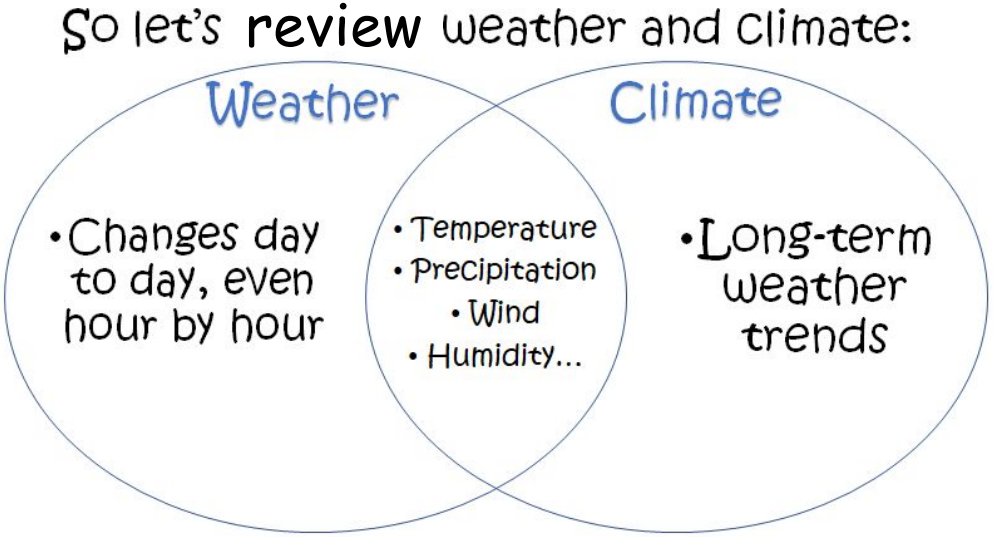
THE CAUSES OF CLIMATE

1. Why do different parts of the world have different climates?
2. What is the role of the sun, oceans, and landforms?

Think About Oregon…

"Oregon lies in the Pacific Northwest region and has a diverse geography that consists of numerous water bodies, deserts, shrublands, dense forests, mountains, and volcanoes. California in the south, the Pacific Ocean in the west, Washington in the north, Idaho in the east, and Nevada in the southeast share borders with the state. Western Oregon along the coast has an oceanic with climate with wet summers, while the southwestern portion of the state has a Mediterranean climate with hot summers; The northeastern portion has a steppe climate subarctic conditions at high altitude, and the rest of the east is semi-arid with cold and snowy winters. The Pacific Ocean has a significant influence on the climate that keeps the temperatures mild in comparison with places at similar latitudes. Oregon, the Beaver State's topography ranges from rain forests along the western coast to semi-arid conditions in the central and southeastern regions. Mount Hood is the highest peak in the state, while Columbia is the most important river that flows through the Cascade Mountains. The three mountain ranges: Coast, Cascade, and the Blue Mountains influence the climate in the parts of the state that lie in their proximity. The river valleys have the most fertile agricultural lands, while mountains and plateaus provide for dry farming and livestock grazing. The arid Columbia plateau covers two-thirds of the total area of the state with elevations ranging from 1500 to 2000 meters."

Source: https://www.weather-us.com/en/oregon-usa-climate#climate_text_1



Weather vs. Climate

- So how is weather different from climate?
- We talked about how weather can differ day to day and even hour to hour. It can be rainy one hour, then bright and sunny the next.
- Climate looks at long-term weather patterns
- To predict the climate of a region, scientists average weather patterns and conditions over a long period of time.
- A desert may receive rain one day, but overall, deserts have a very dry climate.

- Earth is split into climate zones according to similar average temperatures and precipitation rates.
- Three of which include *tropical*, *temperate*, and *polar*.
- Tropical climates are warm and found near the equator.
- Polar climates are the farthest from the equator and have year-round cold temperatures with little precipitation.
- Temperate climates are found in between tropical and polar climates.
- There are many more types of climate zones!

Climate is determined by a few different factors:

- Locations close to the equator normally receive more direct sunlight, so they tend to be warmer.
- Places with high elevation will always have a cooler climate in any location.
- Oceans and lakes take longer to change temperature. Therefore, locations near oceans and large lakes stay cooler in the summer and warmer in the winter than places farther inland.
- Landforms can affect rainfall and weather patterns in large areas.

Vocabulary

Climate
Definition: The average weather in a place over a fairly long period of time (usually 30+ years)

Altitude
Definition: The elevation of a location above or below sea level.

Coriolis Effect
Definition: The movement in the Earth's rotation that causes air and ocean currents to deflect to the right in the northern hemisphere and to the left in the southern hemisphere.

Informational Videos

- https://www.youtube.com/watch?v=lrPS2HiYVp8
- https://www.youtube.com/watch?v=CtH3_nkGe90
- https://www.youtube.com/watch?v=p4pWafuvdrY
- https://www.pbslearningmedia.org/resource/ttv10.sci.ess.land/the-effect-of-land-masses-on-climate/
- https://www.pbslearningmedia.org/resource/ttv10.sci.ess.earthsys.tropical/high-altitude-glaciers-in-the-tropics/

10 The Causes of Climate

READING

CLIMATES ARE DESCRIBED by the same conditions used to describe weather, such as temperature, precipitation, and wind. You now know that oceans have an important effect on climates around the world, but oceans are only one of the factors that influence climates. In this reading, you will find out what other factors cause places to have different climates.

GUIDING QUESTION

Why do different parts of the world have different climates?

MATERIALS

For each student

1 Student Sheet 1.1, "KWL: Climate Change"

PROCEDURE

1. Read the text below.
2. Follow your teacher's instructions for how to use the Stop to Think questions.

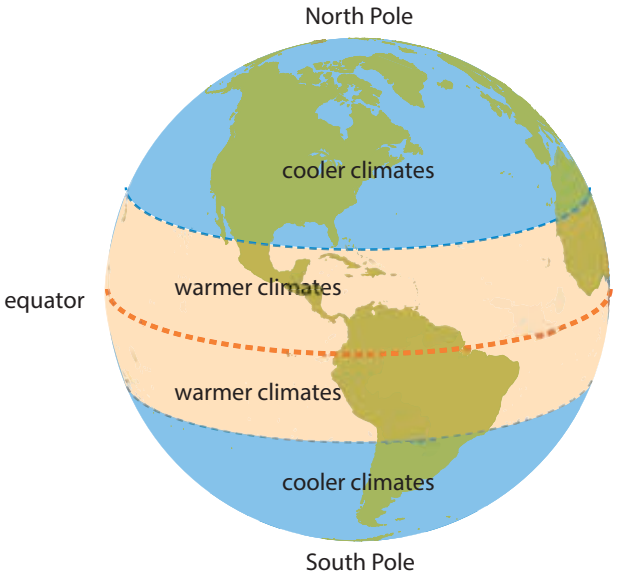
READING

You examined a map of climates in the United States in the activity "Climate Types and Distribution Patterns." You may have noticed that the southern part of Florida has a tropical climate, with warm temperatures and lots of rain year round. The northern part of Florida has a mild climate with much cooler winters. Why does climate vary so much from place to place? Many factors influence climate. Some factors, like the energy from the sun, are global and affect climates on every part of Earth. Other factors, like landforms, affect local climates.

Energy from the Sun

The most important factor affecting Earth's climates is energy from the sun. The temperature of a place depends a lot on the sun's energy because some parts of Earth's surface receive more intense sunlight than others.

Some of Earth's warmest climates are along the equator. In general, the areas around the equator receive more of the sun's energy, while the North and South Poles receive less. The result is that areas around the equator have warmer climates, and areas around the poles have colder climates, as you can see in the figure on the right.



STOP TO THINK 1

Imagine holding a tennis ball in front of a heat lamp for five minutes. What do you predict will happen to the temperature along the "equator" of the ball compared with the top and bottom?

Role of the Oceans

Another major factor influencing Earth's climates is the oceans. This is because the water in the oceans holds a large amount of thermal energy. Ocean currents transfer this energy from one part of Earth to another. Some surface currents move water as warm as 25°C (77°F), while other currents move water as cool as 10°C (50°F). Look carefully at the map on the next page, which shows both warm and cold currents on the ocean surface.

The temperature of ocean currents affects the temperature and moisture content of air. Warm surface currents heat and moisten the air above them. This warm, moist air is carried to different parts of the world, where it makes climates warmer and wetter. Cold surface currents cause air to become cooler, resulting in cooler climates.

The movement of ocean currents depends on energy from the sun. Without the energy from the sun, ocean currents would stop, and climates all over the world would be very different from how they are today. As you learned in the previous activity, a major cause of currents near the ocean's surface is wind. Winds and ocean currents are also affected by Earth's rotation. Earth's counter-clockwise rotation causes winds in the northern hemisphere to swing to the right. The winds in the southern hemisphere swing to the left. The effect is stronger at higher latitudes. This impact on motion is called the **Coriolis effect** after the 19th-century French scientist Gaspard-Gustave de Coriolis. You will learn more about the atmosphere and winds in the next four activities.

STOP TO THINK 2

a. Which coast of the United States is warmed by warm ocean currents?

Hint: Look at the map below.

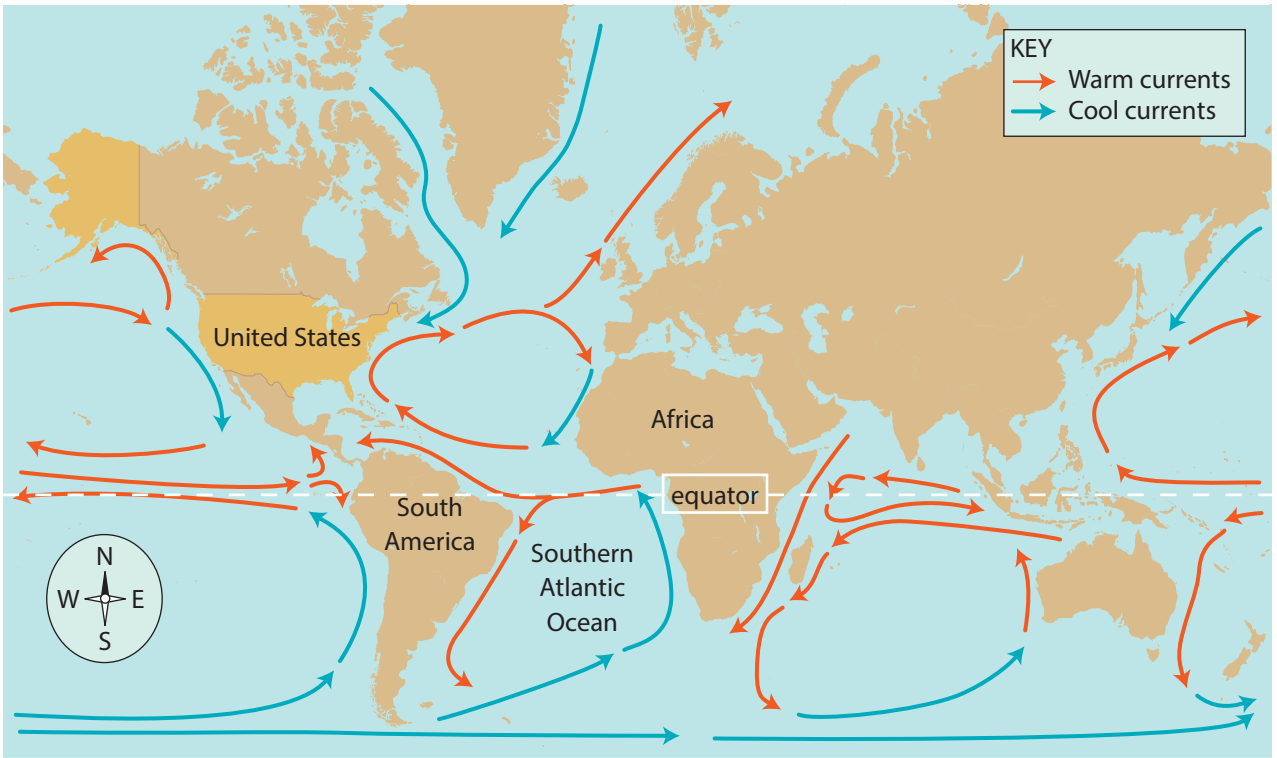
b. Which coast of the United States is cooled by cool ocean currents?

Hint: Look at the map below.

c. Do you predict that the climate of southeastern states along the ocean (such as Georgia and North Carolina) would be warmer or cooler without ocean currents? Explain.

d. Describe the general pattern of surface ocean currents shown on the map below.

Major Ocean Currents



Factors Affecting Local Climates

The shape of land masses and how close they are to water vary from place to place. Climates can be affected by the presence of large bodies of water, the height of land above sea level, and large landforms such as mountains.

In the "Heating Earth's Surfaces" activity, you investigated the differences between the heating and cooling of land and water. You observed that water heats and cools more slowly than land. The climates of land areas that are near large bodies of water are affected by this difference in heating and cooling. In general, land near a large body of water will have milder summer and winter temperatures than a similar area of land that is not near a large body of water.

The height of land above sea level is called its elevation, or **altitude**. The altitude of a place can affect its climate. Land at higher altitudes is usually colder than similar areas of land at lower altitudes. Tall mountains provide a good example of the effect of altitude on climate. Sometimes mountains' peaks are covered in snow and are very cold, whereas their bases, hundreds of meters below, are hot. For example, Africa's Mount Kilimanjaro (bottom right) is very close to the equator and has a tropical climate at its base and glaciers at its peak.

Landforms, such as mountain ranges, hills, and valleys, can also affect climates. When winds blow toward mountains, the air is pushed upward. As the air gains altitude, it cools and begins to release moisture that is in the air. This released moisture often forms clouds and then rain or snow. Because of this, the side of a mountain that is facing the most common wind direction is usually wetter, whereas the other side is usually drier.

STOP TO THINK 3

What three factors affect local climates? Which of these factors do you think affect your local climate?

Climates and weather are a result of complex interactions between the sun's energy, Earth's surfaces, and the atmosphere. Today, many scientists are concerned that human activities are also affecting climates worldwide. Because of the number of factors that influence climates, it is not easy to determine if one factor is causing more change than another. Climatologists and other scientists study Earth's climates to answer such questions.

ANALYSIS

1. Which factors affecting climates were described in the reading in this activity?
2. Oceans can store large amounts of thermal energy. How does this affect climates?
3. Recent scientific studies have indicated that the amount of thermal energy stored in the oceans has increased rapidly since 1970. If the amount of thermal energy stored in the oceans continues to increase, how might this affect weather and climate?
4. At temperatures above 4°C, water expands as it absorbs thermal energy. In the activity "Climate Change," you read about a problem in the Solomon Islands. How might this problem be related to the oceans becoming warmer?
5. Explain the reasons for the patterns of ocean currents in the southern Atlantic Ocean. Use diagrams to help with your explanation.

   Hint: Refer to the map in the reading to locate the southern Atlantic Ocean.
6. Organisms, such as plants and animals, are suited to their environments. Predict what might happen to the organisms in an environment if the local climate changed.
7. **Reflection:** In this activity, you learned that many factors influence climate. If you were a climatologist, which factor would you most like to study? Why?

Glossary

altitude The elevation of a location above (or below) sea level.

anemometer An instrument used to measure wind speed.

atmosphere The mixture of gases ("air") that surrounds a planet.

atmospheric scientist A scientist who studies the atmosphere, from the surface of Earth to several hundred kilometers above.

causal relationship A relationship in which a change in one factor causes a change to another factor. The first event is the cause and the result is the effect.

climate The average weather in a place over a fairly long period of time (usually at least 30 years).

climate change The climate of an area can change over time. Scientists are studying climate change related to global warming.

climatologist A scientist who studies Earth's climates.

cold front An area where a moving mass of colder air is replacing a warmer air mass.

constraint In engineering design, something that limits the solution to a problem.

Coriolis effect The apparent change in direction of a moving body caused by the rotation of the system. Earth's rotation causes air and ocean currents to deflect to the right in the northern hemisphere and to the left in the southern hemisphere.

correlation A measure of how well one set of data relates to another. There may or may not be a causal relationship between two correlated events. *See* causal relationship.

criteria In engineering design, the goals and the desired features of the solution. Plural of criterion.

current (ocean) A defined area of flow within an ocean capable of moving large amounts of water very long distances.

evidence Information that supports or refutes a claim.

front (weather) Areas with unstable, often stormy weather.

global warming The gradual warming of Earth's average surface temperature. Evidence indicates a relationship between human activity and the current global warming event. *See* greenhouse effect, greenhouse gas.

greenhouse effect The process by which certain gases in the air absorb and hold thermal energy, making Earth's surface warmer than it would otherwise be. *See* global warming, greenhouse gas.

greenhouse gas A gas that traps thermal energy in the atmosphere. Examples include carbon dioxide, water vapor, and methane. Evidence indicates that human activity has increased the concentration of greenhouse gases in Earth's atmosphere. *See* global warming, greenhouse effect.

groundwater Water found underground in the spaces and cracks within earth materials.

hydrologist A scientist who studies the distribution and movement of Earth's water.

latitude The means of specifying a location relative to the equator. Lines of latitude run parallel to the equator.

mean A statistical measure of centrality often called the "average." It is calculated by adding up all of the values in a data set and dividing this sum by the total number of values.

median A statistical measure of centrality. It is the middle value after the data set has been listed from smallest to largest OR largest to smallest.

meteorologist A scientist who studies weather.

mode A statistical measure of centrality. It is the value (or values) that appears most often in a data set.

model Any representation of a system (or its components) used to help one understand and communicate how it works.

precipitation Any form of water that falls to Earth, including rain, snow, sleet, and hail.

prevailing wind The most common, or modal, wind direction for a region. On Earth, the direction of the prevailing winds are related to the latitude of the region.

scientific model A representation that can be used to explain and predict what happens in the natural world.

trade-off A desirable outcome given up to gain another desirable outcome.

troposphere The lowest layer of Earth's atmosphere, where people live and most weather occurs.

warm front An area where a warmer air mass is replacing a cooler air mass.

weather The outdoor conditions at a specific time and place. Weather information often includes information related to temperature, precipitation, humidity, and cloud cover.

weather forecast A meteorologist's prediction of the weather.

wind direction The compass point from where the wind originates.

wind The movement of air from areas of higher pressure toward areas of lower pressure.

wind vane An instrument used to measure wind direction.

Name:_____ **Causes of Climate Guided Reading**

Guiding Question: Why do different parts of the world have different climates?

Directions: *There are three major factors that affect the world's different climates. To find out how, complete the following -*

1) *Review the background information on the slides provided.*
2) *Fill out the vocabulary using the glossary on pg. 139 - pg. 140.*
3) *Read the information on pg. 53 - pg. 58. Fill in the blanks for each sentence.*
4) *Answer the **Stop to Thinks** on a separate piece of paper. Be sure to look closely at the pictures and diagrams, they have many clues!*

Vocabulary Definitions:

Climate:_____

Coriolis Effect:_____

_____

Altitude:_____

Guided Reading:

Intro:

1. Many factors influence climate. Some factors like the _____ from the sun, are global and affect climates on every part of the earth. Other factors like, _____, affect _____ climates.

Energy from the Sun

2. The temperature of a place depends a lot on the sun's _____, because some parts of Earth's surface receives more _____ sunlight than others.
3. Some of earth's warmest climates are along the_____. Areas around the equator have _____ climates and areas around the poles have _____ climates.

Stop To Think #1: Imagine holding a tennis ball in front of a heat lamp for 5 minutes. What do you predict will happen to the temperature along the equator of the ball compared with the top and bottom?

Role of the Oceans

4. The oceans hold a large amount of _____ energy. Ocean currents _____ this energy from one part of _____ to another.
5. The _____ of the oceans affect the temperatures and moisture content of _____.
6. Warm surface currents _____ and moisten the air above them. This warm, moist air is carried to _____ parts of the world, where it makes _____ warmer and wetter.
7. _____ surface currents cause air to become _____, resulting in cooler climates.

8. The movement of the oceans depends on energy from the _____.
9. A major cause of currents near the ocean's surface is _____.
10. Winds and ocean currents are also affected by Earth's rotation. Earth's _____ rotation causes winds in the _____ hemisphere to swing to the right and winds in the _____ hemisphere to swing to the left.

Stop to Think #2: Use the Major Ocean Currents map on pg. 56 to answer these questions in your notebook.

a. Which coast of the USA is warmed by warm oceans?
b. Which coast of the USA is cooled by cool ocean currents?
c. Do you predict that the climate of the southeastern states along the ocean would be warmer or cooler without ocean currents. Explain.
d. Describe the general pattern of surface ocean currents shown on the map.

Factors Affecting Local Climates

11. Climates can be affected by the presence of _____ bodies of water, the _____of land above sea level, and large landforms such as _____.
12. In general, land near a large body of water will have _____summer and winter temperatures than a similar area of land that is _____ near a large body of water.
13. The _____ of a place can affect its climate. Land at _____ altitudes is usually colder than similar areas of land at _____ altitudes.
14. When wind blows toward mountains, the air is pushed upward. As the air gains altitude it _____ and begins to release _____ into the air.
15. This released _____ often forms clouds and then _____ or _____.
16. The side of the mountain that is facing the most common wind directions is usually _____, whereas the other side is usually _____.
17. Climates and weather are a result of complex interactions between the sun's _____ Earth's _____ and the _____.

Stop to Think #3: What are factors affecting local climates? Which of these factors do you think affect your local climate?