| Course Title: | Content Area: | Grade Level: | Credit (if applicable) |
|---|---|---|---|
| ECE Environmental | Science | 11-12 | 1.0 |

**Course Description:**

An introduction to basic concepts and areas of environmental science and how environmental problems can be effectively addressed, using the triple bottom line of sustainability school of thought. Topics include human population; ecological principles; conservation of biological resources; biodiversity; croplands, rangelands, forestlands; soil and water conservation; pollution and water management; and wildlife and fisheries conservation.

| Aligned Core Resources: | Connection to the *BPS Vision of the Graduate* |
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| Required textbook for this course is Friedland and Relyea, Environmental Science, 2nd Edition (2015) | CONTENT MASTERY<br>• Develop and draw from a baseline understanding of knowledge in academic disciplines from our Bristol curriculum.<br>CRITICAL THINKING AND PROBLEM SOLVING<br>• Collect, assess and analyze relevant information<br>• Reason effectively. Use systems thinking.<br>• Make sound judgments and decisions. Identify, define and solve authentic problems and essential questions.<br>• Reflect critically on learning experience, processes and solutions.<br>• Transfer knowledge to other situations.<br>COLLABORATION<br>• Demonstrates ability to work effectively and respectfully with diverse teams<br>• Exercise flexibility and willingness to be helpful in making necessary compromises to accomplish a common goal<br>• Assume shared responsibility for collaborative work and value the individual contributions made by each team member |
| **Additional Course Information:**<br>***Knowledge/Skill Dependent courses/prerequisites*** | **Link to *Completed Equity Audit*** |
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**Standard Matrix**

| AP Environmental Science Practices | Unit 1 | Unit 2 | Unit 3 | Unit 4 | Unit 5 | Unit 6 |
|---|---|---|---|---|---|---|
| **Practice 1: Concept Explanation**<br>**Explain environmental concepts, processes, and models presented in written format.** | | | | | | |
| 1.A Describe environmental concepts and processes. | X | X | X | X | X | X |

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| 1.B Explain environmental concepts and processes. | X | X | X | X | X | X |
| 1.C Explain environmental concepts, processes, or models in applied contexts. | X | X | X | X | X | X |
| **Practice 2: Visual Representations**<br>**Analyze visual representations of environmental concepts and processes.** | | | | | | |
| 2.A Describe characteristics of an environmental concept, process, or model represented visually. | X | X | X | X | X | X |
| 2.B Explain relationships between different characteristics of environmental concepts, processes, or models represented visually: (1) In theoretical contexts, (2) In applied contexts | X | X | X | X | X | X |
| 2.C Explain how environmental concepts and processes represented visually relate to broader environmental issues. | X | X | X | X | X | X |
| **Practice 3: Text Analysis**<br>**Analyze sources of information about environmental issues** | | | | | | |
| 3.A Identify the author's claim. | x | | | | | x |
| 3.B Describe the author's perspective and assumptions. | x | | | | | x |
| 3.C Describe the author's reasoning (use of evidence to support a claim). | x | | | | | x |
| 3.D Evaluate the credibility of a source: (1) Recognize bias; (2) Scientific accuracy | x | x | x | x | x | x |
| 3.E Evaluate the validity of conclusions of a source or research study. | x | x | x | x | x | x |
| **Practice 4: Scientific Experiments**<br>**Analyze research studies that test environmental principles** | | | | | | |
| 4.A Identify a testable hypothesis or scientific question for an investigation. | X | X | X | X | X | X |
| 4.B Identify a research method, design, and/or measure used. | X | X | X | X | X | X |
| 4.C Describe an aspect of a research method, design, and/or measure used. | X | X | X | X | X | X |
| 4.D Make observations or collect data from laboratory setups | X | X | X | X | X | X |
| 4.E Explain modifications to an experimental procedure that will alter results. | X | X | X | X | X | X |
| **Practice 5 Data Analysis**<br>**Analyze and interpret quantitative data represented in tables, charts, and graphs** | | | | | | |
| 5.A Describe patterns or trends in data. | X | X | X | X | X | X |
| 5.B Describe relationships among variables in data represented. | X | X | X | X | X | X |

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| 5.C Explain patterns and trends in data to draw conclusions. | X | X | X | X | X | X |
| 5.D Interpret experimental data and results in relation to a given hypothesis. | X | X | X | X | X | X |
| 5.E Explain what the data implies or illustrates about environmental issues. | X | X | X | X | X | X |
| **Practice 6 Mathematical Routines**<br>**Apply quantitative methods to address environmental concepts** | | | | | | |
| 6.A Determine an approach or method aligned with the problem to be solved. | X | X | X | X | X | X |
| 6.B Apply appropriate mathematical relationships to solve a problem, with work shown (e.g., dimensional analysis). | X | X | X | X | X | X |
| 6.C Calculate an accurate numeric answer with appropriate units. | X | X | X | X | X | X |
| **Practice 7 Environmental Solutions**<br>**Propose and justify solutions to environmental problems** | | | | | | |
| 7.A Describe environmental problems. | X | X | X | X | X | X |
| 7.B Describe potential responses or approaches to environmental problems. | X | X | X | X | X | X |
| 7.C Describe disadvantages, advantages, or unintended consequences for potential solutions. | X | X | X | X | X | X |
| 7.D Use data and evidence to support a potential solution. | X | X | X | X | X | X |
| 7.E Make a claim that proposes a solution to an environmental problem in an applied context. | X | X | X | X | X | X |
| 7.F Justify a proposed solution, by explaining potential advantages. | X | X | X | X | X | X |

## Unit Links

*If unit headings are formatted as a heading, then we can link a Table of Contents to better organize and provide faster access to each unit*

| **Unit Title:** | |
|---|---|
| The State Of The Earth And Human Impact | |
| **Relevant Standards: Bold indicates priority** | |
| All College Board Practices are infused in these lessons. | |
| **Essential Question(s):** | **Enduring Understanding(s):** |
| • Why are natural resources critical to human life, and what are the consequences of their depletion or misuse?<br>• What is sustainability, and why is it challenging to achieve given the current state of the Earth?<br>• How do human activities impact the environment, and what are the consequences for ecosystem services and global sustainability? | **Interdependence of Human Life and Natural Resources:**<br>• Natural resources are essential for human survival and well-being.<br>• Depletion or misuse of natural resources can have significant consequences for ecosystems and human societies.<br>**Importance and Challenges of Sustainability:**<br>• Sustainability aims to meet the needs of the present without compromising the ability of future generations to meet their own needs.<br>• Achieving sustainability is challenging due to various environmental, social, and economic factors.<br>**Human Impact on the Environment:**<br>• Human activities exert significant pressure on the global environment.<br>• These pressures manifest through both abiotic (non-living) and biotic (living) factors, affecting ecosystem health and biodiversity.<br>**Interdisciplinary Nature of Environmental Science:**<br>• Environmental science is interdisciplinary, drawing on knowledge from various fields such as biology, chemistry, sociology, and economics.<br>• Understanding environmental issues requires considering multiple perspectives and disciplines.<br>**Triple Bottom Line and Sustainable Development:**<br>• The Triple Bottom Line theory emphasizes the importance of considering environmental, social, and economic factors in decision-making.<br>• Sustainable development seeks to balance these three dimensions for long-term well-being.<br>**Ecological Footprint and Personal Impact:**<br>• The concept of ecological footprint measures the environmental impact of human activities.<br>• Individual choices and behaviors significantly influence personal ecological footprints.<br>**Ecosystem Services and Human Well-being:**<br>• Ecosystem services provide essential benefits to humans, such as clean water, air, and food.<br>• Disruption of ecosystem services can have adverse effects on human health, economies, and ecosystems.<br>**Population Dynamics and Demographic Transition:** |

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| | • Population growth and decline are influenced by various factors, including fertility rates, mortality rates, and migration.<br>• The demographic transition model illustrates shifts in population patterns over time.<br>**Global Population Trends and Challenges:**<br>• The world's population continues to grow, with significant growth occurring in developing countries.<br>• Population growth presents challenges related to resource availability, environmental sustainability, and social development.<br>**Calculating and Interpreting Environmental Data:**<br>• Tools and models, such as ecological footprint calculators and age structure diagrams, help assess and understand environmental impacts and population dynamics.<br>• Interpreting environmental data enables informed decision-making and policy development. |
| **Demonstration of Learning:** | **Pacing for Unit** |
| | 5 weeks |

**Unit-specific Vocabulary:**

Anthropogenic, Carrying Capacity, Demography, Demographic Transition model, Ecological footprint, Ecosystem services, Interdisciplinary, Age structure diagrams, Renewable and nonrenewable resources, Replacement value, Rule of 70, Sustainability, Survivorship curves, Total Fertility Rate, Tragedy of the commons, Triple bottom line.

**Anticipated misconceptions:**

- Misconception: Natural resources are infinite and will never run out.
  - Clarification: Natural resources are finite, meaning there is a limited supply. While some resources can be replenished over time (renewable), others are limited (non-renewable) and can be depleted.
- Misconception: Sustainability only refers to environmental conservation.
  - Clarification: Sustainability encompasses environmental, social, and economic dimensions. It involves meeting the needs of the present without compromising the ability of future generations to meet their own needs, which requires balancing environmental health, social equity, and economic prosperity.
- Misconception: Environmental issues are only caused by human activities.
  - Clarification: While human activities contribute significantly to environmental problems, natural processes and phenomena also play a role. Understanding the interactions between human actions and natural systems is crucial for effective environmental management.
- Misconception: Environmental science is solely about ecology and biology.
  - Clarification: Environmental science is interdisciplinary and incorporates knowledge from various fields, including biology, chemistry, physics, sociology, economics, and political science. It explores the complex relationships between humans and the environment.
- Misconception: Sustainable development means sacrificing economic growth.
  - Clarification: Sustainable development seeks to balance environmental, social, and economic goals. It emphasizes finding ways to achieve economic growth while minimizing negative environmental and social impacts, thus ensuring long-term prosperity.
- Misconception: Ecological footprint only considers carbon emissions.
  - Clarification: Ecological footprint calculations encompass various aspects of human consumption, including energy use, water consumption, land use, and waste generation, in addition to carbon emissions.
- Misconception: Ecosystem services are only provided by natural ecosystems.
  - Clarification: Ecosystem services can be provided by both natural and human-altered ecosystems. For

example, urban green spaces can provide benefits such as air purification and flood control.
- Misconception: Human population growth is the sole driver of environmental degradation.
  - Clarification: While population growth is a significant factor, consumption patterns, technological advancements, and socio-economic factors also influence environmental impact. Addressing consumption habits and promoting sustainable practices are essential alongside population management.
- Misconception: The demographic transition model predicts population growth for all countries.
  - Clarification: The demographic transition model describes historical population changes in industrialized nations. However, its applicability to developing countries may vary due to unique cultural, economic, and social factors.
- Misconception: Age structure diagrams only represent population size.
  - Clarification: Age structure diagrams provide information about population structure, including the distribution of age groups and implications for future population trends. They help identify factors such as birth rates, death rates, and population momentum.

| **Differentiation through *Universal Design for Learning*** | |
|---|---|
| **UDL Indicator** | **Teacher Actions:** |
| **Representation:** Highlight patterns, critical features, big ideas, and relationships | • Highlight or emphasize key elements in text, graphics, diagrams, formulas<br>• Use outlines, graphic organizers, unit organizer routines, concept organizer routines, and concept mastery routines to emphasize key ideas and relationships<br>• Use multiple examples and non-examples to emphasize critical features<br>• Use cues and prompts to draw attention to critical features<br>• Highlight previously learned skills that can be used to solve unfamiliar problems |

| **Supporting Multilingual/English Learners** | |
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| **Related *CELP standards:*** | **Learning Targets:** |

*The CELP guidance is to support the development of language; access to course content expectations should not change as a result of MLL status.

**I can explain the overall arching environmental goal of sustainability and sustainable development.**

An EL can conduct research and evaluate and communicate findings to answer questions or solve problems.

- Level 1: I can recognize the main idea of sustainability and sustainable development using simple words and pictures.
- Level 2: I can recognize and explain the main idea of sustainability and sustainable development using simple words and pictures.
- Level 3 I can describe what sustainability and sustainable development mean and why they are important for protecting the environment and people's future.
- Level 4: I can describe what sustainability and sustainable development mean and why they are important for protecting the environment and people's future. I can use examples to explain.
- Level 5: I can explain the concepts of sustainability and sustainable development in detail, including their goals and why they are important. I can discuss the interconnectedness of environmental, social, and economic factors in achieving sustainability. I can give examples and provide evidence to support my explanations.

| **Lesson Sequence** | **Learning Target** | **Success Criteria/Assessment/Resources** |
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|---|---|---|
| 1<br>State of the Earth | I can explain how natural resources are important to human life.<br><br>I can explain the overall arching environmental goal of sustainability and sustainable development.<br><br>I can diagnose and illustrate the pressures on the global environment. | • I can define both abiotic and biotic factors<br>• I can define the term in environment<br>• I can describe why environmental science is considered interdisciplinary.<br>• I can list a minimum of 5 pressures that humans are placing on the environment.<br>• I can explain the Triple Bottom Line theory<br>• I can define the term sustainability<br>• I can explain why sustainability is difficult with the current state of the Earth |
| 2<br>Ecological Footprint | I can describe the concept of our ecological footprint and what human activities impact our footprint. | • I can calculate my ecological footprint using multiple footprint calculation tools.<br>• I can define what our Ecological footprint is and how our daily choices affect this.<br>• I can identify what countries have the highest ecological footprints.<br>• I can explain how affluence affects the environment |
| 3<br>Ecosystem Services | I can describe how anthropogenic activities can disrupt ecosystem services, potentially resulting in economic and ecological consequences.<br>I can describe ecosystem services | • I can define ecosystem services<br>• I can list a minimum of 5 ecosystem services<br>• I can describe the results of human disruptions to ecosystem services. |
| 4<br>Tragedy of Commons | I can model the Tragedy of the Commons phenomenon and apply this concept to current environmental issues. | • I can calculate my ecological footprint using multiple footprint calculation tools.<br>• I can define what our ecological footprint is and how our daily choices affect this.<br>• I can identify what countries have the highest ecological footprints. |
| 5<br>Human Population | I can demonstrate how resource availability affects population growth.<br><br>I can interpret age structure diagrams.<br><br>I can evaluate factors that affect the total fertility rate in human populations. | • I can identify what the current world population is<br>• I can identify where the highest population growth is occurring in the world<br>• I can explain why population growth in developing countries is the highest in the world<br>• I can explain what demography is<br>• I can illustrate with a population pyramid and give an example of a country that is developing, transitional, or developed<br>• I can explain how TFR directly correlates to a country's population size<br>• I can identify why the world's carrying capacity has continued to increase<br>• I can calculate the doubling time of a country using the rule of "70" |
| 6<br>Demographic Transition | I can articulate why human populations experience growth and decline.<br><br>I can interpret the demographic transition model and apply it to the | • I can explain what the demographic transition model shows about human population<br>• I can draw the demographic transition model<br>• I can graph a country's population and identify what stage of the demographic transition model it falls under. |

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| | current status of selected developed and developing countries. | |

| **Unit Title:** | |
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| The Living World | |
| **Relevant Standards: Bold indicates priority** | |
| All College Board Practices are infused in these lessons. | |
| **Essential Question(s):** | **Enduring Understanding(s):** |
| • How does natural selection work, and what evidence supports this process?<br>• What are the causes of species extinction and mass extinction events, and how do they impact biodiversity?<br>• What are the levels of biodiversity, and why are they important?<br>• How do energy flow and matter cycling operate in ecosystems, and what are their implications for ecological dynamics? | **Natural Selection and Adaptation:**<br>• Natural selection is a key mechanism driving evolution, where organisms with advantageous traits are more likely to survive and reproduce.<br>• Adaptations are inherited traits that increase an organism's fitness for its environment, allowing it to better survive and reproduce.<br>**Biodiversity and Conservation:**<br>• Biodiversity refers to the variety of life forms present on Earth, including genetic, species, and ecosystem diversity.<br>• Biodiversity hotspots are areas with high levels of species richness and endemism, and they are crucial for maintaining global biodiversity.<br>• Human activities, such as habitat destruction, pollution, and climate change, are major contributors to the ongoing sixth mass extinction event.<br>**Population Dynamics and Interactions:**<br>• Populations exhibit characteristics and behaviors that help predict their dynamics, including growth patterns and distribution.<br>• Limiting factors, such as resource availability and competition, influence population growth and distribution.<br>**Ecosystem Structure and Function:**<br>• Ecosystems are the result of biotic and abiotic interactions, where organisms interact with each other and their environment to form complex ecological communities.<br>• Energy flows through ecosystems via trophic levels, with energy decreasing as it moves up the food chain due to inefficiencies in energy transfer.<br>• Matter cycles through ecosystems via biogeochemical cycles, such as the carbon, nitrogen, and water cycles, which are vital for maintaining ecosystem balance.<br>**Succession and Biomes:**<br>• Ecological succession involves the sequential changes in species composition and community structure following disturbances, leading to the establishment of climax communities.<br>• Terrestrial and aquatic biomes are characterized by specific environmental factors, such as climate and |

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| | vegetation, and exhibit distinct distribution patterns across the globe.<br>● Human activities are altering the distribution and composition of biomes worldwide, leading to habitat loss and fragmentation.<br>**Biogeochemical Cycles and Human Impact:**<br>● Biogeochemical cycles regulate the movement and transformation of elements, such as carbon, nitrogen, and phosphorus, between living organisms and their environment.<br>● Human activities, including deforestation, fossil fuel combustion, and agricultural practices, disrupt biogeochemical cycles, leading to environmental degradation and climate change. |
| **Demonstration of Learning:** | **Pacing for Unit** |
| | 6 weeks |

**Unit-specific Vocabulary:**

Biodiversity, Biodiversity hotspot, Biogeochemical cycles, Biome, Climatogram, Density dependent factors, Density independent factors, Energy flow, Eutrophication, Exponential vs. logistic growth, Island biogeography, Keystone species, Positive and negative feedback loops, Primary and secondary succession, Trophic levels.

**Anticipated misconceptions:**

- Misconception: Natural selection only occurs when an organism needs a specific trait.
  - Clarification: Natural selection acts on existing variations within a population. Traits that increase an organism's chances of survival and reproduction are more likely to be passed on to the next generation.
- Misconception: Extinction only occurs because of predators.
  - Clarification: Extinction can result from various factors, including changes in climate, habitat loss, competition, disease, and human activities such as hunting or habitat destruction.
- Misconception: Biodiversity is only about the number of species in an area.
  - Clarification: Biodiversity encompasses genetic diversity, species diversity, and ecosystem diversity. It includes the variety of life forms and their interactions within an ecosystem.
- Misconception: The sixth mass extinction event is natural and not influenced by human activities.
  - Clarification: The current mass extinction event is primarily caused by human activities such as habitat destruction, pollution, over-harvesting, and climate change.
- Misconception: Conservation efforts always succeed in preserving biodiversity.
  - Clarification: Conservation efforts can face challenges such as insufficient funding, lack of political will, and conflicts with human interests. Success depends on effective management strategies and community involvement.
- Misconception: Adaptations are acquired during an organism's lifetime.
  - Clarification: Adaptations are inherited traits that have evolved over many generations through natural selection. They are not acquired within an organism's lifetime.
- Misconception: Trophic levels in a food chain represent distinct categories of organisms.
  - Clarification: Trophic levels represent energy transfer within a food chain, with each level containing organisms that share similar positions in the food web, such as producers, primary consumers, secondary consumers, etc.
- Misconception: Exponential population growth continues indefinitely.
  - Clarification: Exponential growth occurs when resources are unlimited, but it eventually levels off due to factors like resource limitation, competition, and environmental constraints, leading to logistic growth.
- Misconception: All human impacts on the environment are negative.
  - Clarification: While many human activities have negative environmental impacts, some practices, like

sustainable resource management and conservation efforts, can have positive effects on ecosystems.

- Misconception: The carbon cycle only involves carbon dioxide.
  - Clarification: The carbon cycle involves various forms of carbon, including carbon dioxide (CO2), methane (CH4), and organic carbon. It encompasses processes like photosynthesis, respiration, decomposition, and combustion.
- Misconception: Positive feedback loops are always beneficial.
  - Clarification: Positive feedback loops can amplify changes within a system, but they are not always advantageous. For example, in the case of global warming, the melting of polar ice leads to increased absorption of solar radiation, further accelerating ice melt, which is detrimental to ecosystems and sea levels.

| **Differentiation through *Universal Design for Learning*** | |
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| **UDL Indicator** | **Teacher Actions:** |
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| **Supporting Multilingual/English Learners** | |
|---|---|
| **Related *CELP standards:*** | **Learning Targets:** |

**The CELP guidance is to support the development of language; access to course content expectations should not change as a result of MLL status.*

**I can argue that many environmental issues arise from anthropogenic disruption of the biogeochemical cycles producing positive feedback loops**

An EL can conduct research and evaluate and communicate findings to answer questions or solve problems.

- Level 1: I can understand and explain how human actions cause environmental problems.
- Level 2: I can identify simple examples of how people can help the environment, like recycling or planting trees.
- Level 3 I can describe how human activities impact the environment, causing problems like pollution and changes in weather.
- Level 4: I can discuss how changes in weather, like floods or droughts, can be caused by human actions, such as cutting down forests or using too much water.
- Level 5: I can argue that human activities, like burning fossil fuels and deforestation, lead to environmental problems by disrupting the natural cycles of elements, creating positive feedback loops.

| **Lesson Sequence** | **Learning Target** | **Success Criteria/ Assessment** | **Resources** |
|---|---|---|---|
| 1<br>Biodiversity and Natural Selection | I can explain the process of natural selection and cite evidence for this process<br><br>I can analyze reasons for species extinction and mass extinction events | • I can explain the different levels of biodiversity<br>• I can identify who the father of natural selection was and what his early experiments involved.<br>• I can demonstrate the process of natural selection by completing the lab.<br>• I can define what adaptations are and describe how | |

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| | | they affect natural selection.<br>● I can explain what a biodiversity hotspot is and why these are important to the environment<br>● I can identify what is causing the 6th mass extinction even currently.<br>● I can identify the efforts that are being made to conserve biodiversity and why often they fail.<br>● I can describe how organisms adapt to their environment. |
| 2<br>Food webs and energy flow | I can explain how solar energy is acquired and transferred by living organisms.<br><br>I can model how energy flows and matter cycles through trophic levels.<br><br>I can argue that the energy decreases as it flows through ecosystems. | ● I can explain the process of photosynthesis and why it is important to the base of the trophic pyramid<br>● I can define the terms autotroph and heterotroph<br>● I can apply the 10% rule using tangible levels of energy given in Joules<br>● I can illustrate a complex food web of a given ecosystem.<br>● I can differentiate between a food chain and a food web.<br>● I can illustrate the flow of energy in a food chain or food web. |
| 3<br>Population Ecology | I can explain how limiting factors restrain population growth<br><br>I can describe how populations exhibit characteristics that help predict their dynamics<br><br>I can differentiate between exponential and logistic population growth. | ● I can explain the difference between logistical and exponential growth<br>● I can illustrate the difference between logistical and exponential growth using a graph.<br>● I can explain the difference between random, clumped, and uniform population distribution<br>● I can predict what happens to a population that is not restrained by limiting factors.<br>● I can select 3 density dependent factors<br>● I can select 3 density-independent factors<br>● I can differentiate between the characteristics of K and R selected species.<br>● I can calculate the biodiversity of an area using the Shannon-Wiener index<br>● I can estimate a population by using the mark and recapture method |
| 4<br>Species Interactions | I can assess how the availability of resources influences species interactions.<br><br>I can model how ecosystems are the result of biotic and abiotic interactions.<br><br>I can predict the potential impacts of invasive species in communities | ● I can discuss what a keystone species is and its importance to an ecosystem.<br>● I can identify the concept of dieback and off-shoot on a population graph of a predator-prey relationship.<br>● I can explain the concept of Island Biogeography and how that changes a population<br>● I can explain how each species interaction has either a positive, negative or zero effect on the other species. |
| 5<br>Biomes | I can classify the global distribution and principal environmental aspects of terrestrial biomes.<br><br>I can describe the global distribution and | ● I can identify the 2 characteristics that identify a biome<br>● I can identify a particular region across the world for each of the biomes I defined in class.<br>● I can explain the different zones found in a |

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| | principal environmental aspects of aquatic biomes. | freshwater lake.<br>● I can interpret a climatogram to identify biomes when given climatic data.<br>● I can explain how the distribution of vegetation changes from the equator to the poles.<br>● I can identify the major terrestrial biomes and a species that is found in each.<br>● I can research how human impacts are changing the distribution of biomes world wide. |
| 6<br>Primary and Secondary Succession | I can differentiate between primary and secondary succession | ● I can compare and contrast two major types of ecological succession.<br>● I can explain what a pioneer species is and how it is different between the two types of succession.<br>● I can illustrate in a diagram the difference between primary and secondary succession.<br>● I can explain what a climax community is and the types of species that can be found in one. |
| 7<br>Biogeochemical Cycles | I can explain the steps and reservoir interactions in the nitrogen cycle.<br><br>I can explain the steps and reservoir interactions in the hydrologic cycle.<br><br>I can explain the steps and reservoir interactions in the carbon cycle.<br><br>I can explain how humans are impacting each of the major biogeochemical cycles.<br><br>I can argue that many environmental issues arise from anthropogenic disruption of the biogeochemical cycles producing positive feedback loops | ● I can explain why the process of nitrogen fixation is critical in vegetation<br>● I can identify where most of the nitrogen in the world is stored.<br>● I can argue the sun is the source of energy for the water cycle.<br>● I can illustrate the different processes found in the water cycle.<br>● I can classify the water distribution on Earth in terms of saltwater and freshwater.<br>● I can identify the major carbon sinks<br>● I can research how humans disrupting the carbon cycle<br>● I can identify where most of the phosphorus is stored on Earth and what process releases this from rock.<br>● I can argue that the process of eutrophication is caused by a disruption to the natural cycling of nitrogen and phosphorus. |
| 8<br>Feedback Loops | I can differentiate the fundamental differences between positive and negative feedback loops. | ● I can explain what a positive feedback loop is an given an example<br>● I can explain what a negative feedback loop is and give an example |

| **Unit Title:** | |
|---|---|
| Land Use | |
| **Relevant Standards: Bold indicates priority** | |
| All College Board Practices are infused in these lessons. | |
| **Essential Question(s):** | **Enduring Understanding(s):** |
| • How do geological processes at convergent, divergent, and transform plate boundaries shape Earth's surface?<br>• What are the relationships between plate tectonics, soil formation, and erosion?<br>• How do agricultural practices impact soil health and sustainability?<br>• What are the environmental impacts of different methods of meat production and aquaculture?<br>• How does urbanization affect the environment and what strategies can promote sustainable cities? | • **Earth's Dynamic Surface:** Students will understand that Earth's surface is constantly changing due to geological processes such as plate tectonics, weathering, and erosion, which shape the landscape over long periods of time.<br>• **Interconnectedness of Earth Systems:** Students will recognize the interconnectedness between geological processes, soil formation, agricultural practices, and environmental sustainability, understanding how changes in one system can affect others.<br>• **Human Impact on the Environment:** Students will comprehend the significant impact of human activities, such as agriculture, urbanization, and resource extraction, on the environment, including soil degradation, habitat loss, and pollution.<br>• **Importance of Sustainability:** Students will appreciate the importance of sustainable practices in agriculture, urban planning, and resource management for preserving natural resources, protecting biodiversity, and maintaining ecosystem health.<br>• **Complexity of Food Systems:** Students will recognize the complexity of food production systems, including the environmental impacts of different methods of meat production, aquaculture, and agricultural practices, and understand the importance of making informed choices for sustainable food systems.<br>• **Urbanization and Sustainable Development:** Students will understand the challenges and opportunities associated with urbanization, including its effects on land use, transportation, and the water and carbon cycles, and the importance of promoting sustainable urban development strategies.<br>• **Environmental Stewardship:** Students will develop a sense of environmental stewardship, recognizing their role in protecting Earth's natural resources and ecosystems, and advocating for sustainable practices in their communities and beyond. |
| **Demonstration of Learning:** | **Pacing for Unit** |

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| | 8 weeks |

**Unit-specific Vocabulary:**

Agriculture, Clearcutting, Concentrated Animal Feeding Operation, Crop yield, Erosion, Extraction, Genetically modified organism, Green revolution, Integrated Pest Management, Loam, Monoculture, Ore, Organic, Pesticide, Plate boundaries, Plate tectonics, Prescribed burns, Selective burns, SMART growth, Soil Triangle, Synthetic Fertilizer, Tillage, Urban Sprawl, Urbanization, Weathering.

**Anticipated misconceptions:**

- Misconception: Weathering and erosion are the same thing.
  - Clarification: Weathering refers to the breakdown of rocks into smaller pieces by physical, chemical, or biological processes, while erosion involves the transport of these weathered materials by agents such as water, wind, or ice.
- Misconception: All agricultural practices contribute to soil degradation.
  - Clarification: While some agricultural practices, such as excessive tilling or monoculture farming, can lead to soil degradation, others, like no-till farming or cover cropping, help improve soil health and reduce erosion.
- Misconception: Urbanization only affects cities and has no impact on rural areas.
  - Clarification: Urbanization can have far-reaching effects beyond cities, including changes in land use, water quality, and biodiversity, which can impact both urban and rural areas.
- Misconception: Genetically modified organisms (GMOs) are always harmful to the environment.
  - Clarification: While there are concerns about GMOs, such as potential impacts on biodiversity or increased pesticide use, they can also offer benefits such as increased crop yields and reduced chemical inputs.
- Misconception: Aquaculture is always more sustainable than wild-caught fishing.
  - Clarification: While aquaculture can reduce pressure on wild fish populations, it can also have negative environmental impacts, such as pollution, habitat destruction, and disease transmission, which need to be carefully managed.
- Misconception: All mining practices result in significant environmental damage.
  - Clarification: While some mining practices, like mountaintop removal mining, can cause extensive environmental damage, others, such as underground mining with proper reclamation, can minimize impacts and restore ecosystems.
- Misconception: Prescribed burns always harm ecosystems and wildlife.
  - Clarification: Prescribed burns are carefully planned and controlled fires used to manage ecosystems and reduce the risk of wildfires. When conducted properly, they can promote ecosystem health, restore habitats, and reduce the risk of catastrophic wildfires.
- Misconception: Sustainable cities are only concerned with environmental issues.
  - Clarification: Sustainable cities address not only environmental concerns but also social and economic factors, including equity, public health, and economic prosperity, to create livable and resilient communities.
- Misconception: Soil conservation practices are unnecessary because soil is abundant and renewable.
  - Clarification: While soil is a renewable resource, it forms slowly over thousands of years and can be easily degraded by erosion, pollution, and poor land management practices. Soil conservation is essential for maintaining soil health and productivity for future generations.
- Misconception: The Green Revolution solved all global food production challenges.
  - Clarification: While the Green Revolution led to significant increases in crop yields, it also had unintended consequences such as increased dependence on chemical inputs, loss of biodiversity, and environmental degradation, highlighting the need for more sustainable agricultural practices.

**Differentiation through *Universal Design for Learning***

| **UDL Indicator** | **Teacher Actions:** |
|---|---|
| **Representation:** Highlight patterns, critical features, big | • Highlight or emphasize key elements in text, |

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|---|---|
| ideas, and relationships | graphics, diagrams, formulas<br>• Use outlines, graphic organizers, unit organizer routines, concept organizer routines, and concept mastery routines to emphasize key ideas and relationships<br>• Use multiple examples and non-examples to emphasize critical features<br>• Use cues and prompts to draw attention to critical features<br>• Highlight previously learned skills that can be used to solve unfamiliar problems |

**Supporting Multilingual/English Learners**

| **Related *CELP standards:*** | **Learning Targets:** |
|---|---|

**The CELP guidance is to support the development of language; access to course content expectations should not change as a result of MLL status.*

An EL can conduct research and evaluate and communicate findings to answer questions or solve problems.
**I can research the effects of urbanization on the environment.**

- Level 1: With prompting and support, I can explore how urbanization affects the environment by looking at a few pictures and listening to a short story.
- Level 2: With prompting and support, I can learn about how urbanization impacts the environment by reading a provided article and watching a short video.
- Level 3: With guidance and support, I can investigate the effects of urbanization on the environment by reading multiple articles and watching videos from reliable sources. I will summarize what I learn in a short report, including pictures or drawings to illustrate key points, and list the sources I used.
- Level 4: I can research and analyze the effects of urbanization on the environment by gathering information from various sources such as articles, books, and documentaries. Using effective search terms, I will evaluate the reliability of each source, integrate the information into a well-organized report, and cite my sources correctly.
- Level 5: I can conduct thorough research on the effects of urbanization on the environment by analyzing information from diverse sources including scholarly articles, government reports, and expert interviews. Using advanced search terms, I will critically evaluate the reliability of each source, analyze and synthesize the information to form a coherent argument, and present my findings in a well-structured and properly cited written report.

| **Lesson Sequence** | **Learning Target** | **Success Criteria/ Assessment** | **Resources** |
|---|---|---|---|
| 1<br>Geosphere | I can breakdown the geological changes and events that occur at convergent, divergent, and transform plate boundaries<br><br>I can explain how the geological processes have resulted in an ever-changing landscape. | • I can illustrate the ring of fire on a map of the world<br>• I can predict the landforms that are formed at each type of plate boundary.<br>• I can indicate the movements that occur at each type of plate boundaries.<br>• I can conclude how plate tectonics shape the earth beneath our feet.<br>• I can model the mechanical layers of the Earth<br>• I can show how matter is recycled inside of the Earth<br>• I can differentiate between weathering and erosion. | |

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| 2<br>Soils | I can describe the characteristics and formation of soil.<br><br>I can connect the importance of soils to agricultural practices<br><br>I can describe the impacts of agriculture on soils.<br><br>I can compare and contrast the properties of different soil types. | ● I can appraise soil for its health<br>● I can calculate the type of soil present using the soil type pyramid.<br>● I can diagram the layers present in a soil profile<br>● I can describe the importance of soils in terms of agriculture.<br>● I can articulate causes of soil degradation.<br>● I can explain how humans are increasing soil degradation around the world.<br>● I can predict the soil types in loam<br>● I can explain how we protect soils and why it is important we do so. |
| 3<br>Agriculture | I can outline the major historical developments in agriculture.<br><br>I can evaluate agricultural practices for their ecological impact.<br><br>I can explain how the green revolution allowed us to feed our world's growing population. | ● I can explain the different types of irrigation systems used on farms and which system conserves water the best.<br>● I can differentiate between no-till and tilling farming<br>● I can argue for or against different farming techniques used to protect soils and promote successful growing seasons.<br>● I can explain what an organic fertilizer is and its benefits.<br>● I can explain what non-organic fertilizer provides to the soil<br>● I can construct an opinion in the debate over genetically modified food<br>● I can evaluate how we preserve crop diversity<br>● I can categorize and explain the different strategies of pest management. |
| 4<br>Meat Production | I can Identify different methods of meat production.<br><br>I can evaluate the benefits and drawbacks of different methods of meat production | ● I can explain what a CAFO is and why they are used around the world.<br>● I can explain how our food choices also involve different amounts of energy input.<br>● I can determine what meat sources require the most land.<br>● I can reflect on how seeing documentaries about meat production has changed my outlook on food selection.<br>● I can explain how the consumption of meat has more of an impact on the environment than vegetarian options.<br>● I can propose changes to the way we provide food to increase sustainability |
| 5<br>Aquaculture | I can discuss causes of and problems related to overfishing.<br><br>I can determine the positives and negatives to using aquaculture to feed our world's growing population. | ● I can explain how aquaculture provides food security.<br>● I can identify the potential problems associated with aquaculture.<br>● I can classify which fishing technique damages the aquatic ecosystem the most<br>● I can propose the best way to prevent overfishing in our waterways.<br>● I can evaluate whether or not aquaculture is a smart |

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| | | alternative to wild caught fish |
| 6<br>Mining | I can link the extraction of natural resources to land degradation. | • I can explain the difference between ore and gangue minerals.<br>• I can discuss how the extraction of natural resources causes water pollution.<br>• I can model how mining reclamation is an important step to reclaiming a productive environment.<br>• I can differentiate between surface and underground mining. |
| 7<br>Forestry | I can predict the effect of clearcutting on forests.<br><br>I can evaluate the fundamentals of forest management and describe the methods of harvesting timber. | • I can explain what ecosystem services are provided by forest.<br>• I can discuss how the national park system was designed to promote biodiversity.<br>• I can assess how habitat fragmentation affects wildlife.<br>• I can evaluate the different types of timber harvesting techniques used.<br>• I can show how clear cutting affects erosion.<br>• I can argue why prescribed burns are used in many parts of the United States. |
| 8<br>Urbanization | I can research the effects of urbanization on the environment.<br><br>I can explain city and regional planning, along with land use strategies.<br><br>I can justify the pursuit of sustainable cities. | • I can explain how the water cycle is affected by urbanization.<br>• I can explain how urbanization affects the carbon cycle.<br>• I can define urban sprawl<br>• I can assess strategies used by both city and regional planners.<br>• I can justify why public transportation is important during urbanization.<br>• I can argue the role that urban parks and green spaces play in cities.<br>• I can exemplify what “new urbanism” is.<br>• I can explain how urbanization affects human health.<br>• I can describe the difference in population density between urban centers and rural areas.<br>• I can propose the components to a sustainable city. |

| **Unit Title:** | |
|---|---|
| Energy Resources | |
| **Relevant Standards: Bold indicates priority** | |
| All College Board Practices are infused in these lessons. | |
| **Essential Question(s):** | **Enduring Understanding(s):** |
| • How do fossil fuels compare in meeting societal energy needs, and what are the social, environmental, and economic implications of their usage?<br>• What are the formation processes and extraction methods of coal, natural gas, oil, and oil shale/tar sands, and how do they differ in their energy content?<br>• How do intermediate energy sources such as nuclear, biomass, and damming/water compare to fossil fuels, and what are their potential roles in transitioning to renewable energy?<br>• What are the social, environmental, and economic implications of renewable energy sources such as wind, solar, geothermal, and ocean energy, and how do they compare to fossil fuels?<br>• How do the costs and benefits of different energy sources, including fossil fuels, intermediate, and renewable sources, compare, and what are the implications for energy policy and decision-making? | Fossil Fuels:<br>• Fossil fuels are essential energy sources that have significant social, environmental, and economic impacts.<br>• The extraction, processing, and usage of fossil fuels vary, and each type has distinct benefits and drawbacks.<br>• Fossil fuels are finite resources and contribute to environmental degradation and climate change.<br>• Society's reliance on fossil fuels necessitates a balanced understanding of their role and the need for sustainable alternatives.<br>Formation and Extraction:<br>• Understanding the formation processes and extraction methods of fossil fuels helps explain their availability, energy content, and environmental impacts.<br>• Coal, natural gas, oil, and oil shale/tar sands have unique properties and require different extraction techniques.<br>• Extraction of fossil fuels often leads to environmental degradation, habitat destruction, and pollution.<br>• Variations in energy content among fossil fuels influence their suitability for different applications.<br>Intermediate Energy Sources:<br>• Intermediate energy sources like nuclear, biomass, and hydropower offer alternatives to fossil fuels with differing benefits and challenges.<br>• These sources provide a transition towards renewable energy while addressing some limitations of fossil fuels.<br>• Intermediate energy sources have diverse social, environmental, and economic impacts that require careful consideration.<br>• Balancing energy needs with environmental sustainability is crucial in evaluating the role of intermediate energy sources.<br>Renewable Energy:<br>• Renewable energy sources offer sustainable alternatives to fossil fuels with minimal environmental impact and long-term viability.<br>• Wind, solar, geothermal, and ocean energy sources |

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| | harness natural processes to generate clean energy.<br>● Renewable energy technologies continue to advance, making them increasingly competitive and accessible.<br>● Transitioning to renewable energy requires understanding and addressing challenges such as intermittency, energy storage, and infrastructure development.<br>Cost-Benefit Analysis and Policy Implications:<br>● Evaluating the costs and benefits of different energy sources informs policy decisions and energy planning.<br>● Energy policies should prioritize sustainability, affordability, reliability, and environmental stewardship.<br>● Balancing short-term economic gains with long-term environmental and social impacts is essential in energy decision-making.<br>● Sustainable energy policies require collaboration between governments, industries, communities, and individuals to achieve common goals. |
| **Demonstration of Learning:** | **Pacing for Unit** |
| | 7 |

**Unit-specific Vocabulary:**

Anthracite, Bituminous, Biofuels, Carbon neutral, Energy crops, Flaring, Fuel rods, Hydrocarbon, Hydrofracking, Methane digester, Moderator, Natural gas, Non-renewable Resource, Nuclear chain reaction, Nuclear fission, Oil, Peat, Petroleum, Primary extraction, Renewable Resource, Run-of-the-river dam, Secondary extraction, Synthetic fuels, Turbine.

**Anticipated misconceptions:**

- Misconception: Fossil fuels are inexhaustible resources.
  - Clarification: Fossil fuels are formed over millions of years and are considered non-renewable because they are consumed much faster than they can be replenished.
- Misconception: Fossil fuels have no alternatives.
  - Clarification: While fossil fuels have been the primary energy source, there are renewable and intermediate energy sources available as alternatives, each with its own benefits and drawbacks.
- Misconception: Fossil fuels are clean energy sources.
  - Clarification: Fossil fuels, when burned, release pollutants such as carbon dioxide, sulfur dioxide, and nitrogen oxides, contributing to air pollution and climate change.
- Misconception: Nuclear energy is entirely safe and has no environmental impacts.
  - Clarification: While nuclear energy produces low greenhouse gas emissions, it poses risks such as radioactive waste and the potential for accidents like Chernobyl and Fukushima.
- Misconception: Biomass energy is always sustainable and eco-friendly.
  - Clarification: While biomass can be a renewable energy source, unsustainable practices like deforestation for fuel can lead to habitat loss and biodiversity decline.
- Misconception: Hydropower dams have no negative environmental consequences.
  - Clarification: While hydropower is renewable, dam construction can disrupt ecosystems, alter river flow, and displace communities, impacting aquatic habitats and biodiversity.
- Misconception: Renewable energy sources are always available and reliable.
  - Clarification: While renewable energy is abundant, its availability can vary based on factors like weather

and geography, requiring solutions for intermittency and energy storage.
- Misconception: Renewable energy technologies are expensive and impractical.
  - Clarification: Advances in technology have made renewable energy increasingly cost-competitive, with declining costs for solar, wind, and other renewables.
- Misconception: Renewable energy can fully replace fossil fuels overnight.
  - Clarification: Transitioning to renewable energy requires significant infrastructure investment, policy support, and societal changes, which will take time and effort.
- Misconception: Environmental regulations and renewable energy incentives hinder economic growth.
  - Clarification: Well-designed policies can stimulate innovation, create jobs, and drive economic growth while protecting the environment and public health.
- Misconception: Energy independence means reliance solely on domestic fossil fuel production.
  - Clarification: True energy independence involves diversifying energy sources, reducing dependence on fossil fuels, and investing in domestic renewable energy resources.
- Misconception: Energy policy is solely the responsibility of governments.
  - Clarification: Energy policy requires collaboration between governments, industries, communities, and individuals to address challenges and achieve sustainable energy goals.

| **Differentiation through *Universal Design for Learning*** | |
|---|---|
| **UDL Indicator** | **Teacher Actions:** |
| **Representation:** Highlight patterns, critical features, big ideas, and relationships | • Highlight or emphasize key elements in text, graphics, diagrams, formulas<br>• Use outlines, graphic organizers, unit organizer routines, concept organizer routines, and concept mastery routines to emphasize key ideas and relationships<br>• Use multiple examples and non-examples to emphasize critical features<br>• Use cues and prompts to draw attention to critical features<br>• Highlight previously learned skills that can be used to solve unfamiliar problems |

| **Supporting Multilingual/English Learners** | |
|---|---|
| **Related *CELP standards:*** | **Learning Targets:** |

*The CELP guidance is to support the development of language; access to course content expectations should not change as a result of MLL status.

An EL can conduct research and evaluate and communicate findings to answer questions or solve problems.
**I can articulate the social, environmental, and economic benefits and drawbacks of each of the renewable energy usages**

- Level 1: With prompting and support, I can identify some social, environmental, and economic benefits and drawbacks of renewable energy usages.
- Level 2: With prompting and support, I can gather information from provided sources to list some social, environmental, and economic benefits and drawbacks of renewable energy usages.
- Level 3: With guidance and support, I can conduct short research to evaluate provided sources, and describe the social, environmental, and economic benefits and drawbacks of renewable energy usages.
- Level 4: I can conduct research to evaluate various sources, and explain the social, environmental, and economic benefits and drawbacks of renewable energy usages.
- Level 5: I can conduct in-depth research, analyzing multiple sources to critically assess the social, environmental, and economic benefits and drawbacks of renewable energy usages, and propose recommendations based on my findings.

| Lesson Sequence | Learning Target | Success Criteria/ Assessment |
|---|---|---|
| 1 | I can compare and contrast the ways each fossil fuels are used in providing energy to meet the needs of society<br><br>I can articulate the social, environmental, and economic benefits and drawbacks of each of the fossil fuel usages<br><br>I can articulate the social, environmental, and economic benefits and drawbacks of each of the fossil fuel usages | • I can explain why fossil fuels are considered non-renewable<br>• I can illustrate coal was formed and explain how it is extracted and used for energy<br>• I can differentiate the different types of coal and the amount of energy held in each<br>• I can illustrate how natural gas was formed and explain how it is extracted and used for energy<br>• I can illustrate how oil was formed and explain how it is extracted and used for energy<br>• I can illustrate how oil shale/tar sands were formed and explain how it is extracted and used for energy<br>• I can analyze the impacts coal usage has on the environment, economy, and society<br>• I can analyze the impacts natural gas usage has on the environment, economy, and society<br>• I can analyze the impacts that oil usage has on the environment, economy, and society<br>• I can analyze the impacts tar sands/oil shale has on the environment, economy, and society<br>• I can analyze current data on fossil fuel production and consumption by country and determine implications of this<br>• I can conduct a cost -benefit analysis to compare and contrast the suitability of each of the fossil fuel usages. |
| 2 | I can compare and contrast the ways in which “intermediate” energy sources such as damming/water, nuclear, and biomass<br><br>I can articulate the social, environmental, and economic benefits and drawbacks of each of the intermediate energy sources usages<br><br>I can evaluate whether or not intermediate energy sources can help bridge transition from fossil fuels to eventually renewable energy | • I can explain why nuclear, biomass, and dams are considered intermediate on the renewability scale<br>• can illustrate how nuclear power is generated and explain how it is used for energy.<br>• I can illustrate how damming of water generates energy and how it is used.<br>• I can illustrate how different types of biomass, including crops/plants, animals, and waste gene<br>• rates energy and how it is used.<br>• I can analyze the impacts and risks of using nuclear energy to the environment, society and the economy<br>• I can analyze the impacts of damming water sources for energy on the environment, society and the economy<br>• I can analyze the impacts of using biomass energy on the environment, society and the economy.<br>• I can conduct a cost benefit analysis to compare and contrast the suitability of each intermediate energy source.<br>• I can argue for or against the use of intermediate energy sources |
| 3 | I can compare and contrast the ways renewable energy sources are used in | • I can explain why wind, solar, geothermal, and ocean energy sources are considered renewable, along |

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| | providing energy to meet the needs of society<br><br>I can articulate the social, environmental, and economic benefits and drawbacks of each of the renewable energy usages | with any new technologies developing to provide renewable energy sources<br>● I can illustrate how wind generates energy and explain how it is used<br>● I can illustrate how solar generates energy through both active and passive processes and explain how they are used<br>● I can illustrate how geothermal processes generate energy and explain how they can vary in their usages<br>● I can illustrate how ocean energy sources generate energy and how they are used<br>● I can analyze the impacts of wind energy on the environment, society and the economy.<br>● I can analyze the impacts of solar energy on the environment, society and the economy.<br>● I can analyze the impacts of geothermal energy on the environment, society and the economy.<br>● I can analyze the impacts of ocean energy on the environment, society and the economy.<br>● I can conduct a cost benefit analysis to compare and contrast the suitability of each renewable energy source. |

| **Unit Title:** | |
|---|---|
| Land, Air, and Water Pollution | |
| **Relevant Standards: Bold indicates priority** | |
| All College Board Practices are infused in these lessons. | |
| **Essential Question(s):** | **Enduring Understanding(s):** |
| • What are the primary sources of water, air, and soil pollution, and how do they impact the environment, society, and the economy?<br>• How can we develop effective solutions to mitigate pollution in water, air, and soil to lessen their impact on the environment, society, and the economy?<br>• What measures can be taken to improve the efficiency and sustainability of recycling and waste management practices to reduce pollution and conserve resources? | • Pollution has multifaceted impacts on the environment, society, and the economy, highlighting the interconnectedness of human activities and natural systems.<br>• Effective solutions to pollution require interdisciplinary approaches that consider environmental, social, and economic factors.<br>• Sustainable management of resources and waste is essential for mitigating pollution and maintaining environmental quality.<br>• Awareness of pollution sources and impacts empowers individuals and communities to make informed decisions and advocate for positive change.<br>• Continuous innovation and adaptation are necessary for addressing emerging pollution challenges and improving environmental stewardship.<br>• Pollution created by human activities directly impacts ecosystems in the air, on land, and in water. The source of pollution can sometimes be easy to identify, but other times the source is diffused. There are many human health issues that can be linked to pollution. Increases in waste causes global concerns for organisms that live on land, air and in water. Air pollution can be in the form of gasses or particulates in the atmosphere and be generated by both natural and human sources.<br>• Pollution also has negative impacts on the economy. Practices have been put in place to reduce discharges of pollution in water and air and regulate drinking water. |
| **Demonstration of Learning:** | **Pacing for Unit** |
| | 7 |
| **Unit-specific Vocabulary:** | |
| Bioaccumulation, Biomagnification, Dose response curve, Electronic waste (E-waste), Endocrine disruptors, Eutrophication, Waterborne pathogens, Landfill, Lethal dose 50% (LD50), Nonpoint source pollutant, Oceanic dead zones, Persistent organic pollutants (POPs), Point source pollutant, Recycling processes, Sewage treatment, Solid waste, Thermal pollution, Photochemical smog, Industrial smog, Primary air pollutants, Secondary air pollutants, Thermal inversion, Volatile Organic Compounds (VOCs). | |

**Anticipated Misconceptions:**

- Misconception: Pollution only affects the environment.
  - Clarification: Pollution impacts not only the environment but also society and the economy. For example, air pollution can lead to health problems in humans (society) and economic losses due to decreased productivity and healthcare costs (economy).
- Misconception: Pollution is solely caused by industrial activities.
  - Clarification: While industrial activities are significant sources of pollution, other activities like agriculture, transportation, and household practices also contribute. For instance, agricultural runoff containing fertilizers and pesticides can pollute water bodies.
- Misconception: Pollution is only harmful to wildlife.
  - Clarification: Pollution affects various aspects of human life, including health, recreation, and livelihoods. For instance, contaminated water sources can lead to waterborne diseases, affecting human health and well-being.
- Misconception: Pollution problems are unsolvable and too large-scale to address.
  - Clarification: While pollution is a complex issue, there are effective strategies and solutions available. These include regulations, technological advancements, public awareness campaigns, and individual actions that collectively contribute to reducing pollution levels.
- Misconception: Recycling and waste treatment processes eliminate pollution entirely.
  - Clarification: Recycling and waste treatment help manage pollution by reducing the volume of waste and preventing harmful substances from entering the environment. However, these processes may not completely eliminate pollution, and proper disposal methods are still crucial to minimize environmental impact.

**Differentiation through *Universal Design for Learning***

| **UDL Indicator** | **Teacher Actions:** |
|---|---|
| **Representation:** Highlight patterns, critical features, big ideas, and relationships | • Highlight or emphasize key elements in text, graphics, diagrams, formulas<br>• Use outlines, graphic organizers, unit organizer routines, concept organizer routines, and concept mastery routines to emphasize key ideas and relationships<br>• Use multiple examples and non-examples to emphasize critical features<br>• Use cues and prompts to draw attention to critical features<br>• Highlight previously learned skills that can be used to solve unfamiliar problems |

**Supporting Multilingual/English Learners**

| **Related *CELP standards:*** | **Learning Targets:** |
|---|---|

*The CELP guidance is to support the development of language; access to course content expectations should not change as a result of MLL status.

An EL can conduct research and evaluate and communicate findings to answer questions or solve problems.
**I can propose solutions to air pollution to lessen the impact on the environment, society and the economy**

- Level 1: With prompting and support, I can suggest simple ways to reduce air pollution and help the environment, society, and the economy.
- Level 2: With prompting and support, I can propose solutions to reduce air pollution and its impact on the environment, society, and the economy based on information I find.
- Level 3: With guidance and support, I can propose solutions to reduce air pollution and its impact on the environment, society, and the economy by gathering and evaluating information from multiple sources.

- Level 4: I can propose effective solutions to reduce air pollution and its impact on the environment, society, and the economy by conducting research, synthesizing information, and presenting it in an organized manner.
- Level 5: I can propose advanced solutions to reduce air pollution and its impact on the environment, society, and the economy by conducting thorough research, analyzing information critically, and presenting comprehensive solutions with appropriate citations.

| Lesson Sequence | Learning Target | Success Criteria/Assessment/Resources |
|---|---|---|
| 1 | I can identify sources of water pollution and discuss the impacts to the environment, society, and the economy<br><br>I can generate solutions to water pollution to lessen the impacts on the environment, society, and the economy | • I can demonstrate that point source refers to a single, identifiable source of a pollutant while nonpoint sources of pollution are diffused and can be difficult to identify<br>• I can use data to show that increasing ocean temperatures, ocean acidification and sediment runoff from agriculture practices have caused coral reefs to decline.<br>• I can generate examples that show large scale oil spills kill plants and animals due to chemical and physical impacts.<br>• I can conclude that excess nutrients in the ocean from agricultural runoff and other sources causes oceanic and freshwater dead zones.<br>• I can argue that thermal pollution from factories using natural waterways to cool equipment, alters the concentration of dissolved oxygen and tests an organism's physical tolerances.<br>• I can articulate the results of heavy metals impacting the drinking water supply.<br>• I can discuss how endocrine disruptors can lead to birth defects.<br>• I can model how bioaccumulation of toxins in food sources such as large fish can cause issues with the reproductive, nervous, and circulatory systems.<br>• I can generate a list of waterborne pathogens, their sources, and human health impacts to justify the need for potable water globally<br>• I can illustrate how modern landfills put in place efforts to make sure toxins do not drain into watersheds, but are not always effective.<br>• I can justify each step of the sewage treatment processes and distinguish that modern sewage plants do not allow collecting rain water and do not overflow raw sewage into waterways.<br>• I can discuss the recycling process and propose ways to increase its efficiency and sustainability |
| 2 | I can identify both the primary and secondary sources of air pollution and discuss the impacts to the environment, society, and the economy | • I can identify the major primary and secondary pollutants and generate a list of their sources<br>• I can distinguish between industrial and photochemical smog<br>• I can connect photochemical and industrial smog events, including thermal inversions to both atmospheric and geological trends<br>• I can justify the need for solutions to air pollution |

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| | I can propose solutions to air pollution to lessen the impact on the environment, society and the economy | though articulation of impacts to the environment, society, and the economy<br>• I can discuss solutions already in place to reduce air pollution and engineer new ideas or ways to increase the use of existing solutions |
| 3 | I can identify sources of land/soil pollution and discuss the impacts to the environment, society, and the economy<br><br>I can generate solutions to land/soil pollution to lessen the impact on the environment, society and the economy. | • I can illustrate how modern landfills put in place efforts to make sure toxins do not drain into soil, but are not always effective.<br>• I can identify other sources of land/soil pollution such as solid waste, e-waste, runoff of different pollutants and propose solutions that are already in place be expanded or engineer new solutions |

| **Unit Title:** | |
|---|---|
| Global Change | |
| **Relevant Standards: Bold indicates priority** | |
| All College Board Practices are infused in these lessons. | |
| **Essential Question(s):** | **Enduring Understanding(s):** |
| • What are the natural and anthropogenic drivers of climate change?<br>• How are human activities increasing greenhouse gas emissions?<br>• How does human activity impact the ozone layer?<br>• What are human activities that increase the loss of biodiversity globally?<br>• How can humans reduce their global impacts? | • The ozone layer is crucial for protecting life on Earth by absorbing harmful UV radiation, and human activities can significantly deplete it, leading to negative consequences for both the environment and society.<br>• Human activities, such as the use of chlorofluorocarbons (CFCs) and hydrofluorocarbons (HFCs), contribute to ozone depletion and global climate change, highlighting the need for sustainable alternatives.<br>• The Montreal Protocol has been successful in reducing global ozone loss, demonstrating the effectiveness of international cooperation in addressing environmental challenges.<br>• Greenhouse gasses play a critical role in regulating Earth's temperature through the greenhouse effect, but human activities have led to an increase in their concentrations, resulting in global climate change.<br>• Climate change has far-reaching impacts on ecosystems, biodiversity, and human societies, including rising sea levels, habitat destruction, and increased frequency of extreme weather events.<br>• Human behavior poses significant threats to global biodiversity, including habitat destruction, invasive species, and pollution, emphasizing the importance of adopting sustainable practices.<br>• Sustainable alternatives and practices can help mitigate the negative impacts of human activities on the environment, strengthen the economy, and promote social justice and equity.Stratospheric ozone is vital to life on Earth, human activities have caused the depletion of stratospheric ozone. Human activities can increase greenhouse gasses that can cause human health and environmental problems.<br>• Changing ecosystems and pressure from human populations can cause some species to become endangered. |
| **Demonstration of Learning:** | **Pacing for Unit** |
| | 6 |
| **Unit-specific Vocabulary:** | |

Biodiversity, Chlorofluorocarbons (CFCs), Endangered Species, Global climate change, Greenhouse effect, Greenhouse gasses, HIPPCO, Hydrofluorocarbons (HFCs), Invasive species, Ocean acidification, Ocean warming, Stratospheric ozone.

**Anticipated misconceptions:**

- Misconception: Ozone depletion and global warming are the same thing.
  - Clarification: Ozone depletion refers specifically to the thinning of the ozone layer in the stratosphere, while global warming refers to the overall increase in Earth's average temperature due to the greenhouse effect.
- Misconception: Ozone depletion is only caused by human activities.
  - Clarification: While human activities, such as the use of CFCs, contribute significantly to ozone depletion, natural processes also play a role. Human activities have accelerated ozone depletion, but natural processes like volcanic eruptions also release ozone-depleting substances.
- Misconception: Ozone depletion and the greenhouse effect are entirely separate phenomena.
  - Clarification: While they are distinct, there is some overlap. Ozone depletion affects the stratosphere and primarily impacts UV radiation levels, while the greenhouse effect occurs in the troposphere and impacts temperature regulation. However, some ozone-depleting substances also act as greenhouse gases, contributing to both phenomena.
- Misconception: All greenhouse gases are harmful.
  - Clarification: While some greenhouse gases, like carbon dioxide and methane, contribute to global warming and climate change, others, like water vapor, are essential for regulating Earth's temperature and supporting life. It's the excessive accumulation of certain greenhouse gases that poses a problem.
- Misconception: Climate change only affects the environment.
  - Clarification: Climate change has wide-ranging impacts, including on human societies and economies. It affects agriculture, water resources, health, and can lead to social and economic disruptions.
- Misconception: Invasive species are not harmful to ecosystems.
  - Clarification: Invasive species can have devastating effects on native ecosystems, outcompeting native species for resources, disrupting food chains, and altering habitats.
- Misconception: Climate change is a natural phenomenon, and human activities play a negligible role.
  - Clarification: While natural climate variability exists, scientific evidence overwhelmingly shows that human activities, such as burning fossil fuels and deforestation, have significantly accelerated climate change in recent decades.
- Misconception: Biodiversity loss only affects wildlife.
  - Clarification: Biodiversity loss affects ecosystems as a whole, including humans. It can lead to reduced ecosystem services, such as pollination and water purification, which are vital for human well-being.
- Misconception: Sustainable practices are costly and ineffective.
  - Clarification: While there may be upfront costs associated with implementing sustainable practices, they often lead to long-term benefits, including cost savings, improved resource efficiency, and reduced environmental impacts. Additionally, sustainable practices are essential for ensuring a healthy planet for future generations.

**Differentiation through *Universal Design for Learning***

| **UDL Indicator** | **Teacher Actions:** |
|---|---|
| **Representation:** Highlight patterns, critical features, big ideas, and relationships | • Highlight or emphasize key elements in text, graphics, diagrams, formulas<br>• Use outlines, graphic organizers, unit organizer routines, concept organizer routines, and concept mastery routines to emphasize key ideas and relationships<br>• Use multiple examples and non-examples to emphasize critical features<br>• Use cues and prompts to draw attention to critical features<br>• Highlight previously learned skills that can be |

| | | |
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| | used to solve unfamiliar problems | |

| **Supporting Multilingual/English Learners** | |
|---|---|
| **Related *CELP standards:*** | **Learning Targets:** |

*The CELP guidance is to support the development of language; access to course content expectations should not change as a result of MLL status.

An EL can conduct research and evaluate and communicate findings to answer questions or solve problems.
**I can propose sustainable alternatives to human behaviors that preserve rather than threaten biodiversity**

- Level 1: I can identify sustainable alternatives to human behaviors that help protect biodiversity with support.
- Level 2: I can identify and record some sustainable alternatives to human behaviors that help protect biodiversity.
- Level 3: I can research and evaluate multiple sustainable alternatives to human behaviors that help protect biodiversity, and provide a list of sources.
- Level 4: I can conduct research to gather and synthesize information from multiple sources about sustainable alternatives to human behaviors, evaluate their reliability, and integrate them into an organized report, citing sources appropriately.
- Level 5: I can conduct in-depth research to gather and synthesize information from multiple sources about sustainable alternatives to human behaviors, using advanced search terms effectively, evaluating their reliability, analyzing and integrating them into a clearly organized text, and citing sources appropriately.

| **Lesson Sequence** | **Learning Target** | **Success Criteria/Assessment/Resources** |
|---|---|---|
| 1 | I can discuss the importance of the ozone layer and illustrate how it naturally builds and breaks down through chemical reactions<br><br>I can predict how certain human activities will contribute to ozone depletion<br><br>I can propose ways to enhance ozone protections | • I can model that natural build up and break down of ozone in the atmosphere to maintain appropriate functioning<br>• I can model how stratospheric ozone absorbs harmful UV rays preventing them from reaching the Earth's surface.<br>• I can explain how chlorofluorocarbons (CFCs) deplete stratospheric ozone.<br>• I can differentiate that Hydrofluorocarbons (HFCs) are more reactive than Chlorofluorocarbons (CFCs) and are not ozone-depleting chemicals, they are however still very strong greenhouse gasses.<br>• I can evaluate the success of the Montreal Protocol on global ozone loss through analysis of current data and propose ways to increase or maintain successes |
| 2 | I can connect the link between global climate and greenhouse gas concentrations in the atmosphere through the greenhouse effect<br><br>I can analyze and link data showing greenhouse gas emissions from both human and natural activities to climate data<br><br>I can articulate the impacts of global climate change on both the natural and anthropogenic environments | • I can model how the naturally occurring greenhouse effect results in the surface temperature necessary for life on Earth to exist.<br>• I can identify Carbon dioxide, methane, water vapor, nitrous oxide, and chlorofluorocarbons (CFCs) as examples of greenhouse gasses and compare their climate changing potancies.<br>• I can use data to conclude that rising sea levels, disease vectors spreading and extreme weather events are all consequences of increasing global temperature.<br>• I can explain that warming of the ocean causes corals to bleach and eventually die. This causes a loss of habitat for a very complex and diverse |

| | | |
|---|---|---|
| | I can predict the economic toll climate change will have on countries into future based on current data and future projections of climate change | ecosystem.<br>● I can use data and modeling to justify that Increased CO2 concentrations in the atmosphere cause the ocean to acidify |
| 3 | I can assess the ways that human behavior threatens global biodiversity<br><br>I can propose sustainable alternatives to human behaviors that preserve rather than threaten biodiversity | ● I can analyze case studies of how human movement has facilitated invasive species and how these organisms can live outside of their normal habitat and often threaten native species.<br>● I can research and report on an invasive species that is having a negative effect on an ecosystem in the United States.<br>● I can evaluate what techniques have been used to eliminate invasive species.<br>● I can examine how HIPPCO (habitat destruction, invasive species, population growth, pollution, climate change, and over exploitation) are the major reasons for a loss in biodiversity<br>● I can propose sustainable alternatives to human behaviors that reduce impacts to ecosystems, strengthen the economy, and create a more just and equitable society through design/creation of a sustainable city. |