



Activity #38: Topography & Weather

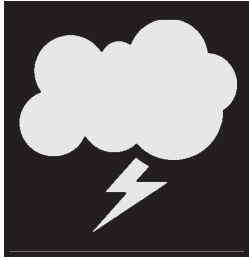
Did You Know? *The higher you go, the thinner the air, and the harder it is to breathe. However, the human body has been able to adapt. Andean Indians, living in mountain villages at about 17,000 feet (5,200 m) have developed larger lungs and hearts than normal, so they can breathe properly even at this great height.*

Air temperature decreases with altitude. The reasons are that (1) the collisions between air molecules decrease at higher elevations, and (2) air heated by the earth’s surface rises and mixes, moving the heat energy higher, so the farther a spot is above the earth’s surface, the less heat will reach it. Air temperature becomes cooler the higher you go; it drops an average of 3.6°F for every 1,000 feet of elevation above sea level. Precipitation is greater on the windward side (in most of North America, this is the western side) than on the leeward side (the eastern side) of mountains. This phenomenon is called the rain shadow effect. As air rises, its pressure drops, causing it to cool. The cooling causes water vapor to condense into clouds and precipitation. As air descends on the leeward side, its pressure increases, causing it to warm.

1. Turn to the weather page in today’s newspaper. Record the high and low temperatures for three cities with different elevations (see chart below). Do this for one week.
2. Then calculate the average (mean) weekly temperature for each city. Which city is the coldest overall? Which city is the warmest overall? Do the cities with higher elevations have cooler average temperatures? (If possible, repeat this activity at different times during the year.)

WEEK DAY	MIAMI, FLORIDA		KANSAS CITY, MISSOURI		DENVER, COLORADO	
	HIGH	LOW	HIGH	LOW	HIGH	LOW
SUNDAY						
MONDAY						
TUESDAY						
WEDNESDAY						
THURSDAY						
FRIDAY						
SATURDAY						
AVERAGE						

Extension Activity: Look at a topographical map of your state, province, or region. What are the topographical features of the area? Locate the mountains, hills, or areas with higher elevations. Identify cities on the windward and leeward sides of these elevated areas. Then, look in your daily newspaper for precipitation information. Chart the precipitation for those cities for a month or more, if possible. What are your findings? Do the cities on the windward side of the elevated areas receive more precipitation? What about cities on the leeward side? Do they receive less precipitation?



Activity #39: Geography & Climate

Did You Know?

The air of the deserts of California and Arizona is often more humid than the air at the North Pole. This is because desert air is warmer than polar air and therefore can hold more water before it is saturated. Antarctica is often referred to as a polar desert.

Latitude, or distance from the equator, affects the range and seasonal variation of temperature. The closer a spot is to the equator, the more direct sunlight it gets, so it is warmer and has less seasonal variation in temperature than a spot farther from the equator. Proximity to the ocean also affects the temperature of coastal areas. They are warmer in winter and cooler in summer than inland areas equally far from the equator, because water takes longer to heat than land does. The effect of water temperature on land temperature is more pronounced if the ocean (or other large body of water) is to the west, because the prevailing wind over most of the earth's land masses moves from west to east. The air is more humid at the equator because there is more evaporation than at other latitudes. Precipitation and the saturation point of the air depend on topography, temperature, and the direction of the prevailing winds and the movement of pressure systems. In summary, the climate of any given spot is the result of its topography and its geographical location interacting with the sun, wind, and moisture in the air.

1. Investigate influences on precipitation patterns in your state, province, or region. Obtain a topographical map of the region and a record of average precipitation for various locations in the area. Using the weather page in your daily newspaper, chart the precipitation information for your region for this week (or month). Compare your current newspaper findings with the average record. Which cities have the most and least precipitation?
2. On the topographical map, locate the city with the highest average precipitation and the city with the lowest. Are the precipitation levels in these two spots affected by their distance from the equator? By terrain? By temperature? By proximity to large bodies of water? Investigate and explain below.

LOCATION	LATITUDE	TERRAIN	TEMPERATURE	PROXIMITY TO WATER
City With Highest Average Precipitation				
City With Lowest Average Precipitation				
Your City				

Extension Activity: Using the information from the weather page in your daily newspaper, chart the high and low temperatures for cities around the world. Then, focus your investigation on the cities having the highest and lowest temperatures. Using a world almanac, determine the geographical and topographical relationship of each city to temperature.



Activity #40: The World's Climate Belts

Did You Know?

Deserts are the hottest and driest places on earth. In some deserts, rain never falls. During the day it can be hot enough to fry an egg on the sand and at night cold enough for water to freeze.

Climate and weather are not the same. Weather is the condition of the atmosphere during a brief period. The weather may change from day to day. One day's weather may be stormy, wet, and cool. The next day's may be sunny, dry, and somewhat warmer. To determine the climate of an area, scientists study the daily weather conditions over many years. Climate is the average weather in an area over time.

1. On the chart below you will find the world's twelve major climate belts. Read the information and determine which belt best describes your region. (All but the first two climate belts can be found in the combined areas of the United States and Canada.)
2. Most food crops grow best in areas that have a certain climate. Scan the grocery advertisement section of your daily newspaper for food product examples. Find and clip at least two examples for each climate belt listed below.

MAJOR CLIMATE BELTS	
<p>TROPICAL WET - Always hot, always wet. Heavy precipitation well distributed throughout the year. (Central and South America)</p> <p>TROPICAL WET & DRY - Always hot, with alternate wet and dry seasons. Heavy precipitation in the wet season. (Central and South America)</p> <p>HIGHLANDS - These areas are affected by altitude and are generally cooler and wetter than the adjacent climates. (Denver, Boise, Calgary)</p> <p>DESERT - Hot to cold, with great changes in daily temperature except in coastal areas. Very little precipitation. (Las Vegas, Phoenix)</p> <p>STEPPE - Hot to cold, with great changes in daily temperature except in coastal areas. Little precipitation. (San Antonio, Cheyenne, Regina)</p> <p>SUBTROPICAL DRY SUMMER - Hot, dry summers and mild, rainy winters. Moderate precipitation in winter. (Los Angeles, San Francisco)</p>	<p>SUBTROPICAL MOIST - Warm to hot summers and cool winters. Moderate precipitation in all seasons. (Miami, Atlanta, New Orleans, Houston)</p> <p>OCEANIC MOIST - Moderately warm summer and mild, cool winter. Moderate precipitation in all seasons. (Seattle, Vancouver)</p> <p>CONTINENTAL MOIST - Warm to cool summer and cold winter. Moderate precipitation in all seasons. (New York City, Pittsburgh, Chicago, Detroit, Minneapolis, Ottawa, Toronto, Winnipeg)</p> <p>SUBARCTIC - Short, cool summer and long, cold winter. Light to moderate precipitation, mostly in summer. (Anchorage, Edmonton)</p> <p>POLAR - Always cold, with a brief chilly summer. Little precipitation in all seasons. (Extreme northern sections of Alaska and Canada)</p> <p>ICECAP - Always cold, average monthly temperature never above freezing. Precipitation always in the form of snow. (Northern-most tip of Canada)</p>

Extension Activity: People wear clothing that protects them against the climate of their area. Find examples in the newspaper of clothing that might be worn in each climate region listed above. Explain your choice.



Activity #41: Seasonal Weather

Did You Know?

If the earth's axis were vertical, there would be no seasons. But, the axis of the earth points to the North Star at a 23.5° slant. It is this slant that makes the seasons change as the earth revolves around the sun.

The earth completes its journey of 598.3 million miles (965 million km) around the sun in a little more than 365 days, moving about 18.5 miles (29.76 km) per second. It revolves around the sun in an oval path, an *ellipse*. Therefore, it sometimes goes a bit faster and at other times a bit slower. The closer to the sun, the greater the speed. Near the equator it remains hot all year round. At the north and south poles it is always cold. But in most parts of the world there are four seasons every year. The earth is tilted or slanted. It is this slant that makes the seasons change as the earth revolves around the sun. When the Northern Hemisphere is tilted toward the sun, it is summer and the sun's rays penetrate more directly. When the Northern Hemisphere is tilted away from the sun, it is winter and the sun's rays strike at a slant giving off less heat and light. At the equator, the sun's rays are always direct. At the poles, the sun's rays always strike at a slant.

1. Caused by the earth's year-long trip around the sun, the seasons bring the biggest swings in hot and cold weather. What are the seasonal temperature ranges in your area? How cold does it get on a winter night? How hot does it get on a summer afternoon? Refer to a local or regional almanac for the exact information.
2. Using the daily newspaper, record and analyze current seasonal data (for a week or two, if possible). Compare your daily newspaper findings for this season to the almanac information. Are current weather patterns typical for your region? Do daily weather statistics (newspaper) correspond to normal seasonal trends (almanac)?

	AVERAGE SEASONAL DATA FROM ALMANAC	CURRENT SEASONAL DATA FROM THE NEWSPAPER
TEMPERATURE		
SUNLIGHT		
WIND		
PRECIPITATION		

Extension Activity: Just as the earth revolves around the sun, the moon takes a trip around the earth every 29 and 1/2 days. In doing so, the moon's gravity pulls on the earth and its large bodies of water. As a result, two bulges called *high tides* are formed on the oceans and seas. As the earth turns, these tidal bulges travel from east to west. Every place along the seashore has two high tides and two low tides daily. Turn to the weather page in today's newspaper to find the high and low tide information. Notice also the information given on the moon's schedule. What is meant by *new moon*, *first quarter*, *full moon*, and *last quarter*? Check the newspaper information against your own direct observation on the dates projected.



Activity #42: El Niño

Did You Know?

In 1957, Jacob Bjerknes worked out the connection between El Niño and the atmospheric anomalies in the northern Pacific and North America. He introduced the idea of warm, cold, and occluded fronts and explained how they are related to extratropical cyclones.

The best-known example of how the ocean and atmosphere are interconnected is the set of patterns known as El Niño, or more properly, the El Niño-Southern Oscillation (ENSO). While the land near the coast of Peru is a desert, the nearby ocean is one of the world’s most productive fishing grounds. Sea life is abundant because cold water, rich in nutrients, is coming up (called upwelling) along the coast as winds push surface water away. The name “El Niño” comes from the Spanish speaking people who live along the Pacific Coast of Peru. Each year in late December, a southward moving current warms the water. (The Peruvians started calling the warm current El Niño or boychild, for the Infant Jesus because it comes around Christmas.) Every few years the ocean warming is greater than normal and leads to disruption of the usually abundant fish and other marine life. It also can bring flooding rains. Until 1957, El Niño was thought to affect only South America’s west coast. Now we know it is part of a global chain of ocean and atmospheric events. Records going back to the 19th century show that some El Niño years were wet along North America’s West Coast (with severe flooding), some dry (causing drought), and others brought average precipitation.

1. Meteorologists today say that El Niño is responsible for changes in weather patterns across the entire continent of North America. It causes some areas to have colder or wetter than average winters, and other areas to have drier or warmer than average winters. What is the weather situation in your region? Has your region experienced unusual winter weather in recent years? Explain.
2. Look in today’s newspaper for news stories or information about unusual weather patterns in different parts of the world. What seems to be the problem? What caused the situation? Is it related to any one particular season or phenomenon? What can be done to solve the problem?

UNUSUAL WEATHER PATTERN	LOCATION	PROBLEM	SOLUTION

Extension Activity: Oceans are a major player in climate. They hold large amounts of heat and move it around via global-scale currents. Look through the daily newspaper or visit the library for information about ocean and atmospheric weather connections (other than the El Niño).



Activity #43: Measuring the Weather

Did You Know?

The Eureka weather station in Canada is the most remote in the world. It is 600 miles (960 km) from the North Pole. Built in 1947, it has many luxuries including a greenhouse where staff grow plants during the 5 months when there is constant daylight.

There are about 10,000 weather stations all over the world in cities, at airports, and on ships. Working together they watch the weather very closely. Every few hours they measure and record humidity, pressure, wind speed and direction, precipitation, and temperature. Using data from weather balloons (radiosonde), radar, and weather satellites, computers at the weather stations analyze all of the information, translate it into an international code, and send it around the world for forecasters to use. Weather reports for specific localities, however, are not always accurate because of variations caused by regional terrain. The national and international information is used as a starting point for local and regional forecasts. A local weather station can usually make a more accurate prediction for the weather in its area.

1. See if you can forecast the local weather! Using the daily newspaper and local television reports as a starting point, chart local and regional weather for a couple of weeks. At the same time, organize a weather station at home and record the information yourself. (Weather equipment should include thermometers, a barometer, hygrometer, wind sock, and anemometer.) Make your weather forecast based on the weather information you have charted and observed.
2. Draw a large regional map on poster board to display your weather forecast. Use standard weather symbols (see the weather map in your daily newspaper). If needed, design symbols of your own for weather conditions specific to your local area.

	SUN	MON	TUES	WED	THUR	FRI	SAT	SUN	MON	TUES	WED	THUR	FRI	SAT
TEMPERATURE														
SUNLIGHT														
WIND														
PRECIPITATION														

Extension Activity: Satellites show weather patterns that cannot be seen from the ground. There are two types of weather satellites: polar orbiting satellites (circle the earth) and geostationary satellites (orbit in a fixed position at the exact speed of the earth’s rotation). Cameras on board these satellites send down photographs of cloud cover, temperature, water vapor, and other atmospheric conditions. Imagine a satellite taking a “close-up” picture of your city. In addition to weather, what would it see? Search through your daily newspaper for things that represent your city. You may want to include community areas like parks, stores, buildings, and schools. Based on your newspaper examples, write a one-page story about your town, as seen through the eyes of a satellite.



Activity #44: The Doppler Principle

Did You Know?

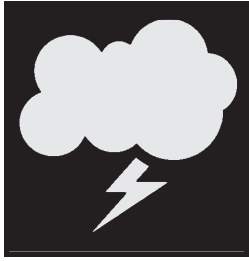
The word "radar" is an acronym for "radio detection and ranging." The German physicist Heinrich Hertz demonstrated in 1888 that metal objects will reflect radio waves. During World War II radar use was perfected and the resulting breakthroughs led to weather radar.

Christian Doppler, an Austrian scientist, explained in 1842 why the whistle of an approaching train has a higher pitch than the same whistle when the train is going away. The frequency of sound waves from an approaching source is shifted to a higher frequency or pitch while those from a receding source shift to a lower frequency. The principle applies to the frequency of radio waves returning to a radar antenna. Precipitation moving toward the radar station increases the radio waves' frequency. If wind is blowing precipitation away from the antenna, the frequency of reflected radio waves is lowered. Doppler radar detects these frequency changes and uses them to show wind patterns. Old weather radar equipment showed the location, movement, and strength of precipitation. Doppler does all that as well as measuring wind speed and direction. In addition, the new Doppler radar uses computer technology to indicate boundaries between cool and warm air. Doppler radar can "see" a front coming, even when it's not kicking up any precipitation. It also can detect winds in clear air. Doppler radar has been extremely helpful to pilots and air traffic controllers. Doppler radar can detect microbursts (a type of wind shear responsible for airplane crashes).

1. Turn to the weather page in your newspaper. Does your daily newspaper subscribe to or use services which provide weather information through Doppler radar technology?
2. Doppler radar can alert pilots to wind shear conditions. Look through your daily newspaper for articles about airplane crashes that may have been caused by the microburst phenomenon. (An airplane near the ground that runs into a microburst first has a head wind, which quickly changes to a tailwind. The tailwind drops the speed of the wind over the wings dramatically, which causes a loss of lifting force. The airplane can crash before regaining the speed needed to create enough lift.)

ACCIDENT LOCATION	CAUSE OF CRASH	DID THE AIRPORT HAVE DOPPLER RADAR?

Extension Activity: Doppler radar is part of the NEXRAD (Next Generation Weather Radar) network. It eventually will include 160 units, most of them operated by the National Weather Service in and near the United States. It also will have a few units at overseas military bases. In addition, Terminal Doppler Weather Radars are being purchased by the U.S. Federal Aviation Administration for all major airports around the United States. These radars cost approximately \$340 million each. Why do you think they cost so much? Look through today's newspaper for articles or information concerning Doppler radar.



Activity #45: Looking to the Future

Did You Know? *The Swedish chemist, Svante Arrhenius, reportedly was the first to use the term "greenhouse effect." He used it in an 1896 article describing how carbon dioxide in the air keeps the earth warmer than it would otherwise be. His article helped solve the scientific mystery of why the earth is as warm as it is.*

Two of the largest issues involving the earth's atmosphere have been in the news since the 1970s: destruction of ozone in the stratosphere, and the possibility that human activities will cause the earth's average temperature to increase, usually called the "greenhouse effect." Scientists have figured out the key factors in the destruction of the earth's ozone layer and are giving policy makers concrete advice. Scientists are able to say with assurance that chlorofluorocarbons (CFCs) and some other chemicals destroy ozone and the only practical way to save the ozone is to stop releasing these chemicals into the atmosphere. While greenhouse warming seems to be a likely result of carbon dioxide, methane, nitrous oxide, and CFCs being added to the atmosphere, much remains to be learned about the earth's climate system and its response to potential warming. Understanding how the earth's climate works and being aware of the millions of interactions that produce it is the start of understanding how humans can affect our atmosphere.

1. A few years ago, *TIME* magazine printed an article suggesting that an Environmental Corps, similar to the Peace Corps, be established. The corps would be sent all over the world to educate and inform people about preserving and protecting the environment. What do you think about this idea? How would you organize such a group? Write an essay explaining your thoughts.
2. Imagine that this organization already exists. Create a newspaper advertisement recruiting citizens to join the corps. Sketch your newspaper advertisement in the space below.

Extension Activity: Create an entire advertising campaign! Keeping with the Environmental Corps theme, design other promotional items to complement your newspaper advertisement. Design, for example, a bumper sticker, an outdoor billboard, a radio jingle, and/or a script for a television commercial.