THE ATTITUDE OF LATITUDE

UNITE US
INSTRUCTIONS
Grade 7-8

Overview:

Students use the Internet to collect and compare data from a regional coastal weather station to data from an inland area and explore reasons for the differences, focusing on topographic features that create unique and variable climate along similar latitude lines.

Objectives:

The student will:

- collect, record and explain temperature data;
- access remote data sets on the Internet;
- create graphs to compare data from two regions;
- recognize that temperature varies from inland regions to coastal regions; and
- recognize that topography and distance from the ocean create a unique environment in Interior Alaska.

Targeted Alaska Grade Level Expectations:

Science

[7-8] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.

[7] SA1.2 The student demonstrates an understanding of the processes of science by collaborating to design and conduct simple repeatable investigations in order to record, analyze (i.e. range, mean, median, mode), interpret data, and present findings.

[8] SA1.2 The student demonstrates an understanding of the processes of science by collaborating to design and conduct repeatable investigations in order to record, analyze (i.e. range, mean, median, mode), interpret data, and present findings.

[8] SB1.1 The student demonstrates an understanding of the structure and properties of matter by using physical and chemical properties (i.e. density, boiling point, freezing point, conductivity, flammability) to differentiate among materials (i.e., elements, compounds, and mixtures).

[8] SD2.1 The student demonstrates an understanding of the forces that shape Earth by interpreting topographical maps to identify features (i.e., rivers, lakes, mountains, valleys, islands, and tundra).

Math

[7] S&P-3 The student demonstrates an ability to analyze data (comparing, explaining, interpreting, evaluating, making predictions, drawing or justifying conclusions) by determining mean, median, mode, or range (M6.3.3).

Vocabulary:

aerosol – very fine particles of a liquid or solid suspended in a gas; one example is mist, which consists of very fine droplets of water in air

climate – the 30-year average weather conditions of a certain region, including temperature, rainfall, and wind

coast – the land near a shore

energy – the capacity or power to do work; can exist in a variety of forms (electrical, mechanical, chemical, thermal or nuclear) and can be transformed from one form to another

ice fog – a fog composed of ice particles in cold air

insulate – to cover or surround with a material that prevents the loss or transfer of heat, electricity or sound

Interior Alaska – the area of the state bounded by the Brooks Range to the north and the Alaska Range to the south; includes river valleys and highland areas, experiences continental climate with large temperature variability, low humidity, and relatively light and irregular precipitation

latitude – distance north or south on Earth's surface, measured in degrees from the equator, which has a latitude of 0°; latitude and longitude are the coordinates used to identify any point on Earth's surface

ocean – a continuous saltwater body; oceans cover about 72 percent of the surface of Earth; includes Atlantic, Pacific, Indian and Arctic Oceans

region – a broad geographic area distinguished by similar features

temperature – a measure of the average kinetic energy of atoms or molecules in a system; a numerical measure of hotness or coldness on a standard scale such as Fahrenheit, Celsius and Kelvin

temperature inversion – a condition where air temperature increases with elevation; it is generally caused by a high-pressure system

thunderstorm – a storm of heavy rain accompanied by lightning, thunder and sometimes hail

weather – the state of the atmosphere at a particular time and place; described by variable conditions such as temperature, humidity, wind velocity, precipitation and barometric pressure

Whole Picture:

Topography, latitude and proximity to the ocean are just a few of the things that play a role in determining a region's weather and climate. The state of Alaska is divided into five geographic regions, each with varied climate.

Alaska has an extensive amount of land that touches four different bodies of water. In fact, the coastline of Alaska is greater than the combined coastlines of all the other states in the U.S., including Hawaii. With the Beaufort Sea to the north, the Chukchi Sea to the northwest, the Bering Sea to the west, and the Pacific Ocean to the south, much of the state's climate is influenced by ocean currents. Coastal areas experience a moderating effect, with slightly warmer winter temperatures and slightly cooler summer temperatures when compared to inland areas of the same latitude.

The ocean surface (the top 300 to 400 meters of water) is influenced by wind, tides, solar heat and other environmental elements. Water warms and cools much more slowly than land and can store large amounts of heat for long periods of time.

Interior Alaska experiences less of the moderating effects of the ocean due to distance and topographic barriers (mountain ranges). Instead such topographic features work to create a unique environment of temperature extremes not found anywhere else in the state.

Temperature Extremes
Wintertime temperatures in the Interior have the greatest range in Alaska, with a possible high of 50° F (10° C) down to a possible low of -65° F (-54° C). Extremely low temperatures happen because of low-level temperature inversions.

Temperature Inversions
Inversions often occur under the clear skies and calm winds of high-pressure systems when more heat can radiate away from Earth's surface. In the winter, the sun is at a lower angle in the sky and, therefore, supplies less warmth to Earth's surface. A layer of warm air acts as a lid across a valley and traps the cold air beneath. Inversions may be broken by wind and clouds moving into the area.

Lightning
Intense lightning can trigger wildfires. Drought can increase the potential for fires, as can prolonged high temperatures. Wildfires are a normal part of the Boreal Forest ecosystem.

Ice Fog
Ice fog is made up of suspended particles of ice. It occurs on cold winter days when the air is too cold to absorb any more moisture. When additional moisture is released (such as from automobile exhaust) it freezes into crystals which are suspended in the air.

Wildfires
Alaska has an average of 550 fires each summer, burning approximately 980,000 acres. Humans generally cause more fires than lightning, however lightning-caused fires cover about 90 percent of the burned areas. Lighting

often strikes in remote areas that are hard for fire fighters to reach. Human-caused fires are usually closer to homes and populated areas and are aggressively fought. Most fires happen in early to midsummer when rainfall is low.

Materials:

- Computer with Internet access (http://climate.gi.alaska.edu/Climate/Location)
- Colored pencils
- Scissors
- Map of Alaska with latitude lines
- Stickers such as stars or circles
- "Climate Vocabulary Toss" cards
- MULTIMEDIA: "We're Hot and We're Cold" on the UNITE US website (uniteusforclimate.org)
- TEACHER INFORMATION SHEET: "We're Hot and We're Cold"
- STUDENT LAB PACKET: "The Attitude of Latitude"
- STUDENT WORKSHEET: "The Attitude of Latitude Pictograph"

Activity Preparation:

1. Read through teacher and student material to become familiar with the lesson.
2. Bookmark http://climate.gi.alaska.edu/Climate/Location on student computers.
3. Print/copy "Climate Vocabulary Toss" cards.

Activity Procedure:

1. Play the Climate Vocabulary Toss Game. Divide students into pairs. Give each pair a selected word from STUDENT WORKSHEET: "Climate Vocabulary Toss." Ask students to read the word and definition together, then cut the sheet in half along the dashed line. Each student should take one half, then crumple it into a "snowball". Using a wall clock or watch, allow students 30 seconds to have a "snowball fight" with the crumpled papers. At the end of the "snowball fight" students should pick up one crumpled paper, open it then find the corresponding word or definition. Repeat (if desired) to give students an opportunity to learn more words. At the end of the snowball fight, ask pairs to read the word and definition to the whole class.
2. Refer to the map of Alaska and review how to find latitude. Ask a student to find an Interior community on the map and mark it with a sticker. Ask a different student to follow the latitude line near the marked community to the coast, find the nearest community then mark it with a sticker. Remind students of the MULTIMEDIA: "Seasons and Ecliptic Simulator" on the UNITE US website (uniteusforclimate.org) where they are able to manipulate latitude by changing the angle of the sun.
3. Ask students whether the two marked communities would have similar temperatures and why or why not. Explain that generally, communities along similar latitudes experience similar climate, however Earth's systems are not always that simple. Topography and proximity to oceans have a dramatic influence too. Ask students what freezes up first: the ground or lakes/rivers. Explain that it takes longer (more energy) to change the temperature of water than air or land. Therefore, temperatures of inland areas tend to change more than temperatures of coastal areas, since the coastal areas are "insulated" by the ocean.
4. Distribute STUDENT LAB PACKETS. Review Testable Question. Instruct students to select their hypotheses on the student worksheet.
5. Following the directions listed in the lab packet under "experiment", help students complete pages 1-3.
6. Introduce the MULTIMEDIA: "We're Hot and We're Cold" on the UNITE US website (uniteusforclimate.org), which outlines some of the unique climate conditions experienced in Interior Alaska. Discuss the slides. Introduce "Think About It" questions, but do not discuss until the end of the presentation. Ask students to hold their answers and comments. When the presentation is finished, review the questions. Refer to TEACHER INFORMATION SHEET: "We're Hot and We're Cold" for reference.
7. Distribute STUDENT WORKSHEET: "The Attitude of Latitude Pictograph." This can be done independently or as a teacher-led activity. As each concept is reviewed, students fill in the next pictograph on the map.

THE ATTITUDE OF LATITUDE

Language Links:

Alaska Native people have always been careful observers of the weather. Their languages are rich in words that describe weather. Ask a local Native language speaker to provide the words in the local dialect for the weather phenomenon listed in the chart below. The local dialect for these words may differ from the examples provided. Share the words with students to build fluency in local terms related to weather. Include local words in songs, stories and games when possible.

English	Gwich'in	Denaakk'e	Lower Tanana	Deg Xinag	Your Language
Land	Nan	Nen'	Nen'	Ngan	
Ocean	Chuu choo	Daagheyukk kk'e			
Fog / ice fog	Ch'atr'ał	Okk	Ok / Ch'ek'wtth doyiya'kwtth, yik	Eq	
Smoke	Òat	Òet	Òet	Łit	
Thunder	Nahtan	Nełten	Nełteni	Niłtin	
Fire/Wildfire	Ko'	Kkun'	Kwn'		
Snow	Zhah	Tseetl	Yeth	Yith	
Trees	Dachan	Ts'ebaa	Ts'eba	Tritr tux	
Fuel/gas	Chuu daak'a'	Gaas	Gasr	Xa	
Warm	Gwiindhaa	Høleł		Xedhił	
Cold	Gwiink'oo	K'ekk'øtl	Dli	Izre	
River	Han	No'	Nik'a	Xin	
Valley	Nihtak	Taayee	Tok'a		
Hill	Taih	Teyh	Teyh		
Mountain	Ddhah	Dleł	Ddheł	Deloy	

Critical Thinking Questions:

1. Compare Alaska coastal communities with those in Interior Alaska. Which do you think would have higher energy consumption for home heating?
2. If water and land both stored and released energy at the same rate, would there be a difference in climate at the same latitude? Why or why not?
3. Burning wood in a wood stove contributes to air pollution, yet many people rely on wood for heat. What might be a solution to this problem?
4. How do wildfires contribute to pollution? Is there a solution?
5. Air currents bring in smog from other countries, such as Russia. This smog is known as the Arctic Haze, and it contributes to poor air quality. Is there anything that can be done about it?

Extension Ideas:

Using the Internet, enter the search phrase "cloud in a bottle" to access directions on how to do an experiment that illustrates the way water vapor clings to pollution particles in the atmosphere. This illustration will help students further understand how ice fog forms.

THE ATTITUDE OF LATITUDE

Answers:

Answers to Student Lab Packet:

Answers will vary for Hypothesis, Experiment and Data sections. In their conclusion, students should choose, "An inland area will have more extreme temperatures (warmer summers and cooler winters) than a coastal area along the same or similar latitude." Descriptions of how this conclusion was reached may vary.

Answers to STUDENT WORKSHEET: "The Attitude of Latitude Pictograph"

Pictographs will vary, but should indicate and understanding of the concepts described.

1. Coastal
2. Interior
3. Interior

WE'RE HOT AND WE'RE COLD

(To Accompany Multimedia)

Think About It: Besides latitude, what else might affect a region's climate?

Topography, latitude and proximity to the ocean are just a few of the factors that play a role in determining a region's weather and climate. Wind patterns and elevation also play a role.

Think About It: Does snow cover affect the way stored energy is released from the land?

Yes, it does. Snow is an insulator. Snow-covered land holds energy (stored summer heat) longer than land that is not snow covered. If you measure the air temperature above the snow, then the temperature under the snow layer, you will find the temperature is warmer underneath the snow. Snow cannot conduct heat as fast as the ground and therefore heat (or energy) gets trapped by the snow layer. If there is a lot of snow on top of permafrost, or snow comes early in the season, it can prevent the active layer from freezing and permafrost will start to degrade.

Think About It: What lies to the east of Interior Alaska? Do you think that region has a coastal climate or one more like Interior Alaska?

Canada lies to the east. It experiences a very similar climate in areas with similar topography.

Think About It: What can you learn just by looking at this map?

There is a clear pattern showing fires clustered in the Interior. It is obviously more prone to fires than the rest of the state due to heavy forestation coupled with a very dry climate. Warm temperatures in the summer contribute as well. Once temperatures begin to cool in August and September, fires die down.

Think About It: Why do you think so much more land burns due to lightning, even though people start more fires?

One reason is that lighting often strikes in remote areas that are hard for fire fighters to reach. Human-caused fires are usually closer to homes and populated areas where they are aggressively fought.

Think About It: How does heavy smoke impact the people who live nearby?

Smoke can cause health issues to people and animals; visibility issues to pilots and drivers; and it blocks out the sun's rays, which decreases light and affects plant growth.

Think About It: Why does ice fog form in cities and towns but not as much in remote areas?

There is more particulate matter in the air near cities and towns, which contributes to aerosols in the air. Aerosols are an important building block of ice fog. Particulate matter mostly comes from burning fuel, such as car exhaust, home and business heating exhaust, wood stove smoke, etc. Water vapor sticks to the particulate matter and forms droplets which freeze into ice when temperatures drop.

Think About It: Why does wind break up an inversion?

Wind is responsible for moving the high-pressure system away and bringing in clouds.

Think About It: Do you need to build a home in a different way in Interior Alaska than you do in California? How about southern Alaska? Why?

When you build a 5-star-energy-rated home, the measure is how much energy is needed to maintain the home (heat, electricity, etc.). The rating is the same no matter where you build, however, it becomes more relevant as energy costs skyrocket. In California the concern may be keeping cool. In Alaska the concern is keeping the heat in!

NAME: _____

THE ATTITUDE OF LATITUDE

Testable Question:

How do the high and low temperatures in Interior Alaska differ from the high and low temperatures in coastal areas?

Hypothesis: Make an educated guess and check one statement below.

___ An inland area will have the same high and low temperatures over the course of a year as a coastal area along the same or similar latitude.

___ An inland area will have more extreme temperatures (warmer summers and cooler winters) than a coastal area along the same or similar latitude.

___ An inland area will have less extreme temperatures (cooler summers and warmer winters) than a coastal area along the same or similar latitude.

Experiment:

1. Read the above background information and select a hypothesis.
2. Look up weather data for an Interior village near your school by visiting the website: http://climate.gi.alaska.edu/Climate/Location.
3. Select "Interior Basin."
4. Select a location from the drop down menu at the far left. If you do not see your village listed, choose the closest station. Your teacher can help you determine this. Notice the latitude and longitude in the upper right corner.
5. Look at the first chart on the page with the title "NCDC Normals."
6. Record the mean (average) temperatures for each month of the year on the Interior Region Data Chart.
7. Return to the website: http://climate.gi.alaska.edu/Climate/Location, and select "West Central" region.
8. Select a location from the drop down menu that is in a similar latitude to the community you chose in step 4. Your teacher can help you determine this if you need help.
9. Look at the chart titled, "NCDC Normals."
10. Record the mean (average) temperatures for each month of the year on the Coastal Region Data Chart below.
11. Create a line graph, in the area provided on page 2, compare the mean temperature at each location. Use a different color line for the Interior village and the coastal village. Provide a key and a title.

Interior Region Data Chart	
Month	**Temperature**

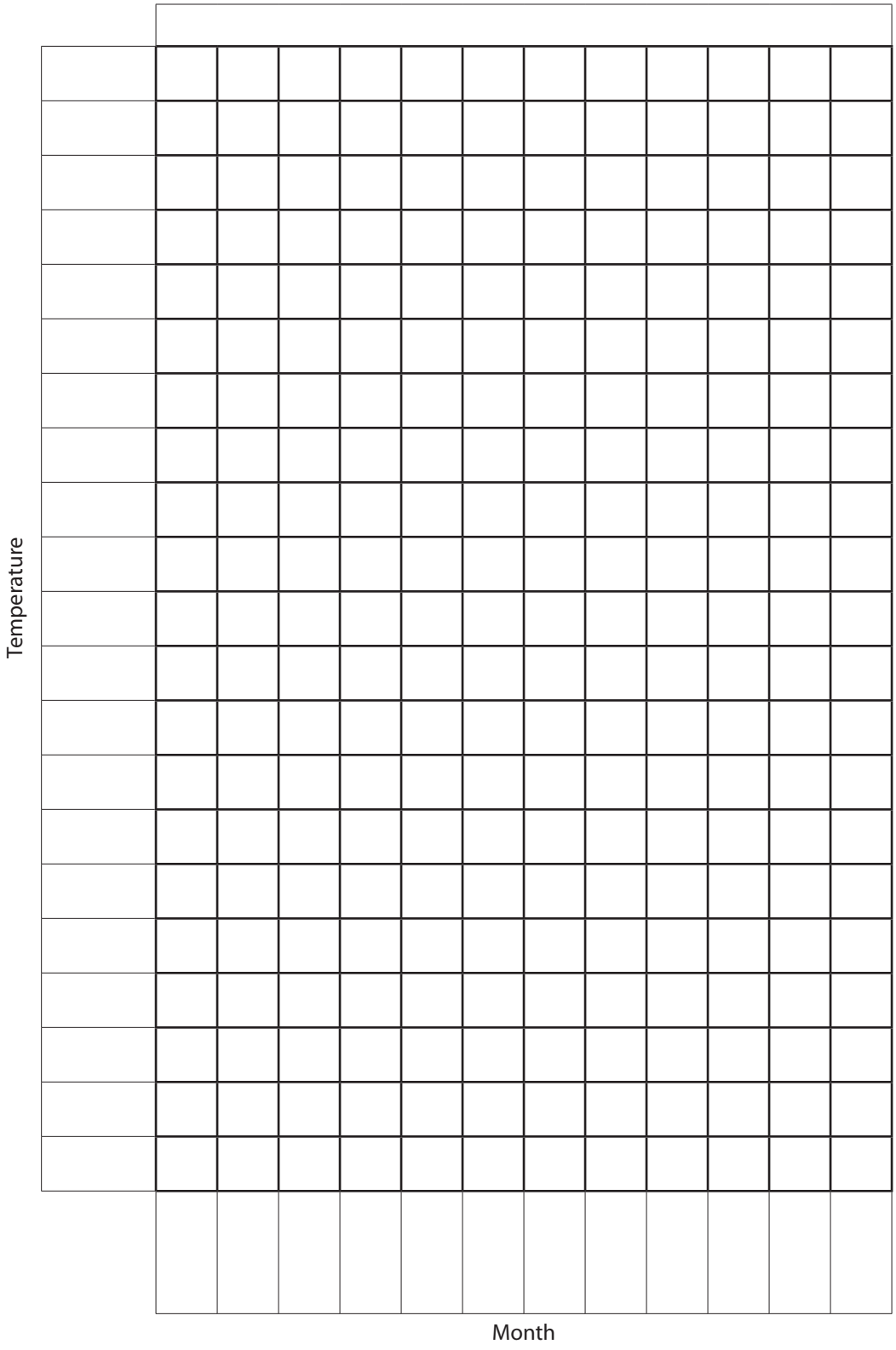
Coastal Region Data Chart	
Month	**Temperature**

NAME: _____

THE ATTITUDE OF LATITUDE

Data:

Create a line graph with the average monthly temperatures for each location. Use a different color line for each location. Label the units on the "X" and "Y" axes. Provide a title and a key.



NAME: _____

THE ATTITUDE OF LATITUDE

Look at the graph to determine:

1. Which location was coldest overall? _____

2. Which location was warmest overall? _____

Conclusion:

1. Select the conclusion reached after the experiment:

___ An inland area will have the same high and low temperatures over the course of a year as a coastal area along the same or similar latitude.

___ An inland area will have more extreme temperatures (warmer summers and cooler winters) than a coastal area along the same or similar latitude.

___ An inland area will have less extreme temperature (cooler summers and warmer winters) than a coastal area along to the same or similar latitude.

2. How did you reach your conclusion? Explain using complete sentences.

NAME: _____

THE ATTITUDE OF LATITUDE PICTOGRAPH

Directions: Refer to the map on Page 2. Use regular and colored pencils to complete the following:

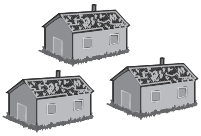
For the Coastal Region:

- Shade the coastal area yellow and write "coastal" along the western shore.
- Draw wind along the coast.

- Draw precipitation along the coast.

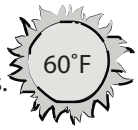
PRECIPITATION

- Draw a few communities.



COMMUNITY

- Draw the sun. Inside, write 60° F, the average summer temperature for some coastal communities.



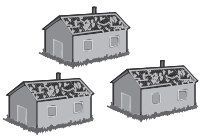
- Draw a snowman with a winter low temp of -15° F, the average low winter temperature for some coastal communities.

For the Interior Region:

- Interior Alaska is bordered to the north by the Brooks Range and to the south by the Alaska Range. Label each range.
- Label the area between ranges "Interior."
- Draw a thunderstorm with a few lightning strikes.

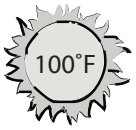
- Draw a forest fire complete with smoke.

- Draw a few communities.



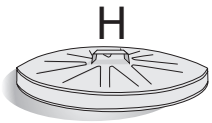
COMMUNITY

- Draw the sun. Inside, write 100° F, the highest temperature recorded for Interior Alaska.



- Draw a snowman. Inside write -80° F, the lowest temperature on record for Interior Alaska.

- Draw a high-pressure system that could cause a temperature inversion. Your high-pressure system can look like a lid that is keeping the cold air close to the surface. Be sure to add an H.



- In the box to the right of the map, the dots you see represent fine particles of pollutants suspended in the air. Using a colored pencil, draw a shaded circle around the particle, representing water that has formed a droplet. These suspended drops are an aerosol. In the winter the aerosol freezes and hangs suspended in the air as ice fog. Label the picture "Ice Fog."

NAME: _____

THE ATTITUDE OF LATITUDE PICTOGRAPH

NAME: _____

THE ATTITUDE OF LATITUDE PICTOGRAPH

Directions: Read each sentence then write the name of the region (coastal or Interior) that corresponds with the description.

1. Warm air, transported over land by wind, brings precipitation and mild temperatures.

   _____

2. High pressure in the atmosphere with clear skies and calm winds can make temperatures in lower valleys colder than in nearby hills, called a temperature inversion.

   _____

3. Lightning strikes cause several hundred forest fires (on average) each year.

   _____

aerosol

very fine particles of a liquid or solid suspended in a gas; one example is mist, which consists of very fine droplets of water in air

climate

the 30-year average weather conditions of a certain region, including temperature, rainfall and wind

coast

the land near a shore

energy

the capacity or power to do work, such as the capacity to move an object of a given mass in a given direction by the application of force; can exist in a variety of forms such as electrical, mechanical, chemical, thermal or nuclear and can be transformed from one form to another; also, usable heat or power

ice fog

a fog composed of ice particles in cold air

insulate

to cover or surround with a material that prevents the loss or transfer of heat, electricity or sound

latitude

distance north or south on Earth's surface, measured in degrees from the equator

ocean

a continuous saltwater body; oceans covers about 72 percent of the surface of Earth; includes Atlantic, Pacific, Indian and Arctic Oceans

region

a broad geographic area distinguished by similar features

temperature

a measure of the average kinetic energy of atoms or molecules in a system; a numerical measure of hotness or coldness on a standard scale such as Fahrenheit, Celsius and Kelvin

temperature inversion

a layer of air with increasing temperature with height generally caused by a high-pressure system; warm air acts as a lid over the area

thunderstorm

a storm of heavy rain accompanied by lightning and thunder and sometimes hail

weather

the state of the atmosphere at a particular time and place; described by variable conditions such as temperature, humidity, wind velocity, precipitation and barometric pressure