

Meteorology

UNIT 1: The Atmosphere



ESSENTIAL QUESTION

What is the nature of our atmosphere past, present, and future?

BIG IDEAS

- Students understand how the atmosphere evolved.
- Students can describe the structure of the atmosphere.
- Students can explain the global energy budget.

GUIDING QUESTIONS

Content: **HS-ESS2-4**

- What is the composition of the atmosphere?
- How has the composition of our atmosphere changed?
- What is the vertical structure of the atmosphere?
- Why does Earth experience seasons?
- What is the Earth's global energy budget?

Process

- How can temperature and pressure changes be demonstrated as altitude increases?
- How can the season cycle be modeled?
- How does incoming solar radiation change with latitude?

Reflective

- What would happen if we changed one portion of the energy budget?
- Why would the upper latitudes warm faster than the lower latitudes in relation to the Earth's energy budget?

FOCUS STANDARDS

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.

Science & Engineering Practice(s):

- **Developing and Using Models:** Use a model to provide mechanistic accounts of phenomena.

Disciplinary Core Idea(s):

- **ESS1.B: Earth and the Solar System:** Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes.
- **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.
- **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.

Crosscutting Concept(s):

- **Cause and Effect:** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes

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UNIT 2: Atmospheric Moisture



ESSENTIAL QUESTION

How does atmospheric moisture influence weather and climate?

BIG IDEAS

- Students identify the interactions within the water cycle.
- Students understands the origin of precipitation.
- Students identify how clouds form and the various cloud types.
- Students understand the how humidity influences atmospheric conditions.

GUIDING QUESTIONS

Content: **HS-ESS2-5**

- What are the mechanisms that move moisture through the atmosphere?
- How is latent heat related to phase changes in water?
- What is the process that forms clouds?
- What are the types of clouds?

Process

- How is relative humidity measured?
- What are the conditions that form specific types of clouds?
- How do the different types of precipitation form?

Reflective

- Which is heavier: Humid Air or Dry Air?
- How can weather conditions be predicted from cloud types?

FOCUS STANDARDS

HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

Science & Engineering Practice(s):

- **Planning and Carrying Out Investigations:** Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

Disciplinary Core Idea(s):

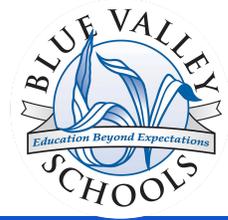
- **ESS2.C: The Role of Water in Earth's Surface Processes:** The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks.

Crosscutting Concept(s):

- **Structure and Function:** The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its materials.

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UNIT 3: Air Masses & Frontal Systems



ESSENTIAL QUESTION

How do air masses and frontal systems influence regional weather?

BIG IDEAS

- Students understand how pressure gradients generate global wind patterns.
- Students understand how the Coriolis Effect impacts global wind patterns.
- Students identify specific types of air masses
- Students identify the weather associated with air masses and fronts
- Students can predict weather based on pressure, temperature and air masses.

GUIDING QUESTIONS

Content: **HS-ESS2-2.**

- What are the global wind patterns?
- How do jet streams impact our weather patterns?
- How do the different types of air masses form?
- What are the major types of fronts and the resulting weather?

Process

- Can students demonstrate the Coriolis Effect using models?
- Can students use isotherms and isobars to predict frontal systems?

Reflective

- Can students create weather maps from evidence based on *National Weather Service* data?

FOCUS STANDARDS

HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.

Science & Engineering Practice(s):

- **Analyzing and Interpreting Data:** Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.
- **Using Mathematics and Computational Thinking:** Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems.

Disciplinary Core Idea(s):

- **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.
- **ETS1.B: Developing Possible Solutions:** Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as

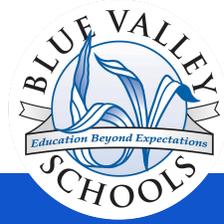
running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.

Crosscutting Concept(s):

- **Stability and Change:** Feedback (negative or positive) can stabilize or destabilize a system.
- **Systems and System Models:** Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows— within and between systems at different scales.

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UNIT 4: Severe Weather



ESSENTIAL QUESTION

What are the forms and consequences of severe weather?

BIG IDEAS

- Students identify forms of severe weather including thunderstorms, lightning, hurricanes, tornadoes, El Nino and La Nina
- Students understand consequences of weather hazards such as flash flooding and blizzards.
- Students understand the weather alert system.

GUIDING QUESTIONS

Content: **S-ESS2-2**

- Under what atmospheric conditions do severe weather events occur?
- Where do specific severe weather events occur and why?
- How can students prepare for severe weather events?

Process

- Can students prepare for severe weather events?
- Can students navigate the weather alert system?
- Can students read a radar map to identify storm features?

Reflective

- Why do tornadoes occur more commonly in the mid-latitudes?

FOCUS STANDARDS

S-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.

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UNIT 5: Climate



ESSENTIAL QUESTION

How is global climate influenced by natural and human factors?

BIG IDEAS

- Students recognize the six global climate types
- Students can differentiate between climate change and global warming.
- Students can interpret evidence regarding global climate change
- Students understand that feedback mechanisms (negative or positive) can stabilize or destabilize a system.
- Students can differentiate between Anthropogenic and natural climate change mechanisms.

GUIDING QUESTIONS

Content: **S-ESS2-2**

- What are the characteristics of the global climate types
- What is the evidence supporting global climate change?
- How do feedback loops help us predict future global climate models?

Process

- Given specific characteristics, how can students determine a climate type?
- How do scientists analyze ancient climates?

Reflective

- Given positive or negative feedback scenarios, what are the resulting global climate consequences?

FOCUS STANDARDS

S-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.

Science & Engineering Practice(s):

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