: Environmental Hazards

Essential Outcome: Environmental hazards are caused by human's increasing needs for energy, an abundance of waste products, as well as natural disasters and natural pollution.

Learning Goals:

a) Students will understand and describe how technological advances in agriculture have led to increased production but also increased damage to the environment for example the effects of herbicides and pesticides on plants and animals. (Env 1.30, 1.35)
b) Students will analyze and take into consideration the political, economic, and technical aspects of waste management. Students will also distinguish between human made pollution and natural pollution. (Env 1.31, 1.34)
c) Students will identify the short and long term effects that natural disasters have on the Earth's environment and human populations. (Env 1.33)
d) Students will describe and comprehend how nuclear energy reduces the amount of by-products released into the atmosphere compared to the burning of fossil fuels but must also recognize the possible dangerous effects on the environment and humans from nuclear by-products and radiation. (Env 1.32)

Declarative Knowledge				Procedural Knowledge	
Concepts	1. Agricultural procedures can have adverse affects on the environment. 2. Human pollution requires the need for waste management. 3. Natural disasters effect the environment as well as population growth. 4. Nuclear energy lessens carbon emissions but can be dangerous as well.			Processes	1. Reading Processes 2. Writing Processes
Organizing Ideas	1. Agricultural advancements have led to increased productivity and products on the market for human use. 2. Agricultural advancements have harmed the environment. 3. Human pollution has led to the necessity of waste management. 4. Natural pollution occurs as well. 5. Natural disasters alter the Earth's environment greatly. 6. Nuclear energy poses health risks to plants and animals.				
Details	1. Agriculture has increased the amount of fertilizer in soil and water. 2. Agriculture has increasingly introduced hormones into food. 3. Agriculture has increased the amount of herbicides and pesticides found within soil, water, plants, and animals. 4. Waste management is an essential aspect to human populations. 5. Natural disasters affect not only the environment but also humans. Investigate Hurricane Katrina's effects on the environment as well as the effect on the human population. 6. Nuclear radiation and nuclear by-products are a serious health risk for plants and animals.			Skills	
Vocabulary	Traditional Agriculture Yield Industrial Agriculture Green Revolution Biological Pest Control Integrated Pest Management (IPM) Pollinator Point-Source Pollution Nonpoint-Source Pollution	Cultural Eutrophication Wastewater Pathogen Red Tide Septic System Earthquake Landslide Volcano Tornado Hurricane Thunderstorm	Avalanche Nuclear Energy Nuclear Fission Nuclear Reactor Meltdown Nuclear Waste Nuclear Fusion		

Environmental Science Bundle #7- Historical Contributions to Environmental Science

<table>
<tr><td colspan="5">Standard Indicator: Historical Perspectives</td></tr>
<tr><td colspan="5">Essential Outcome: The work of Rachael Carson has influenced the use of pesticides, especially DDT, in the US and around the world and Henry Cowles' research at the Indiana Dunes and Lake Michigan lakeshore helped establish it as an important resource for succession research.</td></tr>
<tr><td colspan="5">Learning Goals:
a) Students will understand how the book Silent Spring showed how pesticides, in particular, DDT were causing pollution and poisoning many natural habitats, plants, and animals. (Env 2.1)
b) Students will analyze how Henry Cowles' research in the Indiana Dunes and along the Lake Michigan lakeshore led to the development of important principles in plant succession. (Env 2.2)</td></tr>
<tr><td colspan="3">Declarative Knowledge</td><td colspan="2">Procedural Knowledge</td></tr>
<tr><td>Concepts</td><td colspan="2">1. There are prominent people who have contributed to the study of environmental science.</td><td>Processes</td><td>1. Reading Processes
2. Writing Processes</td></tr>
<tr><td>Organizing Ideas</td><td colspan="2">1. Silent Spring led to the realization of how dangerous DDT is to the environment and humans.
2. Henry Cowles established principles of succession locally at the Indiana Dunes.</td><td></td><td></td></tr>
<tr><td>Details</td><td colspan="2">1. Students should read the entire book or excerpts from Silent Spring.
2. Students will visit the Indiana Dunes National Lakeshore and State Park to witness plant succession at work.</td><td>Skills</td><td>1. Field work skills</td></tr>
<tr><td>Vocabulary</td><td>Primary Succession
Secondary Succession
Dune Succession
Merram Grass
DDT</td><td></td><td></td><td></td></tr>
</table>