

## **Environmental Science Unit 4: Air and Air Pollution**

**25 instructional days**

### **Content Standards**

**HS-ESS2-1.** Develop a model to illustrate how Earth’s internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features. [Clarification Statement: Emphasis is on how the appearance of land features (such as mountains, valleys, and plateaus) and sea-floor features (such as trenches, ridges, and seamounts) are a result of both constructive forces (such as volcanism, tectonic uplift, and orogeny) and destructive mechanisms (such as weathering, mass wasting, and coastal erosion).] [Assessment Boundary: Assessment does not include memorization of the details of the formation of specific geographic features of Earth’s surface.]

**HS-ESS2-6.** Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. [Clarification Statement: Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.]

**HS-ESS2-7.** Construct an argument based on evidence about the simultaneous coevolution of Earth’s systems and life on Earth. [Clarification Statement: Emphasis is on the dynamic causes, effects, and feedbacks between the biosphere and Earth’s other systems, whereby geoscience factors control the evolution of life, which in turn continuously alters Earth’s surface. Examples include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life; how microbial life on land increased the formation of soil, which in turn allowed for the evolution of land plants; or how the evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for the evolution of new life forms.] [Assessment Boundary: Assessment does not include a comprehensive understanding of the mechanisms of how the biosphere interacts with all of Earth’s other systems.]

### **Science and Engineering Practices**

#### **Developing and Using Models**

- Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-ESS2-1), (HS-ESS2-6)

**Engaging in Argument from Evidence**

- Construct an oral and written argument or counter arguments based on data and evidence. (HS-ESS2-7)

**Disciplinary Core Ideas****ESS2.A: Earth Materials and Systems**

- Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (HS-ESS2-1)

**ESS2.D: Weather and Climate**

- Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (HS-ESS2-6),(HS-ESS2-7)
- Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2- 6)

**ESS2.E: Biogeology**

- The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it. (HS-ESS2-7)

**Crosscutting Concepts****Stability and Change**

- Much of science deals with constructing explanations of how things change and how they remain stable. (HS-ESS2-7)
- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS2-1)

**Energy and Matter**

- The total amount of energy and matter in closed systems is conserved. (HS-ESS2-6)

**Rationale and Transfer Goals :**

The purpose of this unit is to understand the different types of pollutants that affect air quality, and the ways in which air pollution is produced and the ways in which it can be reduced. Air pollution has short and long term effects on health. The source of air pollutants can be difficult to determine.

**Enduring Understandings:**

- Many pollutants in the air come from human activities.
- Pollutants in the air can have short term and long term effects on health.
- There are laws in place to monitor air quality, with government agencies in place to regulate.
- Pollutants in the air can negatively impact other species as well. Ex: acid rain from the atmosphere accumulates in the soil and can negatively affect plant growth.

**Essential Questions:**

- How do changes in the geosphere affect the atmosphere?
- How does carbon cycle among the hydrosphere, atmosphere, geosphere, and biosphere?
- How do living organisms alter Earth's processes and structures?

Content/Objectives		Instructional Actions	
Content	Skills	Activities/Strategies	Evidence (Assessments)
<i>What students will know</i>	<i>What students will be able to do</i>	<i>How we teach content and skills</i>	<i>How we know students have learned</i>
<ul style="list-style-type: none"> <li>● Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes.</li> <li>● The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection,</li> </ul>	<ul style="list-style-type: none"> <li>● Describe the primary air pollutants and their main source. (EX: CO is a primary pollutant, and one of it's main sources is cars)</li> <li>● Describe how smog forms.</li> <li>● Explain how temperature inversions can form, and</li> </ul>	<ul style="list-style-type: none"> <li>● Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.</li> <li>● Provide students with multiple choices for how they can represent their understandings (e.g.</li> </ul>	<ul style="list-style-type: none"> <li>● Analyze geoscience data using tools, technologies, and/or models (e.g., computational, mathematical) to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.</li> </ul>

<p>absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space.</p> <ul style="list-style-type: none"> <li>● Feedback (negative or positive) can stabilize or destabilize a system.</li> <li>● Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen.</li> <li>● Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.</li> <li>● The total amount of energy and matter in closed systems is conserved.</li> <li>● The total amount of carbon cycling among and between the hydrosphere,</li> </ul>	<p>how it can trap even more pollutants.</p> <ul style="list-style-type: none"> <li>● Examine the impacts of air pollutants on human health. (short term and long term)</li> <li>● ID problem areas in a house plan that may lead to higher indoor air pollution. (look at types of chemical cleaners in a house, ventilation, smoking etc.)</li> <li>● Correlate sick building syndrome with warmer environments.</li> <li>● Explain the causes of acid precipitation</li> <li>● Design an experiment to test the effects of acid precipitation on plant growth.</li> <li>● Present and analyze data showing effects of acid precipitation on plant growth.</li> <li>● Describe ways that the US and other countries</li> </ul>	<p>multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).</p> <ul style="list-style-type: none"> <li>● Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tools such as SKYPE, experts from the community helping with a project, journal articles, and biographies).</li> <li>● Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).</li> <li>● Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and</li> </ul>	<ul style="list-style-type: none"> <li>● Develop a model based on evidence to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.</li> <li>● Develop a model based on evidence to illustrate the biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere, providing the foundation for living organisms.</li> <li>● Construct an argument based on evidence about the simultaneous co-evolution of Earth's systems and life on Earth.</li> <li>● <a href="#">Environmental Benchmark #2</a></li> </ul>
--	--	---	--

<p>atmosphere, geosphere, and biosphere is conserved.</p> <ul style="list-style-type: none"> <li>The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it.</li> </ul>	<p>monitor acid precipitation and other air pollutants.</p>	<p>multiple ways to demonstrate their understanding.</p> <ul style="list-style-type: none"> <li>Use project-based science learning to connect science with observable phenomena.</li> <li>Structure the learning around explaining or solving a social or community-based issue.</li> <li>Provide ELL students with multiple literacy strategies.</li> <li>Collaborate with after-school programs or clubs to extend learning opportunities.</li> </ul>	
---	---	---	--

**Spiraling for Mastery**

Content or Skill for this Unit	Spiral Focus from Previous Unit	Instructional Activity
<ul style="list-style-type: none"> <li>Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes.</li> <li>Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen.</li> </ul>	<ul style="list-style-type: none"> <li>Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors.</li> <li>In any ecosystem, organisms and populations with similar</li> </ul>	<ul style="list-style-type: none"> <li>Resources from the Holt Environmental Science Text: <ul style="list-style-type: none"> <li>MathPractice: Utility Incentives for Zero-emission Vehicles</li> <li>Student Opportunities: The Yellow Bikes Program</li> <li>Case Study: The Health Effects of Ground-Level Ozone</li> </ul> </li> </ul>

<ul style="list-style-type: none"> <li>● The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it.</li> <li>● The total amount of carbon cycling among and between the hydrosphere, atmosphere, geosphere, and biosphere is conserved.</li> <li>● Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.</li> </ul>	<p>requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. Growth of organisms and population increases are limited by access to resources.</p> <ul style="list-style-type: none"> <li>● Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.</li> <li>● Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.</li> <li>● Adaptation by natural selection acting over generations is one important process by which species</li> </ul>	<ul style="list-style-type: none"> <li>○ Using the Figure: Indoor Air Pollution</li> <li>○ Graphic Organizer: Chain-of-Events Chart</li> <li>○ Maps in Action: Light Sources</li> <li>○ Map Skills: Pollution Levels</li> </ul>
--	---	---

change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes.

**Key resources:**

[Greenhouse Effect](#): Students explore the atmosphere during the ice age and today. What happens when you add clouds? Change the greenhouse gas concentration and see how the temperature changes. Then compare the effect of glass panes. Zoom in and see how light interacts with molecules. Do all atmospheric gases contribute to the greenhouse effect?

[Earth Systems Activity](#): Students model the carbon cycle and its connection with Earth's climate.

[Carbon and Climate](#): Students run a model of carbon sources and sinks and interpret results to develop their own model of the relationship of the carbon cycle to the Earth's climate. Students can also work through the content of the entire module called [Carbon Connections](#) which includes numerous models and interactives to gain a deeper understanding of the role of carbon in the climate system.

[EarthViewer \(IPad or Android\)](#) or for [Chrome](#) browsers: Students explore the co-evolution of the geology and biology found on Earth to develop arguments from evidence for the co-evolution of geology and biology found on Earth. If iPads, Androids or Chrome browsers are not available, similar interactives may be found at this [link](#), and this [link](#).

**21<sup>st</sup> Century Life & Careers:**

9.2.12.CAP.2: Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs.

9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.

9.2.12.CAP.4: Evaluate different careers and develop various plans (e.g., costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment.

**Career Readiness, Life Literacies, & Key Skills:**

9.4.12.CT.3: Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice).

9.4.12.CT.4: Participate in online strategy and planning sessions for course-based, school-based, or other projects and determine the strategies that contribute to effective outcomes.

9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political, economic, cultural) may work better than others.

9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources.

9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.

9.4.12.IML.4: Assess and critique the appropriateness and impact of existing data visualizations for an intended audience.

9.4.12.IML.5: Evaluate, synthesize, and apply information on climate change from various sources appropriately.

9.4.12.IML.6: Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender, and age diversity.

9.4.12.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change.

**Interdisciplinary Connections/Companion Standards:**

**NJSLS Mathematics**

HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-ESS2-1), (HS-ESS2-6)





HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. (HS-ESS2-1), (HS-ESS2-6)

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-ESS2-1), (HS-ESS2-6)

**NJSLS ELA**

WHST.9-12.1 Write arguments focused on discipline-specific content. (HS-ESS2-7)

SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-ESS2-1)

**Companion Standards for ELA in Science and Technical Subjects: Reading**

RST.11-12.1. Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.

RST.11-12.2. Determine the central ideas, themes, or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

**Companion Standards for ELA in Science and Technical Subjects: Writing**

WHST.11-12.1. Write arguments focused on discipline-specific content