Unit 7: Global Weather Systems
UNIT PLAN

8th Grade Science
Suggested Duration: 9 Core Instructional and 1 Assessment Day

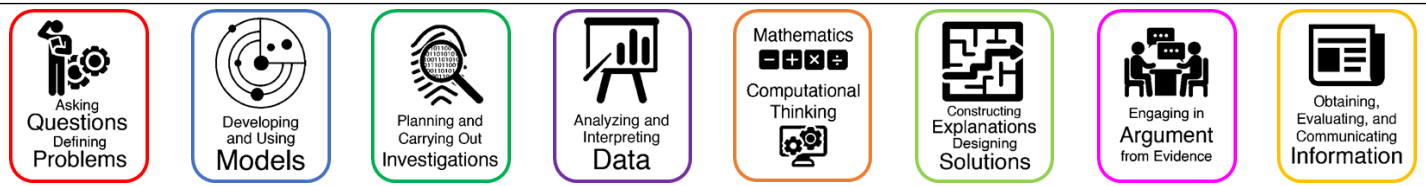
TABLE OF CONTENTS

UNIT NARRATIVE

This unit will focus on the TEKS 8.10A-C. Students will explore factors that influence weather and climate, global patterns of atmospheric movement and the interactions of ocean currents and air masses that produce tropical cyclones. Lesson 1 will be the unit launch, and students will explore the phenomenon of how dust from the Saharan Desert ends up in the air in Texas. Students will also review the concept of weather vs. climate. In lessons 2 and 3 students will investigate how The Sun, Hydrosphere, and Atmosphere interact and influence weather. In lessons 4-6 students will analyze global patterns of atmospheric movement and describe how they influence local weather. Finally, in lessons 7-9 students will describe the interactions between ocean currents and air masses.

Focus on Disciplinary Literacy

In science, disciplinary literacy is synonymous with the science and engineering practices. The SEPs are the context through which all science concepts should be taught. In the lessons, you will find the Science and Engineering practices icons when the SEPs are being explicitly used by students.



CONTENT STANDARDS

Below are the standards **taught** and **assessed** in this unit.

Readiness Standards
8.10A describe how energy from the Sun, hydrosphere, and atmosphere interact and influence weather and climate
Supporting Standards
8.10B identify global patterns of atmospheric movement and how they influence local weather. 8.10C describe the interactions between ocean currents and air masses that produce tropical cyclones, including typhoons and hurricanes.

UNDERSTANDINGS AND QUESTIONS

Important big ideas and processes for the unit.

Key Understandings
• Weather is the current outdoor conditions in an area while climate is the type of weather that occurs in an area over a long period of time, generally around 30 years. • The Sun provides the energy that drives Earth's weather systems and climate. Solar energy is unevenly distributed across the planet due to Earth's tilt, rotation, and orbit, influencing temperature variations and weather patterns. • The atmosphere and hydrosphere work together to distribute solar energy. Processes like evaporation, condensation, and precipitation transfer heat and moisture, affecting weather systems and long-term climate patterns. • Energy transfer in the Earth's system occurs through radiation, conduction, and convection. These processes govern phenomena such as wind patterns, ocean currents, and the development of storms. • Earth's systems are interconnected, with feedback loops (e.g., the greenhouse effect and albedo effect) regulating global climate. Human activities and natural processes can disrupt these balances, altering weather and climate. • Water in the hydrosphere absorbs, stores, and releases energy. This contributes to climate regulation and drives phenomena such as hurricanes, ocean currents, and monsoons. • Regional weather and climate are influenced by global phenomena such as the jet stream, El Niño, and the distribution of heat through ocean currents, which arise from the interaction of solar energy with Earth's systems. • Atmospheric circulation, driven by the uneven heating of the Earth by the Sun, creates global wind patterns such as trade winds, westerlies, and polar easterlies, which influence weather conditions around the world. • High and low-pressure systems, caused by temperature differences, drive the movement of air in the atmosphere. These systems affect wind direction, precipitation, and storm development at local and global scales. • The Coriolis effect, resulting from Earth's rotation, causes winds and ocean currents to curve, influencing the formation and direction of weather patterns, such as cyclones and trade winds.

- The Coriolis effect, resulting from Earth's rotation, causes winds and ocean currents to curve, influencing the formation and direction of weather patterns, such as cyclones and trade winds.
- The movement and interaction of air masses (e.g., warm, cold, moist, or dry) create various weather phenomena, such as fronts, storms, and temperature changes in local areas.
- Large-scale atmospheric circulation establishes climate zones, such as tropical, temperate, and polar regions, influencing long-term weather characteristics in these areas.
- Tropical cyclones form over warm ocean waters where heat and moisture from the sea surface fuel their development, intensification, and sustained strength.
- The interaction between warm, moist air masses and cooler surrounding air initiates rising air currents, forming low-pressure systems that are the foundation of tropical cyclones.
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- The interaction between warm, moist air masses and cooler surrounding air initiates rising air currents, forming low-pressure systems that are the foundation of tropical cyclones.
- Tropical cyclones act as mechanisms for transferring energy from warm oceans to the atmosphere, impacting global weather patterns and helping regulate Earth's climate system.

Key Questions

- How are weather and climate different?
- How does energy from the Sun affect Earth’s weather?
- How does the Sun interact with the hydrosphere and the atmosphere?
- How do air masses cause changes in local weather?
- How does energy from the Sun affect Earth’s weather?
- How does uneven heating and the Earth spinning on its axis cause patterns of atmospheric movement and influence local weather? (Lesson 5)
- How does the Sun interact with the hydrosphere and the atmosphere?
- How do air masses cause changes in local weather?
- What are ocean currents, and what causes them?
- What are air masses, and what effects do they have?
- How do the interactions between ocean currents and air masses produce tropical cyclones?

Common Misconceptions

- Thinking that climates cannot change and only weather changes
- Not realizing that the study of climate takes decades whereas weather is a day-to-day occurrence
- Incorrectly identifying given characteristics as weather when describing climate and vice versa

ROADMAP

ROADMAP AT A Glance: Unit 05 Global Weather Systems				
Day	**Date**	**TEKS**	**Lesson**	**Lesson Title**
There are two flex days built into this unit to use as needed. Flex days can be used for lessons that take longer than one day or for reteaching material the students may not have gotten during tier 1 instruction.				
1		8.10A	1	Unit Launch and Weather vs. Climate
2		8.10A	2	Interacting Energy: The Sun, Hydrosphere, and Atmosphere Part 1
3		8.10A	3	Interacting Energy: The Sun, Hydrosphere, and Atmosphere Part 2
4		8.10B	4	Global Patterns of Atmospheric Movement Part 1
5		8.10B	5	Global Patterns of Atmospheric Movement Part 2
6		8.10B	6	Global Patterns of Atmospheric Movement Part 3
7		8.10C	7	Oceans and Weather Systems Part 1
8		8.10C	8	Oceans and Weather Systems Part 2
9		8.10C	9	Oceans and Weather Systems Part 3
10			Unit Exam	TX_SCI_8thScience_S25_UE5 Scanning Deadline: 1/21/25

Lesson #01: Unit Launch and Weather vs. Climate	**Date:**

Objective

SWBAT distinguish between weather and climate by analyzing data including tables, graphs, weather maps, and descriptions.

Standards

TEKS

8.10A describe how energy from the Sun, hydrosphere, and atmosphere interact and influence weather and climate

Vocabulary

Climate
Weather

Science Practices

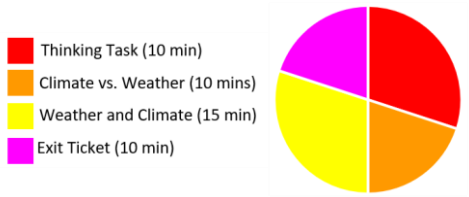
4. Analyzing and interpreting data

Recurring Themes and Concepts

A. Patterns

Instructional Notes

- Students will explore the phenomenon of how dust from the Saharan Desert ends up in the air in Texas.
- Students will review the differences in climate and weather by completing a card sort.
- Students will complete Frayer models on weather and climate and summarize the differences in weather and climate.
- Students will distinguish between weather and climate by analyzing data including tables, graphs, weather maps, and descriptions.



Lesson Look Fors

Look for teachers to:

☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.

☐ Promote the use of partners and whole class discussion.

Look for students to:

☐ Engage in discourse and productive struggle

☐ Justify their reasoning and support their ideas with evidence.

Students Do and Know

Do

- Explore the phenomenon of how dust from the Saharan Desert ends up in the air in Texas.
- Review the differences in climate and weather by completing a card sort.
- Complete Frayer models on weather and climate and summarize the differences in weather and climate.
- Distinguish between weather and climate by analyzing data including tables, graphs, weather maps, and descriptions.

Know

- Weather is the current outdoor conditions in an area while climate is the type of weather that occurs in an area over a long period of time, generally around 30 years
- There are several conditions that combine to create weather. These include temperature, precipitation, wind, cloud cover, humidity, and air pressure.
- The three factors of proximity to water, latitude, and elevation play a big role in the climate of a region.

Lesson #02: Interacting Energy - The Sun, Hydrosphere, and Atmosphere Part 1 | **Date:**

Objective

SWBAT Describe the interactions between the Sun, hydrosphere, and atmosphere, which create wind, ocean currents, and precipitation, which shape weather and climate around the world.

Standards

TEKS

8.10A describe how energy from the Sun, hydrosphere, and atmosphere interact and influence weather and climate

Vocabulary

Wind
Atmosphere
Hydrosphere
High-Pressure System
Low-Pressure System
Weather
Air Masses

Science Practices

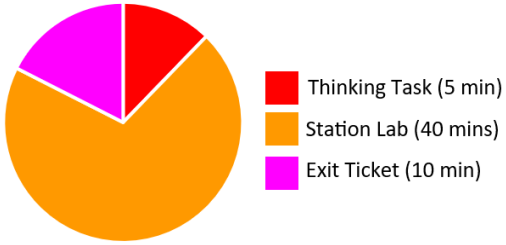
3. Planning and carrying out investigations

Recurring Themes and Concepts

B. Cause and Effect

Instructional Notes

Students will participate in a station rotation lab to explore key concepts regarding how solar energy absorption varies on different parts of Earth, what happens when solar energy is radiated from the surface of Earth to the atmosphere, and how the Sun's energy interacts with Earth's hydrosphere and atmosphere.



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☐ Promote the use of partners and whole class discussion.

Look for students to:

☐ Engage in discourse and productive struggle
☐ Justify their reasoning and support their ideas with evidence.

Students Do and Know

Do

- The interactions between the Sun, hydrosphere, and atmosphere shape long-term climate patterns and short-term weather events.

Know

- The interactions between the Sun, hydrosphere, and atmosphere shape long-term climate patterns and short-term weather events.

Lesson #03: Interacting Energy - The Sun, Hydrosphere, and Atmosphere Part 2 | **Date:**

Objective

SWBAT Describe the interactions between the Sun, hydrosphere, and atmosphere, which create wind, ocean currents, and precipitation, which shape weather and climate around the world.

Standards

TEKS

8.10A describe how energy from the Sun, hydrosphere, and atmosphere interact and influence weather and climate

Vocabulary

Air Pressure
Latitude
Albedo
Greenhouse Gas
Altitude
Humidity

Science Practices

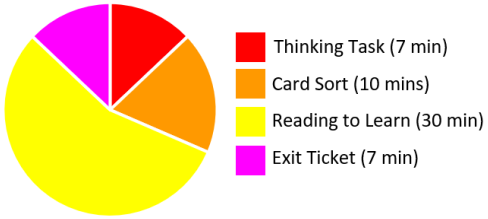
8. Obtaining, evaluating, and communicating information

Recurring Themes and Concepts

E. Energy and Matter

Instructional Notes

Students will conduct a reading to learn to deepen their understanding of how the Sun, hydrosphere, and atmosphere interact and influence weather and climate.



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☐ Promote the use of partners and whole class discussion.

Look for students to:

☐ Engage in discourse and productive struggle
☐ Justify their reasoning and support their ideas with evidence.

Students Do and Know

Do

- Students will conduct a reading to learn to deepen their understanding of how the Sun, hydrosphere, and atmosphere interact and influence weather and climate.

Know

- The interactions between the Sun, hydrosphere, and atmosphere shape long-term climate patterns and short-term weather events.

Lesson #04: Global Patterns of Atmospheric Movement Part 1	**Date:**

Objective

SWBAT explore patterns of atmospheric movement of air masses that influence local weather by creating models.

Standards

TEKS

8.10B identify global patterns of atmospheric movement and how they influence local weather.

Vocabulary

Vocabulary will be introduced in part 3 after students have built a conceptual understanding of the concepts.

Science Practices

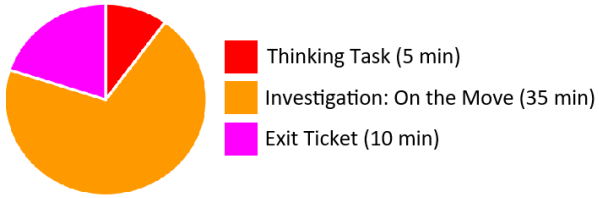
2. Developing and using models
3. Planning and carrying out investigations
6. Constructing explanations and designing solutions

Recurring Themes and Concepts

D. Systems and System Models

Instructional Notes

- Students will engage in two investigations where they create models to represent the movement of air masses that affect local weather.
- Students will then engage in a class discussion to stamp the key points.
- Students will complete a CER to answer the question of how the spinning the of Earth affects local weather.



Lesson Look Fors

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☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.

☐ Promote the use of partners and whole class discussion.

Look for students to:

☐ Engage in discourse and productive struggle

☐ Justify their reasoning and support their ideas with evidence.

Students Do and Know

Do

- Students will engage in two investigations where they create models to represent the movement of air masses that affect local weather.

Know

- Earth is heated unevenly. The equator gets more direct sunlight and tends to be warmer.
- If Earth were not spinning, this warm air would move straight up and straight down to the poles.
- Because Earth spins counterclockwise (as viewed from the North Pole), this air is deflected to the right as it moves from the equator to the pole. This causes air masses and weather to move from west to east in the United States.

Lesson #05: Global Patterns of Atmospheric Movement Part 2	**Date:**

Objective

SWBAT explore patterns of atmospheric movement of air masses and fronts that influence local weather by creating models.

Standards

TEKS

8.10B identify global patterns of atmospheric movement and how they influence local weather.

Vocabulary

Vocabulary will be introduced in part 3 after students have built a conceptual understanding of the concepts.

Science Practices

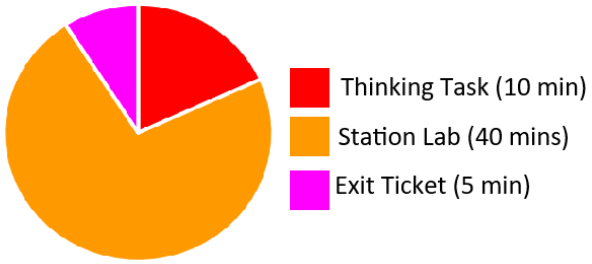
2. Developing and using models
3. Planning and carrying out investigations

Recurring Themes and Concepts

A. Patterns
D. Systems and System Models

Instructional Notes

- Students will engage in a station rotate of 4 investigations to determine how pressure systems, air masses, and fronts, influence local weather.
- Students will then engage in a class discussion to stamp the key points.
- Students will describe how pressure systems, air masses, and fronts influence local weather



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☐ Promote the use of partners and whole class discussion.

Look for students to:

☐ Engage in discourse and productive struggle

☐ Justify their reasoning and support their ideas with evidence.

Students Do and Know

Do

- Students will engage in a station rotate of 4 investigations to determine how pressure systems, air masses, and fronts, influence local weather.

Know

- Global atmospheric patterns, including the movement of pressure systems, air masses, and fronts, influence local weather by driving changes in temperature, precipitation, and wind.

Lesson #06: Global Patterns of Atmospheric Movement Part 3 | **Date:**

Objective

SWBAT identify global patterns of atmospheric movement and how they influence local weather in interpreting weather maps, and descriptions of air masses and fronts.

Standards

TEKS

8.10B identify global patterns of atmospheric movement and how they influence local weather.

Vocabulary

Air mass
Coriolis Effect
Front
High-pressure system
Jet Stream
Low-pressure system
Polar Easterlies
Prevailing winds
Trade winds
Westerlies

Science Practices

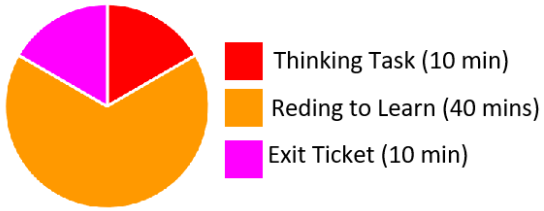
8. Obtaining, evaluating, and communicating information

Recurring Themes and Concepts

A. Patterns

Instructional Notes

Students will conduct a reading to learn to connect the previous 2 days labs to the reading and vocabulary.



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☐ Promote the use of partners and whole class discussion.

Look for students to:

☐ Engage in discourse and productive struggle
☐ Justify their reasoning and support their ideas with evidence.

Students Do and Know

Do

- Students will conduct a reading to learn to connect the previous 2 days labs to the reading and vocabulary

Know

- Global atmospheric patterns, including the movement of pressure systems, air masses, and fronts, influence local weather by driving changes in temperature, precipitation, and wind.

Lesson #07: Oceans and Weather Systems Part 1 | **Date:**

Objective

SWBAT interpret weather maps showing high and low pressure and fronts to predict weather and identify the impact of oceans on weather

Standards

TEKS

8.10C describe the interactions between ocean currents and air masses that produce tropical cyclones, including typhoons and hurricanes.

Vocabulary

Specific heat capacity

Science Practices

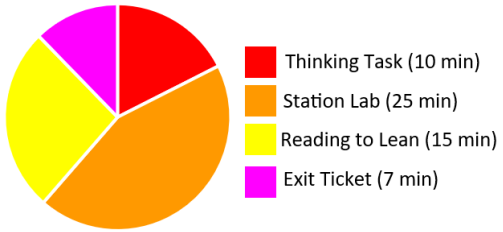
4. Analyzing and interpreting data
8. Obtaining, evaluating, and communicating information

Recurring Themes and Concepts

A. Patterns

Instructional Notes

- Students will participate in a station lab and interpret 4 different weather maps.
- Students will participate in a reading to learn activity.
- Students will interpret weather maps showing high and low pressure and fronts to predict weather and identify the impact of oceans on weather.



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☐ Promote the use of partners and whole class discussion.

Look for students to:

☐ Engage in discourse and productive struggle

☐ Justify their reasoning and support their ideas with evidence.

Students Do and Know

Do

- Analyze and interpret weather maps
- Participate in a reading to learn activity

Know

- A weather map is a graphical representation that displays weather conditions across a specific geographical area. They depicted weather events can pertain to the past, present, or future forecasts

Lesson #08: Oceans and Weather Systems Part 2 | **Date:**

Objective

SWBAT describe how air masses produce surface currents which transport and redistribute heat between different water masses in the ocean.

Standards

TEKS

8.10C describe the interactions between ocean currents and air masses that produce tropical cyclones, including typhoons and hurricanes.

Vocabulary

Gyre
Ocean Current
Surface Current

Science Practices

4. Analyzing and interpreting data
8. Obtaining, evaluating, and communicating information

Recurring Themes and Concepts

A. Patterns
B. Cause and Effect

Instructional Notes

- Students will observe a convection demonstration and make observations and draw conclusions
- Students will participate in a reading to learn
- Students will analyze a map of the Earth's ocean currents and gyres and determine if it is a cold or warm current.
- Students will describe how air masses produce surface currents which transport and redistribute salinity and heat between different water masses in the ocean.

Lesson Look Fors

Look for teachers to:

☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.
☐ Promote the use of partners and whole class discussion.

Look for students to:

☐ Engage in discourse and productive struggle
☐ Justify their reasoning and support their ideas with evidence.

Students Do and Know

Do

- Students will analyze a map of the Earth's ocean currents and gyres and determine if it is a cold or warm current.
- Students will describe how air masses produce surface currents which transport and redistribute salinity and heat between different water masses in the ocean.

Know

- Air masses produce surface currents in the ocean primarily through the force of wind. When wind blows across the surface of the water, it transfers energy to the water, creating currents. These surface currents move warm or cold water across the ocean, redistributing heat and salinity between different regions.
- Surface currents are caused by winds, winds are caused by differences in air pressure, air pressure is caused by uneven heating of Earth's surface by the sun. When the sun heats certain areas more than others, the air in warmer regions expands, becomes less dense, and rises, creating low-pressure zones. In cooler areas, the air is denser and sinks, creating high-pressure zones.

Lesson #09: Oceans and Weather Systems Part 3 | **Date:**

Objective

SWBAT explain how ocean currents and air masses interact to form tropical cyclones

Standards

TEKS

8.10C describe the interactions between ocean currents and air masses that produce tropical cyclones, including typhoons and hurricanes.

Vocabulary

Tropical Cyclone
Hurricane
Typhoon
Tropical Depression
Tropical Storm
Storm Surge

Science Practices

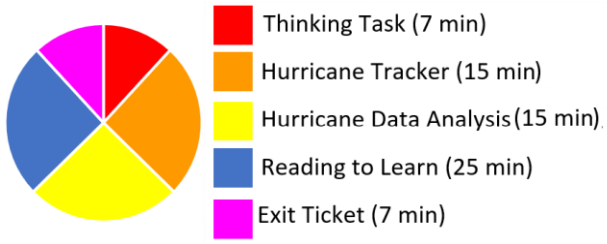
4. Analyzing and interpreting data
8. Obtaining, evaluating, and communicating information

Recurring Themes and Concepts

A. Patterns
G. Stability and Change

Instructional Notes

- Students will explore how air masses and ocean currents interact to create tropical cyclones by mapping past hurricanes and ocean currents.
- Students will analyze data from 4 hurricanes to determine the relationship between air pressure and the strength of the hurricane.
- Students will conduct a reading to learn to deepen their understanding of the concept.
- Students will describe how warm ocean currents and warm, moist air masses work together to create tropical cyclones.



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☐ Promote the use of partners and whole class discussion.

Look for students to:

☐ Engage in discourse and productive struggle
☐ Justify their reasoning and support their ideas with evidence.

Students Do and Know

Do

- Students will describe how warm ocean currents and warm, moist air masses work together to create tropical cyclones.

Know

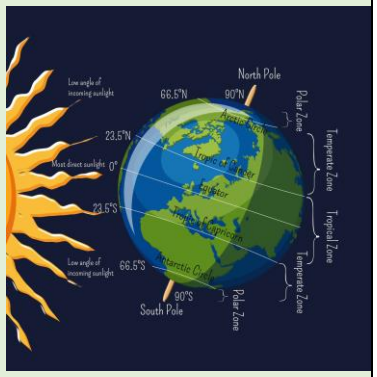
- Tropical cyclones need warm water, moisture, light upper-level winds, and a pre-existing low-pressure system to develop.
- In order for the storm to grow, the atmosphere must also be unstable meaning warm air near the surface and cooler air higher up.

UNPACKED STANDARDS

Focus standards for this unit.

Standard:	8.10A describe how energy from the Sun, hydrosphere, and atmosphere interact and influence weather and climate

Specificity	**Content Builder**

Cognition: Describe
Content: how energy from the Sun, hydrosphere, and atmosphere interact and influence
 	
Including but not limited to:
• Drives processes in the atmosphere and hydrosphere
• The Sun is much closer to Earth than any other star.
• Energy travels to Earth from the Sun as solar radiation through electromagnetic waves.
• The Sun provides energy (solar, thermal, or radiant).
• Unequal heating of the hydrosphere and atmosphere creates temperature differences and changes in density.
• Convection currents – When temperature differences cause liquids and gases (fluids, for example air and water) to expand and move, the less
• dense areas continually rise, and the more dense areas continually sink creating a cyclical current.
• Within the atmosphere – An envelope of mixed gases is held to the Earth by gravity.
  ○ Jet stream
  ○ Global winds
  ○ Caused by uneven heating of the Earth’s surface
  ○ Drive the ocean’s surface currents
  ○ Prevailing winds
• Within the hydrosphere – the ice, water vapor, and liquid water in the atmosphere, ocean, lakes, streams, soils, and groundwater
  ○ Ocean currents move from warm water, near the equator, and cooler water, near poles.
  ○ Coriolis effect – clockwise in the Northern hemisphere and counterclockwise in the Southern hemisphere
• Interactions
  ○ Water cycle – Water evaporates from the surface of water and condenses, forming clouds and eventually falls back to the surface as precipitation (rain, snow, sleet, and hail).
  ○ Heat from the Sun changes liquid water to water vapor, which rises in the atmosphere.
	Energy from the Sun interacts with the hydrosphere (e.g., oceans, lakes) and atmosphere to influence weather. The Sun’s radiation heats the Earth’s surface, causing the hydrosphere to absorb and store heat. This leads to the formation of various weather patterns (e.g., winds, storms, and precipitation). Additionally, the atmosphere plays a crucial role in distributing this energy through processes such as convection and radiation, further shaping weather patterns on Earth.
	Uneven Heating
	The surface of Earth is heated unevenly due to the tilt of Earth and different rates of heating and cooling of land and water. Over the long term, the resulting repeated weather patterns lead to global climate zones dependent on latitude and proximity to ocean currents. Polar regions have dry and cold climates, while tropical regions experience wet and hot climates. Subtropical regions have moderate climates that are mild and dry.
	Earth’s Tilt
	The tilt of Earth results in varying angles of sunlight heating the surface with different intensities of heat. Polar regions receive the most indirect rays, resulting in colder climates. Equatorial regions receive the most direct rays, resulting in the hottest climates. The temperature areas fall in between those extremes and have moderate climates.
	 
	
	Sunlight falls perpendicular to Earth’s surface at the equatorial region resulting in the most direct, most intense rays of light that result in the warmest climates. When sunlight falls at extreme angles in the polar regions, the light rays are spread out indirectly and are less intense, resulting in the coolest climates. The most populated areas of Earth lie at temperate latitudes between those extremes and have mild ranges of climate with moderate sunlight intensity.
	When solar radiation heats the surface of Earth, land and water absorb and lose heat at different rates. Over time, these differences in weather conditions form regional climates. Water has a high specific heat capacity, meaning that it takes large amounts of energy to warm it up. In contrast, land heats up and cools quickly due to its low specific heat capacity. An analogy would be setting a pot on the stove, placing your hand inside on the bottom, and turning on the burner. Almost immediately, you would have to

- As the water vapor rises into cooler air, it condenses into water droplets, which form clouds.
- If the water droplets become too heavy, they fall back to Earth and eventually encounter the water cycle again.
- The relationship of air masses and the temperature of oceans
- Warm air masses form over warm water.
- Cool air masses form over cool water.
- Local winds – Air over cooler water moves inland over warmer land, and air over cooler land moves toward areas with warmer water.

- Weather – the condition of the atmosphere in an area at a particular time
  - Temperature
  - Precipitation
  - Cloud cover
- Climate – the long-term pattern of weather in an area
  - Average temperature
  - Average precipitation
  - Number of days with Sun

Student Misconceptions

- Students may struggle to synthesize the information since the topic encompasses a wide range of factors and variables that influence weather.
- The process of energy transfer from the Sun to Earth is harmful
- Thinking that weather and climate are the same, without realizing the distinct differences between short-term weather patterns and long-term climate conditions
- Oversimplifying the concept of energy transfer from the Sun by assuming it solely involves direct heating of the Earth's surface, without considering factors such as atmospheric circulation and ocean currents
- Thinking that weather is mainly driven by the heating and movement of the atmosphere, overlooking the significant influence of the hydrosphere
- Thinking the Sun's heat is evenly distributed across Earth

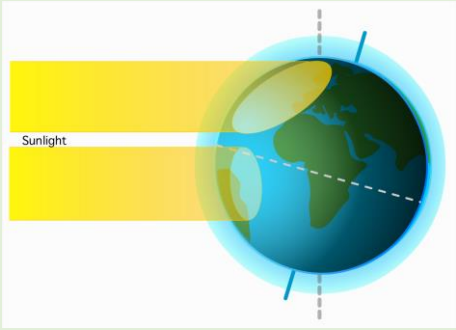
Possible STAAR Stimuli

Demonstration	Graph	Diagram
Visual/Image/ Illustration	Model	Map

Vocabulary

atmosphere	evaporation	precipitation
conduction	hydrosphere	radiation
convection	Ocean currents	weather

remove your hand from the pot. Now fill the pot with water, place your hand into the water, and turn on the burner. It will take much longer for your hand to feel enough heat to remove it from the pot. The Sun's energy also causes ocean surface water to evaporate, which transfers the thermal energy to the air molecules in the atmosphere.



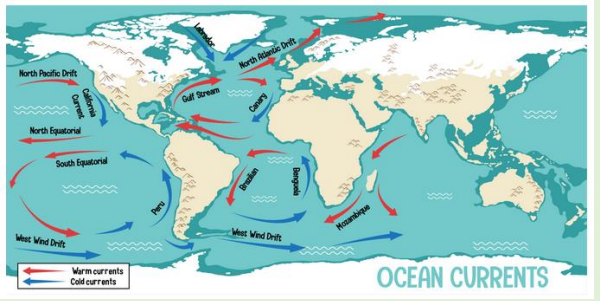
Convection Currents

Warm air masses rise while cool air masses sink. This creates convection currents that move weather across the land. This difference in heating causes land and sea breezes for locations along the coastal areas. During the day, the ocean's surface warms slowly, and the land heats up quickly. Air over the land is then heated up by thermal radiation and it rises. This rising warm air is replaced on the land by the cooler air over the ocean, so the wind blows onto the shore. This is how a sea breeze is formed. At night, the land cools off much faster than the ocean, so the air will slowly rise over the ocean, causing air from the land to blow toward the water. This is called a land breeze.

The Role of Oceans in Weather

Ocean currents play an important role in regulating weather patterns around the globe. As warm water moves into an area, it raises the humidity and temperature because more evaporation takes place. As cold water moves into an area, it can lower the temperature by absorbing more heat from the surrounding area, leading to colder and drier conditions on land. Proximity to oceans gives locations a milder climate than locations far inland. Warm ocean currents bring warmer temperatures and humidity to typically cold places.

As warm water moves into an area, it raises the humidity and temperature because more evaporation occurs. As cold water moves into an area, it can lower the temperature by absorbing more heat from the surrounding area, leading to colder and drier conditions on land.

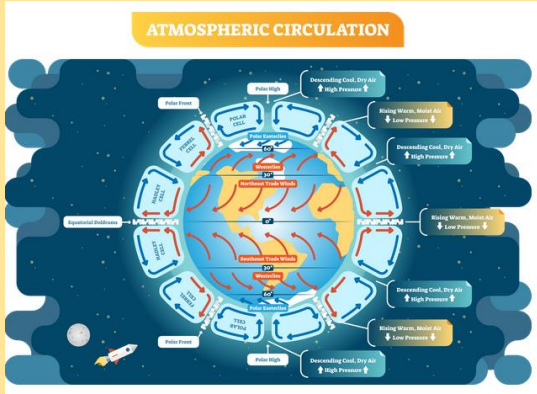


Instructional Implications

When you teach this concept, remember to:

	• Conduct hands-on investigations to help students visualize the concepts of radiation, conduction, and convection, allowing them to see firsthand how energy transfer occurs and impacts weather patterns. • Use diagrams, models, and animations to explain the complex processes of ocean currents and atmospheric circulation. • Provide real-world examples (e.g., the formation of weather fronts) to help students relate theoretical concepts to observable phenomena. • Provide opportunities for students to describe influences on weather both verbally and in writing.

Standard:	8.10B identify global patterns of atmospheric movement and how they influence local weather.
Specificity	**Content Builder**

Cognition: Identify
Content: global patterns of atmospheric movement and how they influence local weather
 	
Including but not limited to:
• Air masses – a body of air that has about the same temperature and humidity throughout
  ○ High pressure mass – more dense; holds less water vapor; associated with cooler temperatures and clear skies
  ○ Low pressure mass – less dense; holds more water vapor; associated with warmer temperatures and cloudy skies
  ○ Continental – formed over land
  ○ Maritime – formed over water
  ○ Polar – cooler air mass; formed in higher latitudes, near the poles; can form over land or water
  ○ Tropical – warmer air mass; formed within 25 degrees latitude of the equator; can form over land or water
  ○ Global patterns of atmospheric movement caused by Earth's rotation and uneven heating from the Sun create: prevailing winds
  ▪ Gulf stream
  ▪ Jet stream
  ▪ Coriolis effect
  ▪ Global winds
• Interactions of atmospheric movement
  ○ Wind forms when air moves from an area of high pressure to an area of low pressure.
	Global atmospheric circulation, driven by the Hadley, Ferrel, and Polar cells, significantly influences local weather patterns by determining wind directions, storm tracks, and temperature conditions. The jet stream, a fast-moving air current between the Ferrel and Polar cells, further shapes local weather by steering storm systems and influencing temperature shifts. This complex interaction of air masses, pressure systems, and the jet stream impacts weather globally and locally.
	Global Wind Patterns
	 
	
	Earth's rotation causes storms to swirl clockwise in the southern hemisphere and counterclockwise in the northern hemisphere. This curving motion of air is known as the Coriolis effect. The Coriolis effect creates various major wind patterns in different regions of Earth.
	
	Earth's rotation is not equal for all latitudes. At the poles, the spin rate is slower than at the equator, where the spin rate is the greatest. This results in unequal atmospheric movement at different latitudes. The wind directions over the oceans are called trade winds and tend to blow from the northeast toward the southwest in the northern hemisphere. In the southern hemisphere, the trade winds tend to blow from the southeast toward the northwest. Around the southern latitudes in the 40-degree range, the lack of land masses does not alter wind patterns and sustained west-to-east wind flows most of the year with severe storms. Otherwise, intervening land

- Fronts – the boundary where air masses meet; cause changes in weather
  - Cold front – high overtakes low pressure mass
  - Warm front – low overtakes high pressure mass
  - Occlude front – more than 2 masses meet
  - Stationary front – neither mass can move and overtake the other
- Local weather conditions
  - Local conditions
    - Temperature
    - Precipitation
    - Humidity
    - Cloud cover
  - The type of air mass in an area determines the current weather conditions.
    - H and L air masses
    - Frontal boundaries
- Weather map – a tool used to identify current local weather and predict future weather

Student Misconceptions

- Students may find it challenging to understand how these broad patterns affect weather at a local level.
- Seasons cause weather to change.
- The Coriolis effect causes water in a sink, toilet or pan to rotate on one direction in the Northern hemisphere and the opposite direction in the southern hemisphere.
- Thinking that local weather is entirely independent of global atmospheric movement and is solely influenced by local factors
- Thinking temperature is the sole factor influencing local weather without considering the broader impacts of atmospheric circulation on other weather elements such as precipitation, wind patterns, and air pressure
- Thinking that weather patterns are entirely predictable and can be attributed to a single cause rather than understanding the complexity of multiple factors, including global atmospheric circulation
- Assuming the wind only blows from the north to the south or west to east.
- Thinking that the Earth's atmosphere is stationary and wind is solely caused by the rotation of the Earth
- Assuming the equator is the hottest place on Earth because it's closest to the Sun

Possible STAAR Stimuli

Demonstration	Graph	Web/Cycle/Chain
Model	Informational Text/List	Map

Vocabulary

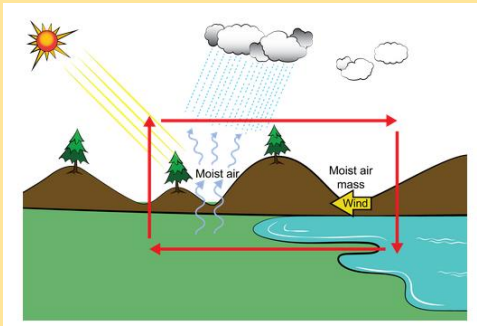
masses and islands create eddies in the outflow from the poles. Because land heats faster than oceans, Earth's weather has an unequal effect. This causes local patterns of turbulence in the overall weather patterns.

The uneven heating of land and water around the globe creates and drives wind patterns. More of the Sun's energy reaches the equator, causing warm air currents to rise. However, at the poles, the Sun's energy is lower, causing air currents to sink. Considering the areas where large continents and large oceans are located, even the same latitudes can have very different heat absorptions, resulting in many different wind patterns forming around the world.

Local Weather

The evaporation of seawater in coastal areas transfers thermal energy to the atmosphere. This energy drives weather systems. Global ocean currents affect ocean and atmospheric temperatures and influence the rate of evaporation in different regions of the world.

This diagram illustrates how the process works. As water evaporates from bodies of water, a moist air mass is created. The rising warm air cools and condenses to form clouds, bringing thunderstorms and rain. Thunderstorms are generated by moist, warm air rising. Near the coast, moist air masses are blown inland. This air mass can run into a colder air mass, triggering thunderstorms. On warm days, the land begins heating rapidly, pushing the moist air up where it reaches cooler temperatures, condenses, and begins to rain. The more rapidly the air is forced upward, the more intense a thunderstorm can become.



Most tornadoes form from thunderstorms. Warm, moist air from the Gulf of Mexico meets cool, dry air from Canada. A change in wind direction and an increase in wind speed with increasing height create an invisible, horizontal spinning effect in the lower atmosphere. Rising air within the storm tilts the rotating air from horizontal to vertical. Most strong and violent tornadoes form within this area of strong rotation. Tornadoes form out of hurricanes in much the same way. Spinning winds from the hurricane reach land where rising warm air currents force them upward.

Instructional Implications

When you teach this concept, remember to:

- Use visual aids, diagrams, and models to illustrate the global patterns of atmospheric movement such as the Hadley, Ferrel, and Polar cells and jet streams.

convection cells Coriolis effect global pattern	jet stream map pressure system (high, low)	weather weather front (cold, warm) weather map

- Use real-time weather data, maps, and satellite images to demonstrate how global atmospheric circulation patterns influence local weather conditions in different regions.
- Engage students in weather mapping exercises, where they plot weather data on maps and analyze how atmospheric movement affects weather patterns.
- Use local weather case studies to show students how global atmospheric movement impacts weather events in their region.

Standard:	8.10C describe the interactions between ocean currents and air masses that produce tropical cyclones, including typhoons and hurricanes.

Specificity

Cognition: Describe
Content: the interactions between ocean currents and air masses that produce tropical cyclones

Including but not limited to:

- Conditions needed for a tropical cyclone to occur:
  - Low pressure system
  - Warm ocean waters
- Interactions between ocean currents and air masses
  - Warm air masses form over warm water near the equator where the Sun provides energy from direct rays.
  - Cool air masses form over cool water closer to the poles where the Sun provides less energy due to indirect rays.
- Tropical cyclones and tropical storms form over warm water when warm, humid air rises and cools and a storm develops around the low pressure area.
  - Predictable patterns – travel westward over the ocean until they lose energy over cooler water or make landfall, then curve eastward
  - Hurricanes – form in the Atlantic or East Pacific Oceans
  - Typhoons – form in the Northwest Pacific Ocean

Student Misconceptions

- Students may struggle to comprehend the formation of tropical cyclones due to the complexity of concepts involved, including ocean currents, air masses, atmospheric pressure, and the Coriolis effect.
- Thinking that tropical cyclones are caused by the tides, rather than being driven by ocean currents
- Thinking that tropical cyclones are possible year-round or that they only form over the Atlantic Ocean

Content Builder

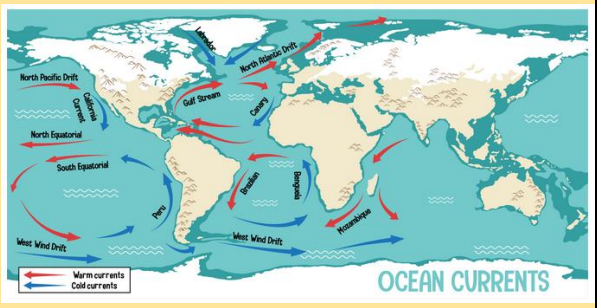
Tropical cyclones (typhoons and hurricanes) form over warm ocean waters. Warm ocean currents provide heat and moisture to fuel them while air masses contribute to their circulation. As warm ocean currents flow over warm water, they transfer heat and moisture to the atmosphere, creating low pressure. The Coriolis effect from Earth's rotation influences their rotation, leading to powerful storms. The combination of warm ocean waters, moist air, and the Coriolis effect drives cyclonic circulation, intensifying these storms.

Ocean Currents and Air Masses

The Sun's radiation provides energy for Earth. This energy from the Sun heats Earth's surface and all things on it. Even though the Sun emits a constant amount of energy, Earth does not receive equal amounts of energy during the year as it revolves around the Sun.

Ocean Currents

Not all areas on Earth receive equal amounts of energy from the Sun due to the tilt of Earth's axis. Because of this uneven heating of the Earth, the equator receives more direct radiation than the poles. The convection process redistributes this energy north from the equator and south from the poles.



Convection

Heat moves in fluids (liquids and gases) through several processes, including convection. Convection is the transfer of heat by the actual movement of the heated fluid. Any substance that flows is considered a fluid—things such as water, shampoo, sunscreen,

- Thinking that tropical cyclones are caused by mixing cold and warm ocean currents rather than being primarily fueled by warm ocean water

Instructional Implications

When you teach this concept, remember to:

- Use visual aids, diagrams, and models to illustrate the processes involved in tropical cyclone formation.
- Use real-life examples of past tropical cyclones to demonstrate how specific ocean currents and air masses contributed to their formation.
- Engage students in hands-on activities such as creating models of tropical cyclones or conducting simulations.

Possible STAAR Stimuli

Investigation	Graph	Diagram
Visual/Image/ Illustration	Model	Informational Text/List
Map		

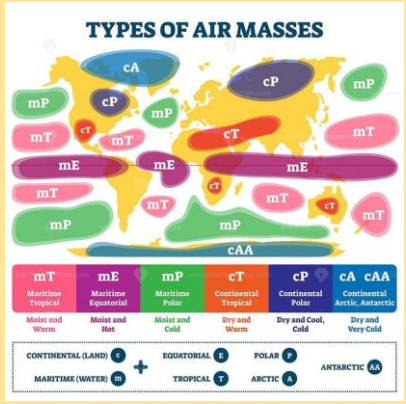
Vocabulary

air mass	Doppler radar	surface temperature
atmospheric pressure	hurricane	tropical cyclone
cold front	ocean currents	tropical depression
convergence	storm surge	typhoon
Coriolis effect	storm system	

Background Cont.

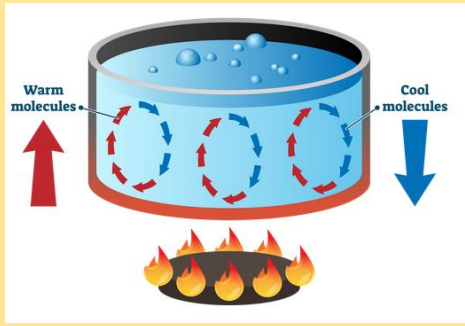
Air Masses

Air masses are bodies of air with similar pressure, temperature, and moisture levels. The properties of these air masses are gathered from the area when they originate. Air masses that are formed over the northern portions of the globe are composed of cold, dense air, whereas air masses formed over the equator are less dense, warmer air. Air masses formed over bodies of water have a higher humidity level than those formed over land. Air masses move around the globe, causing changes in weather. Air masses move because of the atmosphere's upper-level atmospheric winds and convection. Where air masses meet, fronts are formed.



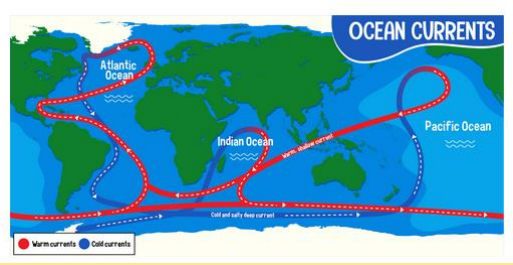
and even honey. This includes a commonly missed misconception about gases as fluids. Even gases, such as air, can be classified as fluids.

Convection is the process that transfers heat in fluids such as gas or liquid. For example, when you boil a pot of water, the water on the bottom heats first. As this water warms, it expands, becomes less dense, and rises to the surface. Cooler (more dense) water at the top sinks to the bottom to replace it, and this convection current continues. The same process occurs in the atmosphere.



As Earth's surface is warmed by the Sun, the air closest to the surface is heated, expands, rises, and is replaced at the surface by cooler air that sinks from above. Air pressure and winds are created by the convection process. Differences in air pressure create winds. Different air pressures are due to differences in density of air masses, which can happen during convection. Jet streams in the atmosphere are responsible for transporting high- and low-pressure systems, which are responsible for local weather conditions. Just like the jet stream, currents in the ocean move in a predictable pattern.

Ocean Circulation



Though major surface ocean currents are driven by wind, temperature and salinity (the amount of salt) are also drivers of ocean currents, particularly deep ocean currents. This is because temperature and salinity affect water density. Warm water is less dense than cold water, and fresh water is less dense than salty water. Water temperature and salinity vary with location. Convection currents caused by temperature and salinity differences result in deep ocean currents. Deep ocean currents act like conveyor belts on Earth's seafloors, moving thermal energy around the globe and bringing deep waters rich in nutrients to the surface

The average global sea surface temperature is around 17 degrees Celsius, but it ranges from around freezing at the poles to 35 degrees Celsius in some areas of the tropics. In addition, the oceans' average salinity is 3.47%, but this can vary depending on location and depth.

The thermohaline circulation is the major deep ocean current that transports energy from the tropics to the poles. The Gulf Stream is a component of this circulation, transporting warm, tropical surface waters north. As water in the Gulf Stream moves

Tropical Cyclones Tropical cyclones are large weather systems that bring wind, rain, and rough seas to the areas they impact. Tropical cyclones form when warm ocean water interacts with a low-pressure air mass. The increase in thermal energy causes the weather disturbance to organize and rotate. These cyclones generally form near the Equatorial regions and move along ocean currents. They are steered by the atmospheric winds. These cyclones are known by two names depending on where the storm occurs. Hurricanes are tropical cyclones that occur in the North Atlantic, central North Pacific, and eastern North Pacific Oceans. Tropical cyclones that occur in the Northwest Pacific Ocean are called typhoons.	north, the heat energy in the water is transferred to the air, and the water becomes cooler, denser, and sinks. This new cold, dense water then flows back towards the equator deep in the ocean.

VERTICAL STANDARDS

This section details the **progression** of key student expectations/standards** in the courses **before** and **after** this course. This will help you understand what **prior knowledge skills to build upon** and guide you in knowing what **skills you are preparing your students** for in the subsequent course.

4th Grade	5th Grade	8th Grade
4.10C differentiate between weather and climate.	5.10A explain how the Sun and the ocean interact in the water cycle and affect weather;	8.10A describe how energy from the Sun, hydrosphere, and atmosphere interact and influence weather and climate
		8.10B identify global patterns of atmospheric movement and how they influence local weather.
		8.10C describe the interactions between ocean currents and air masses that produce tropical cyclones, including typhoons and hurricanes.

VOCABULARY GLOSSARY

Domain-specific words and definitions for this unit.

Key Content Vocabulary

List and define key vocabulary terms

- **Air mass:** A body of air extending over a large area (1,000 miles or more) that develops and retains specific characteristics of pressure, temperature, and humidity
- **Air Pressure:** The force exerted by the atmosphere on Earth's surface by the weight of the air above the surface
- **Altitude**: the vertical elevation of an object above a surface, such as sea level or land
- **Atmosphere:** The layer of gas surrounding a planet that is held in place by gravity
- **Atmospheric movement:** Global air circulation patterns within the atmosphere held to Earth by gravity and warmed as heat radiates from Earth; influenced by convection of warm, less dense air (rises and spreads out) and cold, dense air (sinks)
- **Climate:** the type of weather that occurs in an area over a long period of time, generally around 30 years.
- **Cold front:** The border between an advancing cold air mass and a retreating warm air mass
- **Conduction:**
- **Convection:**
- **Coriolis effect:** the movement of wind and water to the right or left that is caused by Earth's rotation.
- **Evaporation:**
- **Front:** a boundary between two air masses.
- **Global pattern:**
- **High-pressure Air Mass**: An air mass with greater atmospheric pressure than the surrounding air masses; air moves away from the center of the high pressure, traveling in a clockwise direction in the northern hemisphere and a counterclockwise direction in the southern hemisphere
- **Humidity:** the amount of water vapor in the air.
- **Hydrosphere:** All the water on Earth's surface; includes all water sources above and below the surface
- **Interaction:** A circumstance where two or more substances, organisms, or events act upon and affect each other
- **Jet stream:** Near the top of the troposphere is a narrow band of high winds
- **Latitude:** the distance in degrees north or south of the Equator.
- **Low-Pressure Air Mass:** An air mass with less atmospheric pressure than the surrounding air masses; air moves toward the area of low pressure, traveling in a counterclockwise direction in the northern hemisphere and a clockwise direction in the southern hemisphere
- **Ocean currents:** Directional movements of ocean water; surface currents result from steady winds over the ocean surface; deep currents result from density variations due to temperature and salinity differences
- **Precipitation:**
- **Radiation:**
- **Tropical cyclone:** A large storm system that formed over warm ocean waters; known as hurricanes in North America and typhoons in Southeast Asia; arms of wind and rain rotate around a center "eye"
- **Typhoon:** a tropical cyclone occurring especially in the region of the Philippines or the China Sea.
- **Warm Front:** The boundary between an advancing warm air mass and a receding cooler air mass
- **Weather:** the current outdoor conditions in an area
- **Wind:** A natural movement of air, sometimes with considerable force, from an area of high density and pressure to an area of low density and pressure

Consumable Materials and Lab Supplies for Unit 7 (1 per group of 4 students unless noted)

Lesson	Commercial Vendor	Lab Supplies (Science Vendor)
Lesson 01: Weather vs. Climate	None	None
Lesson 02: Interacting Energy Part 1	<u>Stations 1a and 1b</u> 50 mL Sand (per group) 50 mL Water (per group) 1 Heat lamp (per station) <u>Stations 2a and 2b</u> 1 Balloon (per group) 1 Toaster (per station) 1 Pinwheel (per station) 2–3 L Hot water (per group) 2–3 L Ice water (per group) 2 Shoeboxes, plastic (per station) 1 Bottle, 2 L, without lid (per station) <u>Stations 3a and 3b</u> 2–3 L Hot water (per group) 2–3 L Ice water (per group) 1 Bottle of blue food coloring (per group) 1 bottle of red food coloring (per group) 1 Shoebox, clear, plastic (per station) 5 Foam cups, same size (per station)	1 Pair of goggles (per student) 2–4 Hot plates (per teacher) 2–4 Beakers, large (per teacher) 2–4 Beaker tongs or gloves (per class) 3 Containers, large (per teacher) <u>Stations 1a and 1b</u> 2 Beakers, 100 mL (per station) 2 Thermometers (per station) 1 Ring stand (per station) 1 Timer (per station) 1 Metric ruler (per station) <u>Stations 2a and 2b</u> <u>Stations 3a and 3b</u> 2 Pipettes (per station)
Lesson 03: Interacting Energy Part 2	None	None
Lesson 04: Global Patterns of Atmospheric Movement Part 1	<u>Part 1- Per Pair</u> • 2 Balloons, round <u>Part 2- Per Group of 4</u> • 2 Sticky notes • 2 Aluminum foil sheets, 3” x 3” • 2 Plastic bags, resealable • 1 Dropper of red food coloring • 1 Dropper of blue food coloring • 1–2 c. Ice • 2 Binder clips • 2 L Water	<u>Part 1- Per Pair</u> • 1 Marker, red • 1 Marker, blue • 1 Colored pencil, red • 1 Colored pencil, blue <u>Part 2- Per Group of 4</u> • 1 Shoebox plastic, clear • 2 Droppers • 1 Hot plate • 1 heat-resistant glove
Lesson 05: Global Patterns of Atmospheric Movement Part 2	<u>Station 1</u> Rubber band	<u>Station 3</u> Goggles

	Gauze Water 2-liter plastic bottle with cap Small cup Piece of cardboard Matches	Warm water Fire blanket 2 thermometers Pipette
	Station 4	
	Shallow pie pan Water Penny Birthday candle Matches Food coloring	Paper towels Large test tube
Lesson 06: Global Patterns of Atmospheric Movement Part 3	None	None
Lesson 07: Oceans and Weather Systems Part 1	None	None
Lesson 08: Oceans and Weather Systems Part 2	Convention Current Demo teacher supplies	
	Two index cards Food coloring, two colors Hot and cold water Four identical wide-mouth glass bottles	Two plastic plates or trays (to hold any spilled water) Scissors
Lesson 09: Oceans and Weather Systems Part 3	Red and blue colored pencils	None