What Can We Learn from Clouds?

Besides their shapes, how do clouds differ from each other?

What kind of information can we get by looking at clouds?

Lab Activity

What Do You See in the Clouds?

1 Observe the sky and think about the following questions. Discuss them with your team.

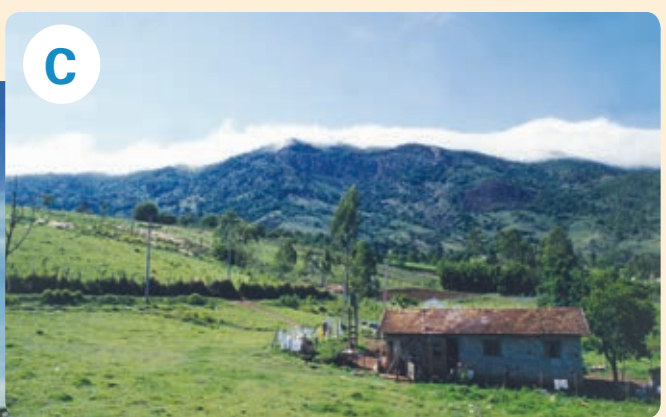
- What do the clouds look like today?
- What else can you describe about today's weather?
- What are the clouds made of?
- What do you see happening in the clouds?

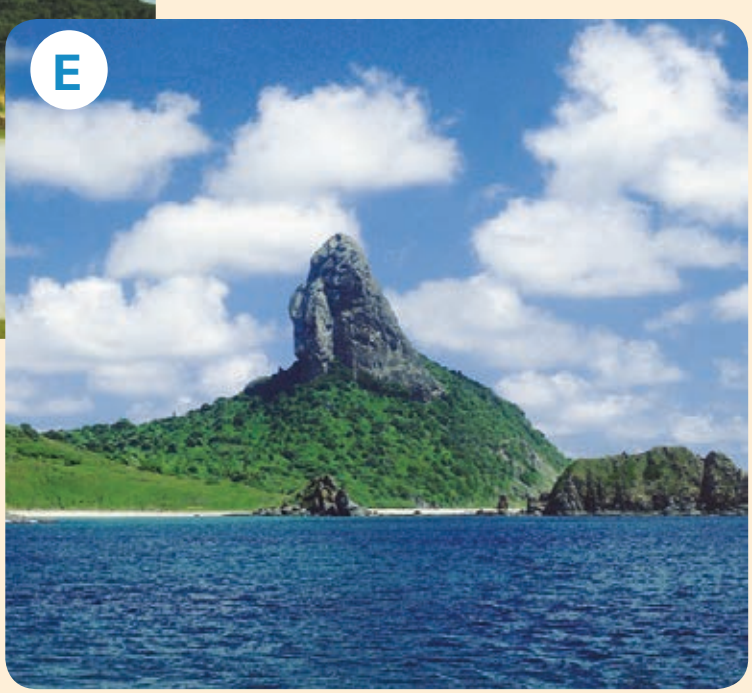
2 Scientists classify clouds as four types—cirrus, stratus, cumulus, and cumulonimbus. The photographs show different types of clouds.

- Compare the clouds shown in the five photographs on the next few pages.
- Work with your team to arrange the Cloud Cards according to the characteristics of each type of cloud (color, shape, and height).
- What differences are there among the types of clouds you identified?

3 Discuss the following questions with your teammates.

- What are clouds made of?
- How are the clouds formed?
- How do they reach such high altitudes?
- What kind of information about the weather can meteorologists obtain by observing the clouds?



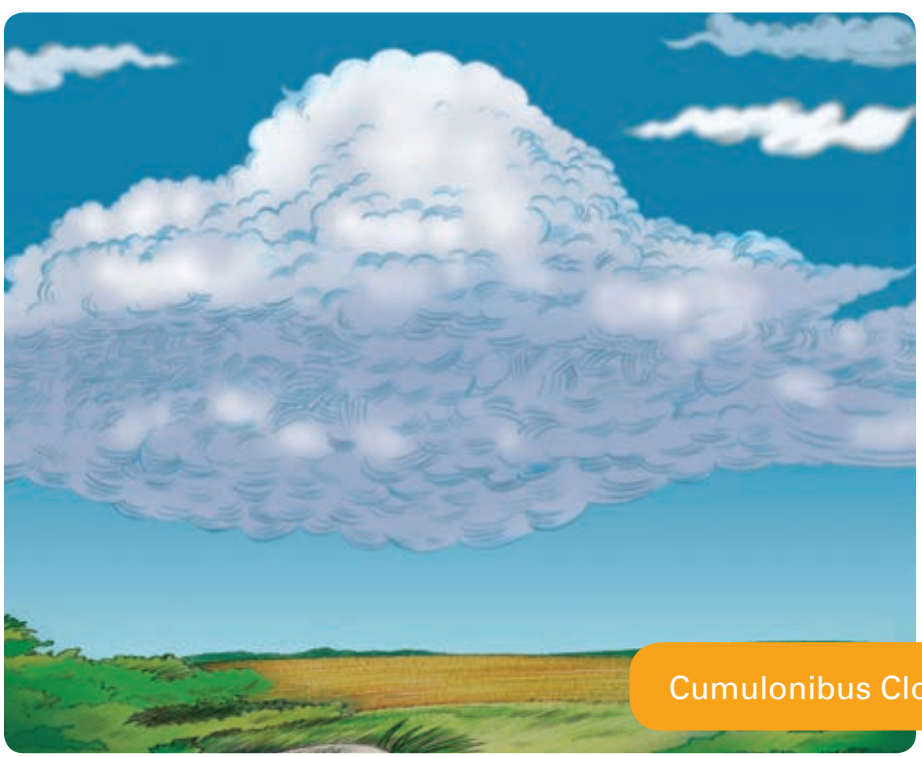


Learn More

How Summer Storms Are Formed

You may be surprised to learn that the sun does not warm the ground evenly. Some places get much hotter than others. Large cities and areas without many plants heat up much faster than other areas.

Land covered by forests, for example, takes longer to absorb heat from the sun than an open area without trees does. Warmed soil heats the air around it. As the air warms up, it rises. This forms the tall cumulonimbus clouds that produce big storms. During a storm, friction among the rising air, water in the air, and ice crystals formed in the clouds produce electrical charges. This process causes the lightning so often seen during summer storms.



Cumulonibus Cloud

Sometimes ice pellets become very large and form hail, which does not completely melt before reaching the ground.

Thunder and lightning are often part of summer storms.

Cirrus, stratus, and cumulus clouds constantly form and then are gone again. The type of cloud that forms depends on the weather conditions. During hot summer days, as water evaporates, the rising warm air carries water vapor upward. This forms a current of hot and humid air. The currents of hot, humid air reach very high altitudes. There, the temperature is cooler. When the humid air reaches a cooler area, the water vapor condenses and forms clouds. In the highest parts of cumulonimbus clouds, the temperatures may be low enough to freeze the water. This forms ice crystals. These crystals can link together, forming larger pieces that fall to the ground. As they fall, the ice pieces may meet warmer air and melt. Or, they might fall to the ground as hail. Hail is usually one sign of a violent storm with lots of rain and wind.

Cumulonimbus clouds reach altitudes as high as 15,000 meters.

Hot air rises. This property of hot air is used by balloonists to make their balloons rise.


JAMES CLARK ROSS

What Makes It Always So Cold at the Poles?

Why is there ice at the poles the whole year through?

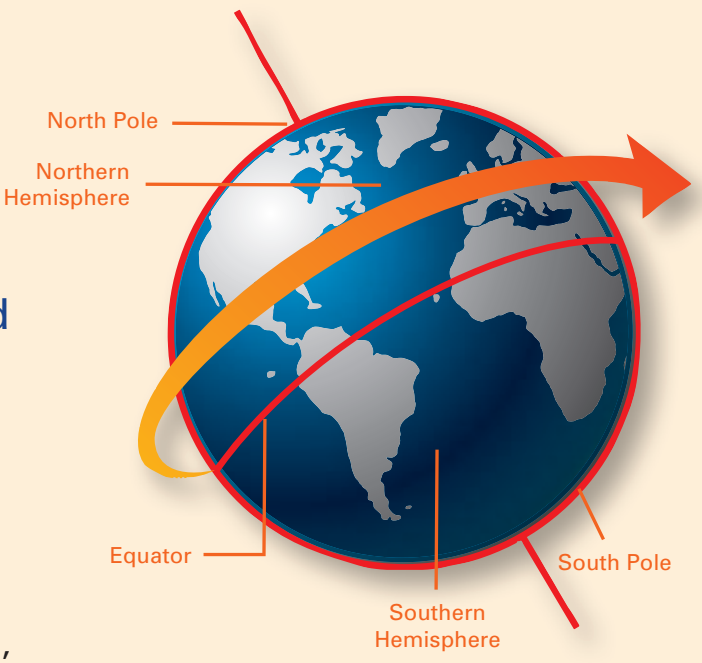
Who lives in these regions?

Lab Activity

Sun's Rays

1. The equator is an imaginary line that divides the earth's surface in two. One half is called the Southern Hemisphere and the other half is called the Northern Hemisphere. What makes Earth's polar regions so cold?

2. This activity will help you understand why the polar regions are colder. In this activity, the light from the flashlight represents the sun and the foam ball is Earth.



3. Demonstrate how sunlight reaches different regions of Earth.

A. Draw a line all the way around your ball, right at the middle. This will be the equator of your Earth. Then, make a mark on your foam ball that will be the North Pole. Next, make a mark for the South Pole at the exact other side of the ball. Finally, discuss with your team and decide where you live on this Earth. Make a mark there.

B. Hold the ball in such a way that the equator line is maintained in a tilted position. Insert a toothpick at both the North and South Pole marks. Hold the toothpicks and always keep the ball in the same position during the activity.

C. Turn on the flashlight, hold it level, and point it at the line that represents the equator. Keep the flashlight in the level or horizontal position at a distance about 10-cm from the ball so that the light projects a circle on its surface.

D. Rotate the ball while holding the flashlight still. What happens? When the light is striking your home location, what is happening to other parts of Earth?

E. Compare the amount of light that is striking the equator, your home location, and the Poles. In your *Science Notebook* write a description of what you see.

4 Think about what you have observed. Discuss with your teammates and give an explanation to each question below:

- On which area of the globe is the circle of light smaller: the equator or the Poles?
- In which regions of Earth's surface are sun's rays more spread out: the equator or the polar regions?
- How does the size of the circle of light relate to the amount of heat and light energy an area of Earth receives from the sun?

Discuss your answers with the other teams and record your explanations in your *Science Notebooks.*

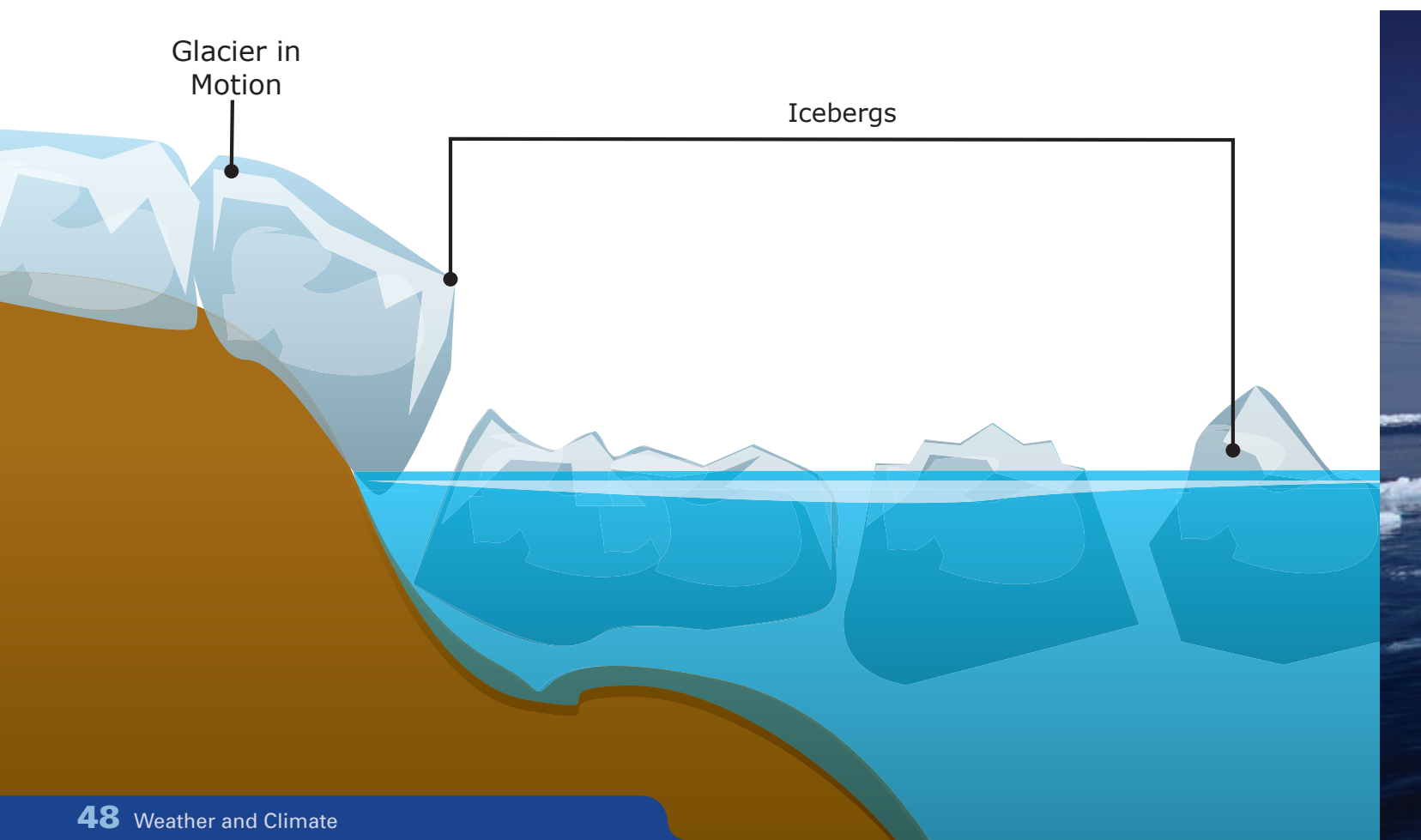
Learn More

What Are Icebergs?

In very cold areas, such as the North Pole or the South Pole, or on top of high mountains, a lot of snow gets deposited. Over time, this can lead to ice masses that you know as glaciers.

Glaciers contain a large volume of Earth's fresh water. Glaciers do not sit still. They are constantly moving, but they move very slowly. As they move, the ice scrapes against rocks, and it drags sediments along with it. This causes erosion.

Icebergs are large blocks of ice that break off from polar glaciers. After falling into the sea, icebergs float. Ocean currents carry them long distances. When they reach warmer regions, they slowly melt. Some icebergs can be 120 meters above the surface of the water. That seems large. However, the part of the iceberg that is under water is seven or eight times larger than the part above the surface. This means that most of an iceberg cannot be seen. Icebergs are a great potential danger to ships. The most famous ship and iceberg accident occurred in April

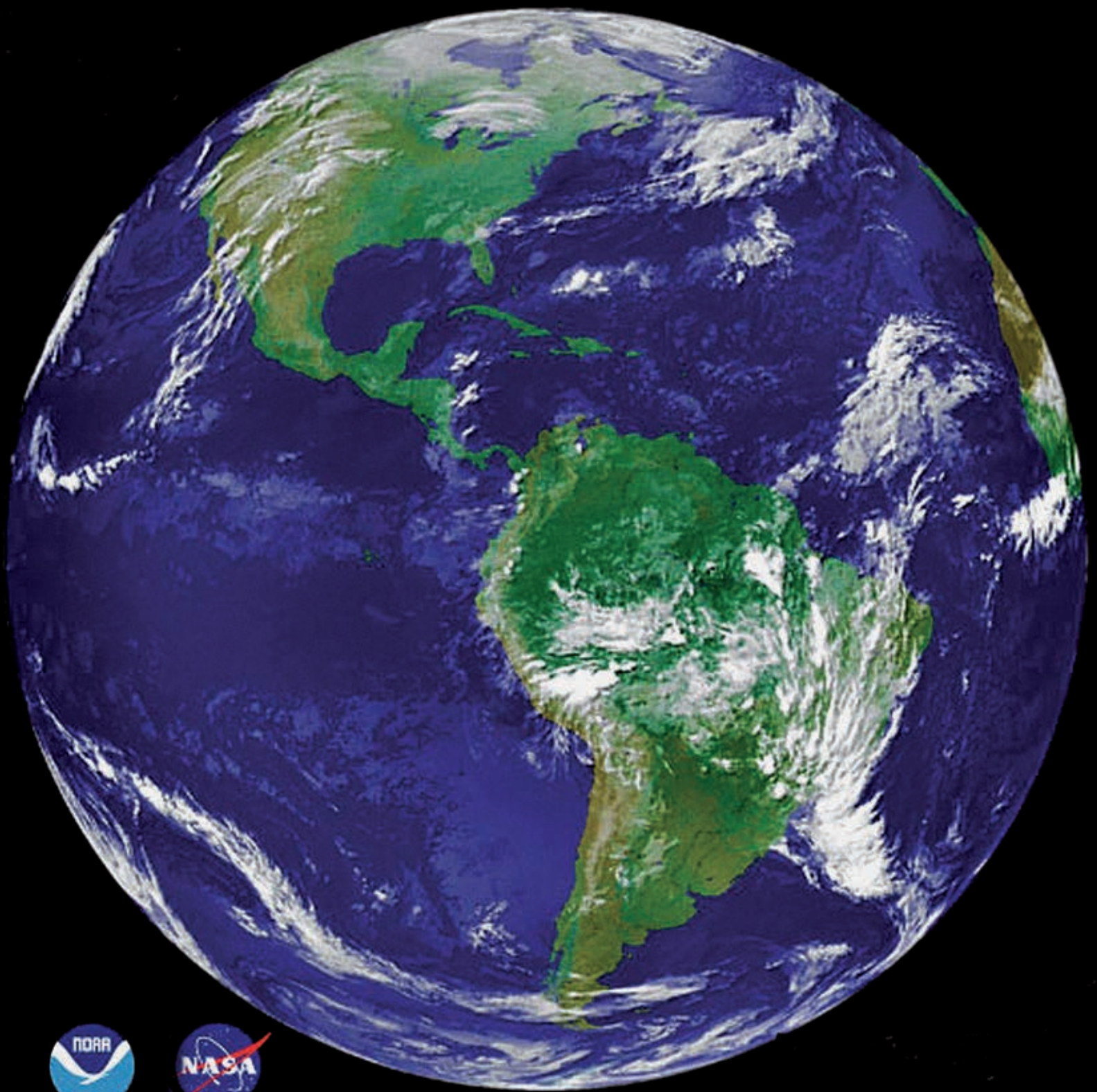


1912. A ship called *Titanic* sank after hitting an iceberg in the North Atlantic Ocean. Many people on board the ship died. As a result, a service was created to observe and monitor the position of all icebergs and to predict their routes. This service alerts people who navigate ships, but cannot see what is deep under water. Airplanes and satellites are part of the monitoring service.

One of the biggest icebergs ever seen, was photographed in March of 2000. This iceberg was 160-km long.

Icebergs are dangerous. The largest part of an iceberg is underwater. It cannot be seen by people who navigate ships.

Only one seventh of the total volume of an iceberg stays above water; most of it stays submerged.


NOAA
NASA

What Are the Climates of the World?

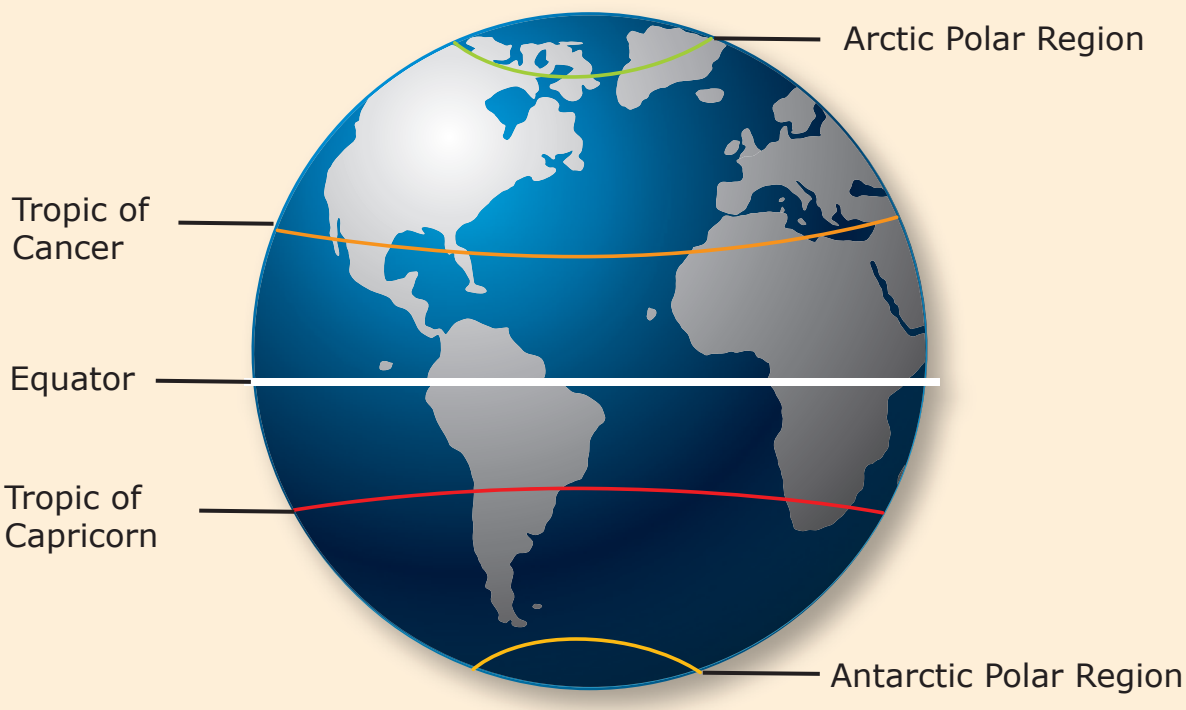
What causes different climates?

Where are the tropical forests?

Lab Activity

Climates of the World

1 Look at the map of the world. What do you know about the Arctic Polar Region and the Antarctic Polar Region? How are these Poles similar? How are they different? Locate these Poles on a globe. Where are they relative to the equator? What is the latitude of the Poles?



2 Watch the video, *Earth's Climate*. Take notes in your *Science Notebook*. During this video, you will get acquainted with the climate of different regions of the planet.

3 Name the climate zones you just saw in the video. What are some characteristics of each of the zones? Review your notes and choose a climate to give a report about.

A. Provide information, such as average temperature, amount of precipitation, and other characteristics.

B. Research how people live in this region.

- What do their houses look like?
- What kind of clothes do they wear?
- What kind of food do they eat?
- What type of play activities are they involved in?
- How does the climate of the area affect the answers you determined?

Learn More

Warming up the World: the Greenhouse Effect

Climate determines which plants and animals can live in a region. Climate also affects how organisms live. Life at the equator, for example, is very different from life in the Arctic and Antarctic Polar Regions.

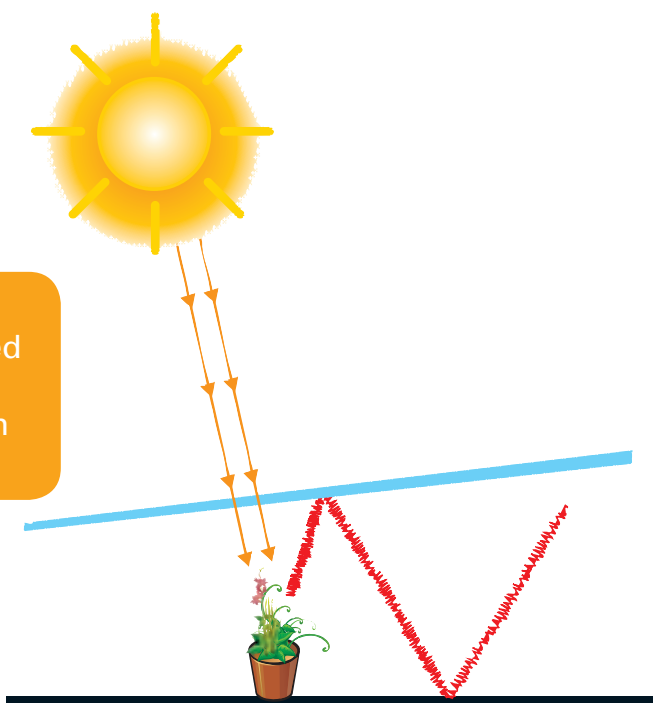
Regions at different latitudes can be very different from one another.

The greenhouse effect is a natural phenomenon. It has always been present on Earth. The greenhouse effect keeps the temperature on the surface of the earth suitable for living organisms. As you read, try to figure out why what happens to the earth is called the "greenhouse effect."

What happens to the earth is similar to what happens in places where plants are grown all year around. A greenhouse is a building with a glass ceiling and walls. Sunlight penetrates the glass and heats the inside of a greenhouse. As objects inside, including the ground, warm up, they emit radiation. This is form of energy transfer from one object to another. The glass walls prevent some of the radiation from escaping, so a greenhouse warms up. Farmers in cooler climates can cultivate plants in greenhouses all year around.

Something similar happens in a car when the doors and windows are closed and the sun shines on it. The temperature outside the car may be only 15°C, but the temperature inside the car may rise to over 40°C.

The expression greenhouse effect comes from the way greenhouses work.

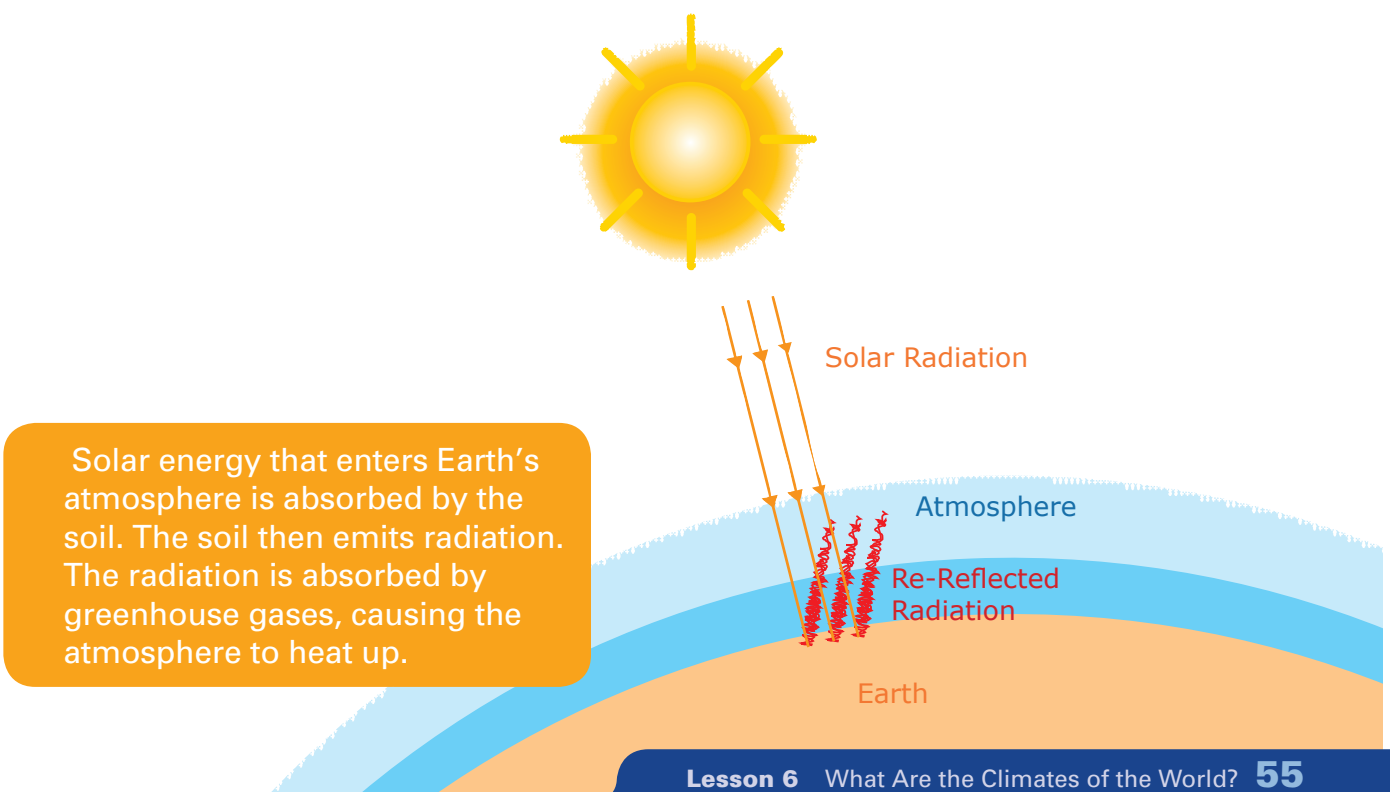


In a greenhouse, solar energy (from the sun) passes through the glass. It is absorbed by the plants inside. The plants then emit radiation that is trapped by the glass, which is what heats up the greenhouse.

In these conditions, the air inside the car becomes much warmer than the air outside. On Earth, the atmosphere acts like the glass walls of a greenhouse. It prevents the radiation emitted by the soil from escaping. Reflected radiation that is trapped keeps the temperature suitable for life on Earth. Changing the balance of natural systems can have severe consequences. The atmosphere is a mixture of gases. It contains nitrogen and oxygen, and small amounts of carbon dioxide and methane gases. These gases act like the glass walls of a greenhouse. They allow the sun's rays to enter, but they keep the heated air from leaving again. This is why they are called *greenhouse gases*.

Intensifying the Greenhouse Effect

In recent years, the quantity of carbon dioxide in the atmosphere has increased. The main source of this gas in the atmosphere is burning. Burning forests and burning fossil fuels such as coal and petroleum, lead to more carbon dioxide in the atmosphere. This increased quantity of carbon dioxide intensifies what happens in nature. Greenhouse warming increases the temperature of the atmosphere beyond what is healthy. Many scientists predict that this could cause temperatures on Earth to rise 5°C by 2100. If this happened, it would cause ice in the Polar Regions to melt, causing sea levels to rise. Many coastal cities could be washed away, and the climate of the whole planet could change.



Solar energy that enters Earth's atmosphere is absorbed by the soil. The soil then emits radiation. The radiation is absorbed by greenhouse gases, causing the atmosphere to heat up.

What Is the Climate Like in North America?

In some places it rains every day, and in others rain is scarce. What might cause these differences?

Lab Activity

Climates of North America

1. *Weather* refers to what is happening right now, like rain, sunshine, or clouds. *Climate* is the general weather in a region over a long period of time. What is the climate like where you live? What do you know about the climate in North America?

2. Read the *Learn More* section on the following pages. After you read, answer the questions below in the *Explain* section of your *Science Notebook*. What other questions do you have about the climate in North America?

   - What types of climates or biomes exist in North America?
   - How can there be different kinds of climates within the same climate zone?
   - How would you compare the climate of the area where you live with the climate of another region?

Learn More

Biomes in North America

The word *biome* describes specific areas on Earth that have similar climates, plants, and animals.

Tundra

In America, the only tundra biome is in Alaska. It is very cold there. Less than 25cm of rain and snow fall in the Alaskan tundra. The small amount of water in the tundra is permanently frozen in the soil. This layer of frozen soil is called *permafrost*.

Caribou are common animals in the Alaskan tundra and are migratory in this region.

Tundra

Rainforest

In the United States the only tropical rainforests are found in Hawaii. These rainforests get more than 200cm of rain every year.

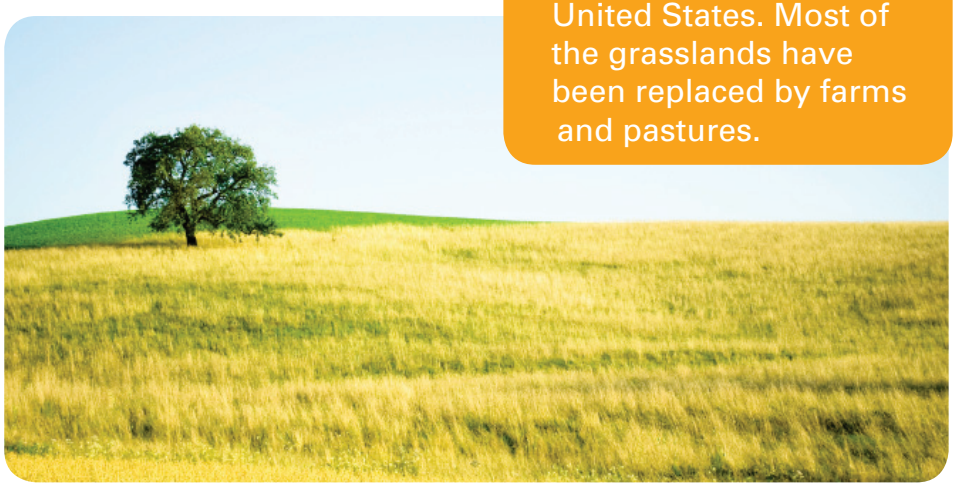
Rainforest

Rainforests are home to many exotic animals. These exotic birds thrive in the large canopies of the rainforest.

Grasslands

The large section in the center of the United States is known as the Midwest. The Midwest contains most of the U.S. grasslands. Some of the grasses on the prairies are over two meters tall. The grasslands of the Midwestern plains get approximately 25-75cm of rain each year.

Long ago millions of American Bison roamed the grasslands of the United States. Most of the grasslands have been replaced by farms and pastures.



Grasslands

Coniferous Forests

The higher elevations of the Rocky Mountains and parts of Alaska are cold and home to large expanses of coniferous forests. These include firs, spruces, and pines. Coniferous forests are also located in lower, cooler areas. Giant redwoods, for example, grow in California and most of the southeastern United States was once pine forest.

Coniferous forests

Deciduous Forests

The Northeastern United States supports deciduous forest biomes. Summers in these regions are warm and winters are cold. Rainfall is between 75 and 150-cm per year.

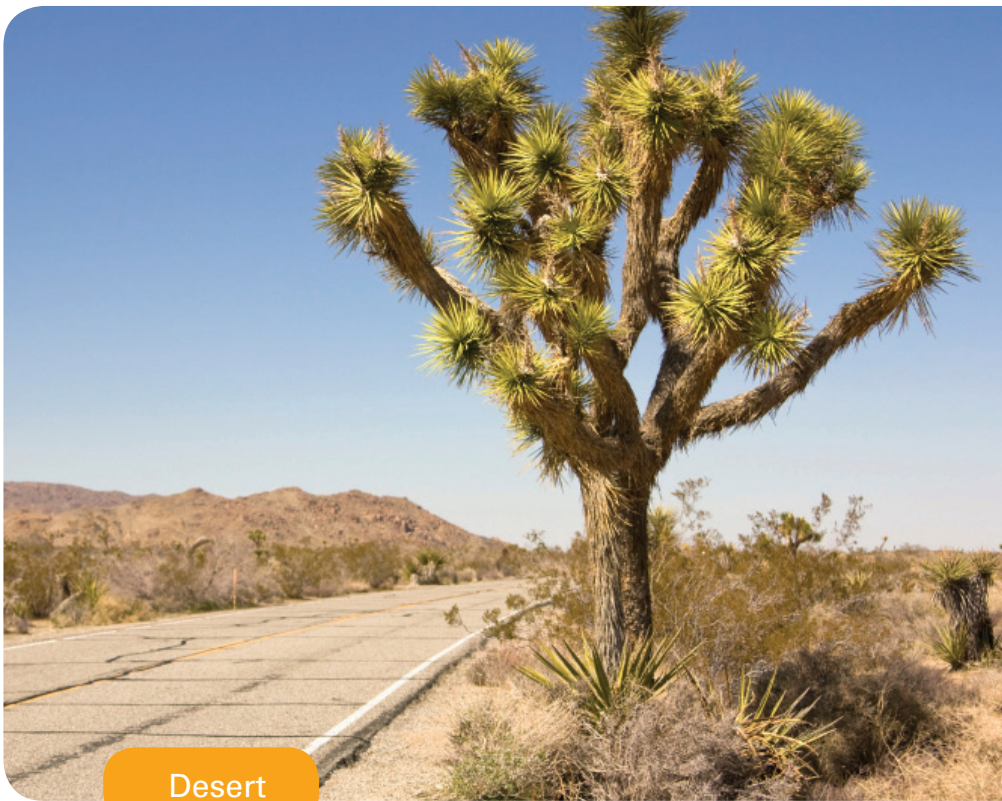
While black bears can climb trees, they actually live in dens on the ground.

Redwood and Sequoia trees are known to live over 3,000 years and grow taller than the Statue of Liberty.

Deserts

Desert biomes are unique for their lack of water. They receive less than 25cm of rainfall each year. To survive, desert animals and plants must be able to live without much water. If desert organisms did not adapt to this climate, they would die, and their species would face extinction.

Another cause of extinction is pollution. Pollution can change the biome so much that organisms cannot adapt enough to survive in the biome.



Desert

Cougars obtain most of their water by eating plant-eaters.

How Is It Possible to Live in an Extreme Climate?

What is life like in this place?

How do people adapt and survive in extreme climates?

Lab Activity

Extreme Climates

1. Imagine a place where the climate is very different from the climate of the area you live in. How would you adapt to live as comfortably there as you do now? For example, what would your house look like? What clothes would you need? What forms of transportation would you use? What would you eat? What would you do for fun? Write your ideas in your *Science Notebook.*

2. Observe the photographs of different regions and imagine what life is like for people living in these regions.

   - How is it possible to live in these regions?
   - Describe the animals and plants of these regions.
   - What are the houses like? In what ways are they similar? How are they different?

Adapting to Extreme Temperatures

3 Every member of the team must choose a photograph. Then, each will make a drawing showing the imagined way of life for the people living in the region shown in the photograph. Research the climate you have chosen using magazines, the Internet, books, or by interviewing people who know about these climates.

Make drawings with as much detail as possible. Show the animals and plants of the region. Write captions that explain what is in the drawings.

4 Present your drawings to the class. How are your drawings different from the drawings of your classmates? How are they similar? How are the animals similar or different? Why do people wear certain clothing in different climate zones?

Learn More

Penguins: Animals from the South Pole

Penguins are birds that live only in the Southern Hemisphere. Most species of penguins live in the Antarctic region. Even though penguins are birds, they cannot fly. They use their wings for swimming. Penguins are excellent swimmers. Some species can reach speeds of 40km per hour.

Penguins can stay underwater for long periods of time. Some can stay up to 30 minutes without coming to the surface of the water to breathe. As they swim, penguins look for food. They usually eat fish.

Another characteristic of penguins is their ability to live in very low temperatures. They live where it is below 0°C. Penguins have a thick layer of fat under their skin. This fat protects them against the cold.

Scientists have described 18 species of penguins. During the polar winter, when the cold is extreme, some species migrate to warmer areas within the region.

A penguin's principal food is fish. Penguins dive to great depths looking for food.

Polar Bears: Animals from the North Pole

Polar bears live in the Northern Hemisphere. Male and female polar bears mate in the spring. After an 8-month gestation period, the female usually gives birth to two cubs. Polar bears are meat-eaters. They hunt other large animals. You may be surprised to learn that polar bears' white hair is hollow. The layer of air provides them with insulation against the cold. But, a polar bear's skin is black, enabling it to absorb more light energy from the sun to keep the polar bear warmer.

The polar bear, whose scientific name is Ursus maritimus, has white fur but his skin and muzzle are black.

Learn Even More

Can You Explain This?

Penguins are social animals. When they are on the ground, a large number of them usually stay together. Penguins walk slowly, often in very long lines. Why don't polar bears eat penguins?

The Emperor Penguin is the biggest of all penguins. An adult can reach a height of 1.2 meters and weigh up to 40 kilograms.

Glossary

adapt – to change in order to live in a certain environment

air mass – a large body of air

Antarctic Polar Region – a zone that is characterized by a very cold climate around the South Pole

Arctic Polar Region – a zone that is characterized by a very cold climate around the North Pole

atmosphere – mixture of gases that surround Earth

barometer – an instrument for measuring air pressure

biome – a major natural community, with distinct climate, plants, and animals, such as forest, desert, and marine biomes

cirrus – high, wispy, white clouds with feathery edges, often made of ice crystals

climate – usual weather in a particular place over a long period of time

climate change – important changes in measures of climate, such as average temperature, precipitation, or wind

climatologist – a person who studies weather patterns over time

condensation – water vapor changing to a liquid state

cumulonimbus clouds – tall, dense clouds, often seen in thunderstorms

cumulus – large, white or gray cloud with a flat base and round, fluffy top

cylinder – a round, elongated container

drought – a long period of dryness from lack of rain or other precipitation

dynamic – active, changing, or moving

equator – an imaginary line that goes around the middle of the earth located halfway between the North Pole and the South Pole

evaporation – liquid turning into a vapor (gas)

expansion – an increase in size

extinction – loss, disappearance

flood – an excess of water in a short time

forecast – prediction of what the weather will be in the future

front – the leading edge of an air mass that can be cold or warm

glacier – large body of moving ice

greenhouse warming – effects of gases that collect in the atmosphere and warm up the atmosphere around Earth

hemisphere – one-half of earth

icebergs – blocks of ice that break off from glaciers

latitude – distance north and south from the equator, measured in degrees

meteorologist – a person who studies weather

meteorology – study of weather and climate

North Pole – the northernmost part of Earth

Northern Hemisphere – half of the planet that is north of the equator

pollution – contamination

precipitation – water falling from the sky in the form of rain, ice, hail, or snow

pressure – a force applied to an area

rain gauge – an instrument for measuring quantity of rain (or other precipitation)

region – an area with identifiable features

relative humidity – the percentage of water vapor in the air compared to the maximum amount it could hold

resource – something useful; a source of help

runoff – rain water that falls back into lakes, rivers, or streams soaking into the earth and becoming part of the groundwater

South Pole – the southernmost part of Earth

Southern Hemisphere – half of the planet that is south of the equator

stratus – low, white or gray clouds that cover large areas of the sky

thermometer – a tool used to measure temperature

thermoscope – an instrument that shows whether the temperature is rising or falling

variable – a thing that can change

weather – atmospheric condition at a specific place and time

weather data – weather information used to make forecasts

weather trend – long or short-term pattern of weather information including precipitation and temperature

wind – air in motion

windmill – a machine operated by the wind that can turn a shaft to grind grains and draw water from wells, among other work

wind turbine – a machine that has large propellers and uses wind energy to generate electricity

wind vane – an instrument for measuring wind direction

Weather and Climate

sangari **active science**