

BPS Science Department Earth Science - Unit 9- The Atmosphere

Unit 9- During this unit, students will analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth's systems. They will use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. Students will plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. They will also develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. Students will analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

Driving Questions:

- How does solar energy flow from the sun to Earth, within Earth's spheres, and between Earth's spheres?
- How have natural processes and human activities changed Earth's atmosphere and climate over time?
- What evidence supports the claim that Earth's climate is being affected by human activities?
- How do changes in Earth's atmosphere, weather, and climate affect other systems on Earth?

NYSSLS Standards:

Lesson 9.1: In this lesson, students analyze and interpret the composition of the atmosphere (**SEP Analyzing and Interpreting Data**) and describe the structure of Earth's atmosphere based on how air density and temperatures change with increasing altitude (**CCC Stability and Change, DCI ESS2.A Earth Materials and Systems**). Students explore evidence (**SEP Engaging in Argument from Evidence**) of how the atmosphere interacts with Earth's other spheres (**CCC Stability and Change, DCI ESS2.D Weather and Climate**). Students develop models (**CCC Systems and System Models**) of how the motion of air in the atmosphere is driven by unequal heating of Earth's atmosphere (**DCI ESS2.D Weather and Climate**) and the corresponding effects (**CCC Cause and Effects**) that has on variations in air pressure and temperature around the globe and investigate (**SEP Planning and Carrying Out Investigations**) the influence of Earth's rotation through the Coriolis effect.

- **HS-ESS2-6 Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.**
HS-ESS2-7 Construct an argument based on evidence about the coevolution of Earth's systems and life on Earth.
 - **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)
- **HS-ESS2-2 Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to Earth's systems.**
 - **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-ESS2-2)
 - **ESS2.D Weather and Climate**
 - The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. (HS-ESS2-2)

Lesson 9.2: In this lesson, students learn that descriptions of weather (**DCI ESS2.D Weather and Climate**) are based on analysis and interpretation of data (**SEP Analyzing and Interpreting Data, CCC Scale, Proportion, and Quantity**) measuring atmospheric conditions at various times and places (**SEP Scientific Knowledge is Based on Empirical Evidence**). Students study how weather evolves (**CCC Stability and Change**) in time based on interactions between Earth systems such as air masses (**DCI ESS2.A Earth Materials and Systems, DCI ESS2.C The Role of Water in Earth's Surface Processes, CCC Cause and Effect**). Students explore how measurements and models (**SEP Developing and Using Models**) allow the forecasting of weather and the value of accurate forecasts.

- **HS-ESS2-2 Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to Earth's systems.**
 - **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-ESS2-2)
 - **ESS2.D Weather and Climate**
 - The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. (HS-ESS2-2)
- **HS-ESS2-5 Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.**
 - **ESS2.C The Role of Water in Earth's Surface Processes**

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- The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks. (HS-ESS2-5)
- **HS-ESS2-4 Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.**
 - **ESS2.D Weather and Climate**
 - Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-4)

Lesson 9.3: In this lesson, students develop arguments based on evidence (SEP Engaging in Argument from Evidence) describing how the geologic record shows changes to global and regional climate (DCI ESS2.A Earth Materials and Systems) and use computational representations to illustrate the cause-and-effect relationships (CCC Cause and Effect) related to these changes. Students use models (SEP Developing and Using Models) to study how the rates of weather and climate changes have varied over time (CCC Stability and Change, DCI ESS2.D Weather and Climate). They will study the role humans have played in global climate change (DCI ESS3.D Global Climate Change) and explore potential solutions to deal with these changes (SEP Constructing and Designing Solutions).

- **HS-ESS2-4 Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.**
 - **ESS2.A Earth Materials and Systems**
 - The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. (HS-ESS2-4)
- **HS-ESS2-2 Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to Earth's systems.**
 - **ESS2.D Weather and Climate**
 - The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. (HS-ESS2-2)
- **HS-ESS3-6 Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.**
 - **ESS3.D Global Climate Change**
 - Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6)
- **HS-ESS3-5 Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.**
 - **ESS3.D Global Climate Change**
 - Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. (HS-ESS3-5)

Science & Engineering Practices (link to SEP break-down):

- Developing and Using Models
- Engaging in Argument from Evidence
- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data
- Scientific Knowledge is Based on Empirical Evidence
- Constructing Explanations and Designing Solutions




Crosscutting Concepts (link to guiding questions for CCC):

- Stability and Change
- Cause and Effect
- Systems and System Models
- Influence of Engineering, Technology, and Science on Society and the Natural World









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Opportunities for Student Collaboration p. 493H (Complete Collaboration Strategy Guide):


- Accessing Prior Knowledge p. 494 • See-Run-Do p. 497 • Think, Pair, Share pp. 504, 534, 536 • Self-Assessment p. 512 • Claims, Evidence, Reasoning pp.515, 518, 524, 540 •
- Four Corners pp. 501, 507, 517, 533, 542 • Which is False? p. 520 • Group Activity p. 505, 521 •

Time Frame	Lesson Framework	Instructional Sequence	Resources- HMH Dimensions- Earth & Space Science Textbook	Resources- HMH Dimensions Digital Component	Additional Resources
3/13/23-3/31/23	Unit 9: The Atmosphere		<ul style="list-style-type: none"> • Unit Opener (Pre-Assessment): Predict- How would the biosphere, geosphere, and hydrosphere be different without the thin layer of gases surrounding Earth? (pp. 492-493) 	<ul style="list-style-type: none"> • Unit Project: Design a Weather Instrument- Students design (with the aid of instructions), build, and test their own instrument or method for measuring one or more of the following weather conditions: temperature, wind speed and/or direction, air pressure, or humidity. Students test and refine their instrument and compare the results to official measurements or measurements using standard instruments. Then they use the tool/method to predict local weather. 	
	<p><u>Lesson 9.1- Earth's Atmosphere</u></p> <p>In this lesson, you will investigate the composition, structure, and function of Earth's atmosphere and analyze evidence for how these factors affect weather and climate.</p> <p><u>Vocabulary:</u> troposphere stratosphere Coriolis effect</p>	<p style="text-align: center;">Engage</p>	<ul style="list-style-type: none"> • Phenomenon: Can You Explain It?- Why does the atmosphere have layers, and what roles does each layer have? (p. 494) 		<p>ESRT:</p> <ul style="list-style-type: none"> • Selected Properties of Earth's Atmosphere (p. 14) • Average Chemical Composition of Earth's Crust, Hydrosphere, and Troposphere (p. 1) • Planetary Wind and Moisture Belts in the Troposphere (p. 14) • Surface Ocean Currents (p. 4) <p>Selected Properties of Earth's Atmosphere Three Level Guide for Diagram Interpretation</p> <p>Struggling to Breathe Pre-Assessment Probe</p>
		<p style="text-align: center;">Explore/ Explain</p>	<ul style="list-style-type: none"> • Exploration 1- The Structure of the Atmosphere (pp. 495-498) • Exploration 2- Interaction with Earth's Other Spheres (pp. 499-501) • Exploration 3- The Atmosphere in Motion (pp. 502-507) 	<ul style="list-style-type: none"> • Lesson 1- Earth's Atmosphere PPT (editable) • Exploration 1:  Hands-On Lab- Temperature Trends- In this lab, students will plot temperature changes with altitude on a graph. • Exploration 2:  Hands-On Lab- Measuring Particulates- In this lab, students will measure the rate at which solid materials are deposited around your school, compare the amount of particulates in the air at different places around your school, and determine the sources of those particulates. • Exploration 3:-  Hands- On Lab- Curved Motion- In this lab, students will explore the Coriolis effect using a lazy Susan to model Earth's rotation. 	
		<p style="text-align: center;">Elaborate</p>	<ul style="list-style-type: none"> • Continue Your Exploration- Guided Research: Studying the Atmosphere from Space (p. 508) 	<ul style="list-style-type: none"> • Continue Your Exploration: <ul style="list-style-type: none"> ○ The Coriolis Effect ○ Building with Wind 	
		<p style="text-align: center;">Evaluate</p>	<ul style="list-style-type: none"> • Lesson Self Check (pp.509-511)- Can You Explain It- Revisit • Make Your Own Study Guide (p. 511) • Checkpoint Questions (pp.510-511) 	<ul style="list-style-type: none"> • Can You Explain It? Revisit • Checkpoint Questions • Make Your Own Study Guide • Unit 9- Lesson 1 Quiz 	

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<p><u>Lesson 9.2- Weather Prediction and Modeling</u></p> <p>In this lesson, you will analyze how changes in weather conditions are predicted from data collection, analysis, and interpretation using models.</p> <p><u>Vocabulary:</u> air mass front</p>	<p>Engage</p> <ul style="list-style-type: none"> ● Phenomenon: Can You Explain It?- Why isn't weather prediction more accurate? (p. 512) 		<p>ESRT:</p> <ul style="list-style-type: none"> ● Key to Weather Map Symbols (p. 13) ● Pressure (p. 13) ● Humidity (p. 12) ● Dewpoint (p. 12) <p>Why does air pressure in the atmosphere change as altitude changes?</p> <p>What is Air Pressure?</p>
	<p>Explore/ Explain</p> <ul style="list-style-type: none"> ● Exploration 1- Weather (pp. 513-517) <ul style="list-style-type: none"> ○  Hands-On Lab- Measuring Cloud Cover (p. 514)- In this lab, students will estimate cloud cover in units of oktas. ● Exploration 2- Weather in Motion (pp. 518-520) ● Exploration 3- Weather Forecasting and Technology (pp. 521-525) 	<ul style="list-style-type: none"> ● Lesson 2- Weather Prediction and Modeling PPT (editable) ● Exploration 3:  Hands-On Lab- Correlating Weather Variables- In this lab, students measure and record weather variables twice every day and predict weather conditions based on collected data. ● Exploration 3:  Hands-On Lab- Weather Forecasting- In this lab, students observe and record locations of weather fronts, and predict weather conditions based on collected data. 	
	<p>Elaborate</p> <ul style="list-style-type: none"> ● Continue Your Exploration-  Hands-On Lab- Forecast Limitations- In this lab, students will compare predicted weather to observed weather to figure out the accuracy of their local weather forecast. 	<ul style="list-style-type: none"> ● Continue Your Exploration: <ul style="list-style-type: none"> ○ Find the Location of a Low-Pressure system ○ Lake Effect 	
	<p>Evaluate</p> <ul style="list-style-type: none"> ● Lesson Self Check (pp. 527-529)- Can You Explain It- Revisit ● Make Your Own Study Guide (p.529) ● Checkpoint Questions (pp.528-529) 	<ul style="list-style-type: none"> ● Can You Explain It? Revisit ● Checkpoint Questions ● Make Your Own Study Guide ● Unit 9- Lesson 2 Quiz 	
<p><u>Lesson 9.3- Climate and Climate Change</u></p> <p>In this lesson, you will use models to engage in argument, obtain information about how global climate has changed over time, and evaluate the causes of current climate change.</p> <p><u>Vocabulary:</u> climate climate change</p>	<p>Engage</p> <ul style="list-style-type: none"> ● Phenomenon: Can You Explain It?- What is the cause of the decrease in Arctic sea ice, and how could this decrease impact regional and global ecosystems? 		<p> You Solve It Simulation- How Would You Prepare for Rising Sea Levels? Students will use a sea-level-rise model, population data, elevation data, and future-climate-change prediction models to recommend three to five locations in the Chesapeake Bay area to reinforce first and to set deadlines for completion against the coming higher water levels.</p> <p>Investigating Climate Change at the Micro- and Macroscopic Level</p>
	<p>Explore/ Explain</p> <ul style="list-style-type: none"> ● Exploration 1- Climate (pp. 531-534) ● Exploration 2- Earth's Changing Climate (pp. 535-538) ● Exploration 3- Our Role in Climate Change (pp. 539-543) 	<ul style="list-style-type: none"> ● Lesson 3-Climate and Climate Change PPT (editable) ● Exploration 1:  Hands-On Lab- Microclimates- In this lab, students compare weather conditions from three different areas, and relate differences in the plants and animals observed to the microclimates of the areas. ● *Exploration 1:  Hands-On Lab- Comparing Climate Features- In this lab, students record, graph, and analyze temperature and precipitation data for multiple regions. ● Exploration 1:  Hands-On Lab- Factors that Affect Climate- In this lab, students determine whether land or water absorbs heat faster, and explain how the properties of land and water affect climate. 	

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		Elaborate	<ul style="list-style-type: none"> ● Continue Your Exploration- Guided Research: Iron Solutions or Iron Problems? (p. 544) 	<ul style="list-style-type: none"> ● Continue Your Exploration: <ul style="list-style-type: none"> ○ Tidal Energy ○ Calculate Your Carbon Footprint 	<ul style="list-style-type: none"> ● https://phet.colorado.edu/en/simulations/glaciers
		Evaluate	<ul style="list-style-type: none"> ● Lesson Self Check (pp. 545-547)- Can You Explain It- Revisit ● Make Your Own Study Guide (p.547) ● Checkpoint Questions (pp. 546-547) 	<ul style="list-style-type: none"> ● Can You Explain It? Revisit ● Checkpoint Questions ● Make Your Own Study Guide ● Unit 9- Lesson 3 Quiz 	<p>*Figure 2- Vegetation in Yemen and Democratic Republic of the Congo (p. 531)</p> <p>*In the Community- Climate Change in the Community (p. 493H)</p>
		Thing Explainer	<ul style="list-style-type: none"> ● Cloud Maps (pp. 548-551) 		
		Enrichment: Unit Connection Activities (Optional)	<ul style="list-style-type: none"> ● Engineering- Testing Sunscreen ● *Social Studies- Clothing and Climate ● *Health- Climate Change and Infectious Diseases 		
	Unit Close	<ul style="list-style-type: none"> ● Synthesize the Unit (p.553) ● Driving Questions (revisit) ● Practice and Review Questions (pp.553- 554) ● Unit Project Revisited (p. 554) ● Unit Performance Task (p.555) 	<ul style="list-style-type: none"> ● Assessment Guide: <ul style="list-style-type: none"> ○ Unit Test A- provides an in-depth assessment of the Performance Expectations aligned to the unit. ○ Unit Test B can be used to assess students who need extra support 	 HMH Earth & Space Science Unit 9- The Atmosphere (Editable item bank available under Public Assignments in Castle Learning)	

Resources

- <http://ngss.nsta.org/Classroom-Resources.aspx> - Searchable NYSSLS/NGSS aligned resources curated by NSTA
- [BPS Earth Science Website](#)– BPS Earth Science curriculum resource hub
- [BPS Science Department Recommended Virtual Labs](#) – Virtual lab resources with embedded links to virtual labs and student sheets. Must be logged into BPS google account through BPS Gmail account to access.
- [BPS Science Department CER Student Writing Template](#) ([BPS Science Department CER Practice with a Graph](#))
- [NYSED’s Office of State Assessment webpage](#) - Access to Released Regents Earth Science Examinations
- [Science Learning Standards \(HS\)](#) – NYSSLS High School Standards for Earth Science
- [NYSED Bilingual Glossaries](#) – NYS Statewide Language Regional Bilingual Education Resource for NYSED approved bilingual glossaries.

English Language Learners (ELL) Enhancements To access hyperlinked	Listening <ul style="list-style-type: none"> ● Cross- Linguistic Practices: Gives students opportunities to make connections between what they hear and their home language (For example, allow students to listen to a passage and identify cognates.) 	Speaking <ul style="list-style-type: none"> ● Sentence Frames - to begin a sentence - such as <i>Evolution is...</i> or <i>I think that evolution is...</i> ● Academic Conversation Starters: Have a visual of a list of academic sentence starters that 	Reading <ul style="list-style-type: none"> ● Supplementary Text to reinforce concepts. If necessary, use lower Lexile levels to ensure comprehension. ● Visual Aids - Pictures or models to support vocabulary words/ concepts 	Writing <ul style="list-style-type: none"> ● Sentence Frames - to begin a sentence- such as <i>Biodiversity is...</i> or <i>An example of competition is....</i> ● Cloze passages with word banks 	Instructional Accommodations (depending on the student’s needs) <ul style="list-style-type: none"> ● Extended time for tests in class, projects and assignments ● Directions read. Broken down as necessary
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<p>material, you must be logged into your BPS Google Drive</p>	<ul style="list-style-type: none"> ● Build background knowledge ● Activating Prior Knowledge ● Activating prior knowledge means both eliciting from students what they already know and building initial knowledge that they need in order to access upcoming content ● Visuals - GIFs, pictures- will assist students in understanding what they are listening to. Visual thinking strategies set the lens for learning. ● Video to review/ introduce a topic – use closed captioning so students see the words and pronunciations while they listen to the content. ● Word stretching / Vowel stretching allows student to listen closely to the pronunciation words ● Performance Level Descriptors - this document provides teachers with a description of what output they can expect from students based on earned NYSESLAT levels in the modality of listening Scroll for grades 9-12. 	<p>students can refer to in a discussion such as <i>I expect __ to happen.</i> or <i>My data shows that...</i> This aids students in having more science focused dialogue.</p> <ul style="list-style-type: none"> ● Choral Reading - Build fluency, self-confidence and motivation with reading/speaking ● Create movement to go with the word. Movement can be a motivating factor and kinesthetic tool for conceptualizing the rhythm and flow of fluent reading while triggering brain function for optimal learning ● Performance Level Descriptors - this document provides teachers with a description of what output they can expect from students based on earned NYSESLAT levels in the modality of speaking. Scroll for grades 9-12 	<ul style="list-style-type: none"> ● Video to review introduce a topic - use closed captioning so students can read along and listen to content ● 4 Square / Frayer models to help students gain a deeper understanding of vocabulary. ● Highlighting important text to assist students in answering questions after the reading. ● Chunking-Break reading of text into chunks or paragraphs ● Vocabulary Morphology- segmenting words into affixes (prefixes/suffixes) and roots/base words. Understanding that words connected by meaning/origin can be connected by spelling can be critical to expanding a student’s vocabulary. ● Performance Level Descriptors- this document provides teachers with a description of what output they can expect from students based on earned NYSESLAT levels in the modality of reading. Scroll for grades 9-12. 	<ul style="list-style-type: none"> ● Word banks ● Graphic Organizers to help break down the writing process and organize thoughts ● Standards-based sentence stems ● Performance Level Descriptors- this document provides teachers with a description of what output they can expect from students based on earned NYSESLAT levels in the modality of writing. Scroll for grades 9-12. 	<ul style="list-style-type: none"> ● Model how to complete the activity in the lesson ● Oral simplification of directions or questions ● Translated version of test when available. Student may have both version English and native language version ● Use of approved bilingual glossaries from NYS in each subject
<p>Special Education Modifications</p> <p>Special Education students must have accommodations as per Individual Educational Plan (IEP)</p>	<p>Instructional</p> <ul style="list-style-type: none"> ● Pre-teach vocabulary ● Use picture vocabulary ● Scaffold Depth of Knowledge questions ● Provide copy of notes/notes in “cloze” form ● Use of Think, Pair, and Share strategy to help process information ● Scaffold written assignments with the use of graphic organizers ● Allow for multiple ways to respond (verbal, written, response board) ● Provide model of performance task ● Modify informational text to fit the needs of the students ● Provide a digital or paper interactive notebook ● Present complex tasks in multiple ways ● Provide mnemonic strategies for Living Environment concepts 	<p>Technology:</p> <ul style="list-style-type: none"> ● Audio reading of text ● Text to type functions ● Videos to clarify/visualize Living Environment concepts ● Record class lecture/discussions and make accessible to student ● Nearpod- interactive presentations of notes ● Playposit - show a video clip about the topic and add your own questions for them to answer as they watch ● Allow students to type answers in chat on Teams <p>Other:</p> <ul style="list-style-type: none"> ● Arrange seating for maximum engagement and minimum distraction ● Accessible lab space (counter level) 	<p>In Class Assessments</p> <ul style="list-style-type: none"> ● Provide review packet or review sheet of concepts covered on the test ● Practice similar questions prior to the test ● Provide multiple options for projects ● Give a timeline of when things are due and remind them of the process often. ● Use of timer in class ● Break all complex tasks into chunks 		
<p>BPS Science K-12 Schoology Folder:</p>	<p>SUTW Strategies</p> <ul style="list-style-type: none"> ● Informal Outline ● Color-Coding – Informative/Explanatory Text 				

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9-12 Resources Earth Science Resources Curriculum Materials	<ul style="list-style-type: none">● Two-column notes● I-V-F Topic Sentence progressing to Four Step Summary Paragraph● CUPS – Capitalization, Usage, Punctuation, Spelling● Transitions
Culturally and Linguistically Responsive Teaching (CLRT) in the Science Classroom	<p>Materials, resources, and/or discussions address diverse cultural backgrounds and real-world applications</p> <ul style="list-style-type: none">● Artifacts (posters, charts, etc.) in the science classroom are representative of the cultures of the student population● All students are given an opportunity to engage in science discourse● Teacher demonstrates high expectations for all students <p>CLRT resources which align to Science content are denoted with a *</p>