



Weather

Lessons 1–2

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Weather

Lesson 1–2

Lesson 1

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How Does Uneven Heating of Earth Affect Weather?

VOCABULARY

- atmosphere
- weather
- air pressure
- convection
- current
- local wind
- prevailing wind



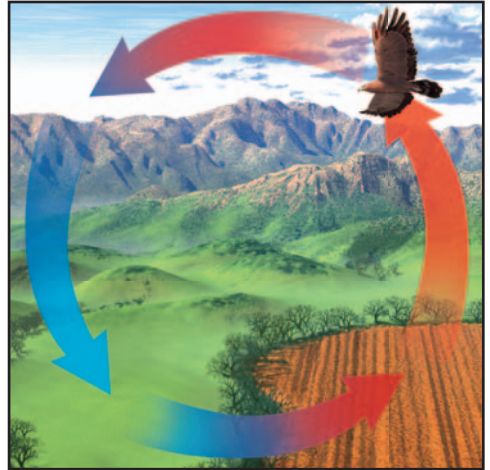
The **atmosphere** is layers of air that cover Earth.



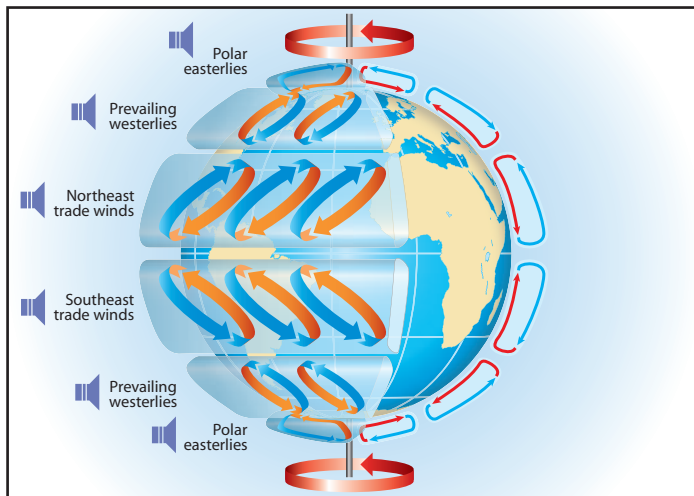
I can watch **weather** as it changes.



▶ The atmosphere presses down on Earth and causes **air pressure**.



▶ When temperature changes, it causes **convection currents** in the atmosphere, as well as a **local wind** to blow across the land.



▶ Columbus used the **prevailing winds** to help him sail his ships.



READING FOCUS SKILL

MAIN IDEA AND DETAILS

The **main idea** is what the text is mostly about.

Details tell more about the main idea.

The main idea is about uneven heating of Earth. Look for **details** about how uneven heating affects Earth's weather.



The Atmosphere

There is a blanket of air that surrounds Earth. The blanket is the **atmosphere**.



The atmosphere is made up of many layers. The layer closest to Earth's surface is the *troposphere* (TROH•puh•sfeer). Most of Earth's weather happens in the troposphere.



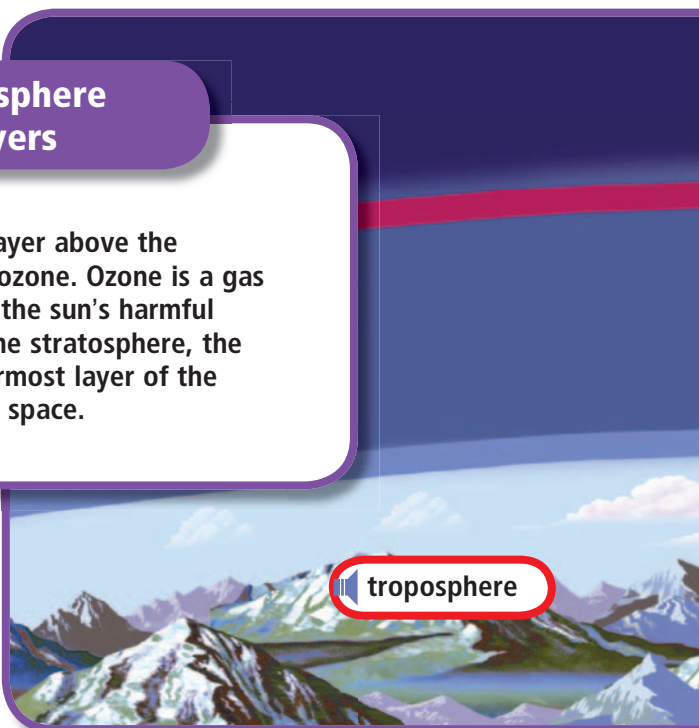
Atmosphere Layers



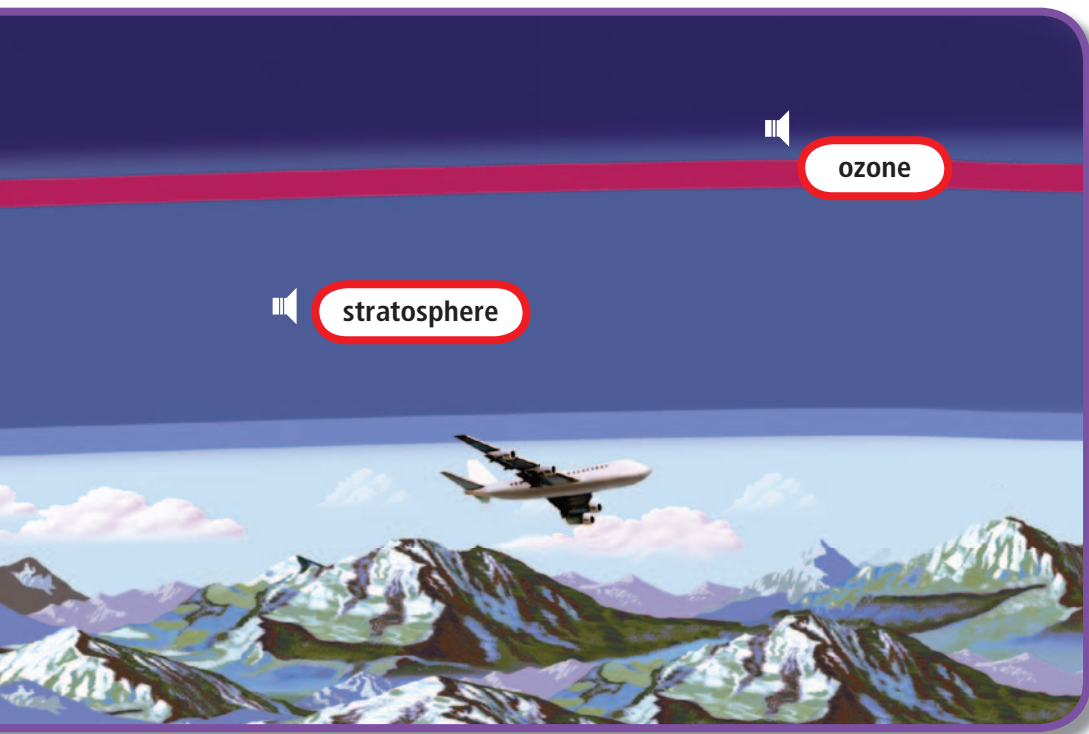
The stratosphere is the layer above the troposphere. It contains ozone. Ozone is a gas that protects Earth from the sun's harmful ultraviolet rays. Above the stratosphere, the air is very thin. The outermost layer of the atmosphere extends into space.



troposphere



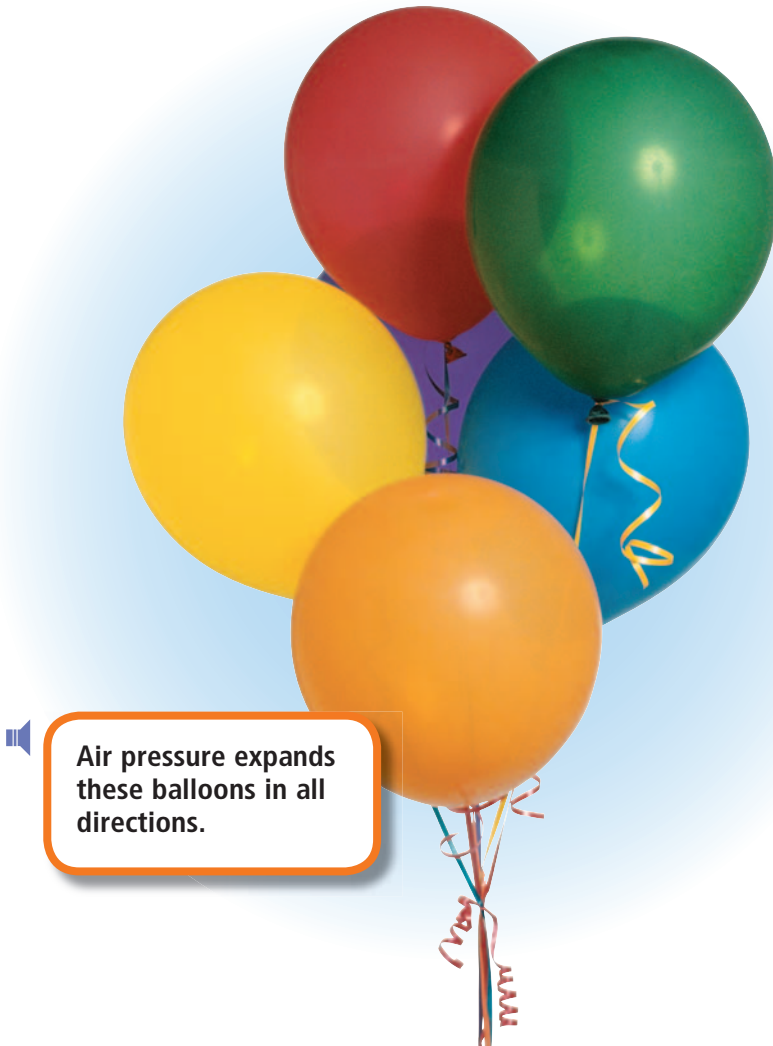
- Earth's atmosphere experiences many different conditions. We call these changing conditions **weather**. Weather is the condition of the atmosphere at a certain place and time.
 - You cannot see, taste, or touch air, but you can feel it. When the wind blows, you can feel the air against your face.
 - Air has mass, and it presses down on Earth. The weight of air in the atmosphere is called **air pressure**.
 - Air closest to Earth's surface has more weight than air higher up in the atmosphere. Air is denser closer to Earth because of gravity's pull. The dense air causes air pressure to be greater at sea level.
-  **In which layer of the atmosphere does most weather occur?**



Air Pressure

As you go higher into the atmosphere, there is less air. Less air above you means you feel less air pressure.

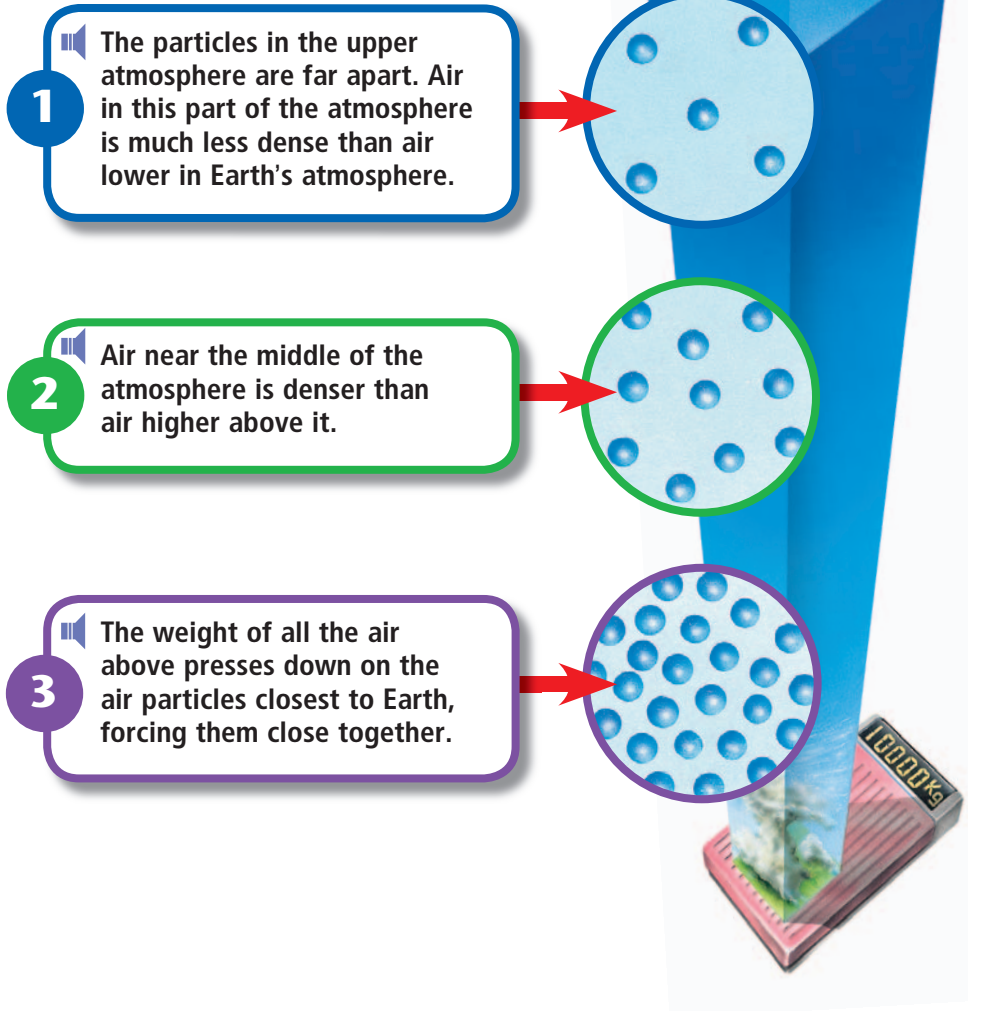
 You can measure air pressure. Air presses downward because of gravity. Air also pushes in other directions. Blowing air into a balloon shows this idea. As you blow into the balloon, the air pressure increases and the balloon expands. The balloon expands in all directions.



Temperature also affects air pressure. Cold air is denser than warm air. Because of this, cold air sinks toward Earth's surface. As it sinks, the cold air forces warmer air to move up. When warm air rises, it begins to cool and become more dense. Then this cooler air sinks back to the surface.

Dense, cold air has high pressure and sinks. Warm, less dense air has low pressure and is pushed up. The areas of high pressure balance the areas of low pressure.

Focus Skill How does temperature affect air pressure?



Uneven Heating and Local Winds

How did the air feel when you left home this morning? Was it hot or cold? Was it windy or was it calm? Does the air feel the same right now? It probably does not feel the same. Air is always moving and changing.

 The sun is always sending heat toward Earth. Some of it bounces off air and clouds. Earth absorbs the rest of the heat from the sun. However, land and water absorb heat in different ways.

 Soil warms up faster in the sun than water. That means at the beach, it is cooler in the water. During the day, the sand is hotter than the water. The sand gives off more heat. If the sand is hot, the air over the sand is hot, too.

The Sun's Energy and Earth

 5% reflected by Earth's surface.

 25% absorbed and reflected by Earth's surface.

 50% absorbed by Earth's surface.

Remember water is cooler than the sand, during the day. That means the air over the water is cooler.

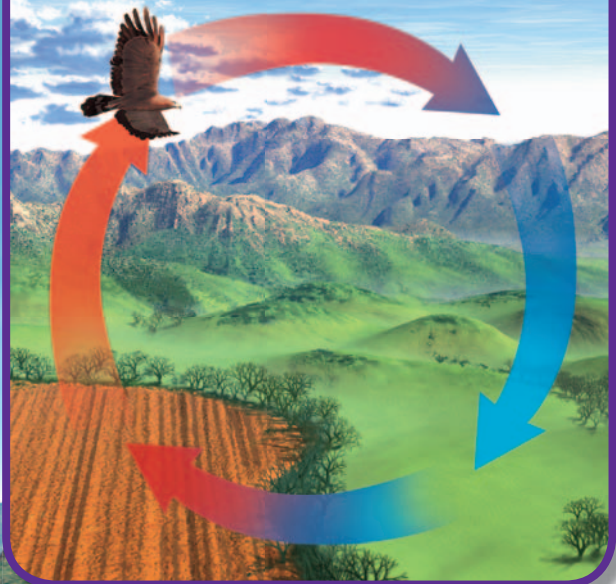
Cool air is denser than warm air. Cool air sinks. Warm air is less dense, so cooler, denser air pushes it up. This air movement in the atmosphere is called a **convection current**.

Air also moves horizontally. When cool air sinks it spreads out along the surface. Air moves from low pressure areas to high pressure areas. This moving air is called wind. Sometimes, areas close together have different temperatures. This is because of uneven heating. Different temperatures cause different air pressures. This makes **local wind**. Local winds often happen along shores, like the beach.

 **Tell one detail about cool air.**

 20% absorbed and reflected by air.

 The arrows in this diagram show that in convection currents, air moves across the Earth's surface as well as up and down.



Global Winds

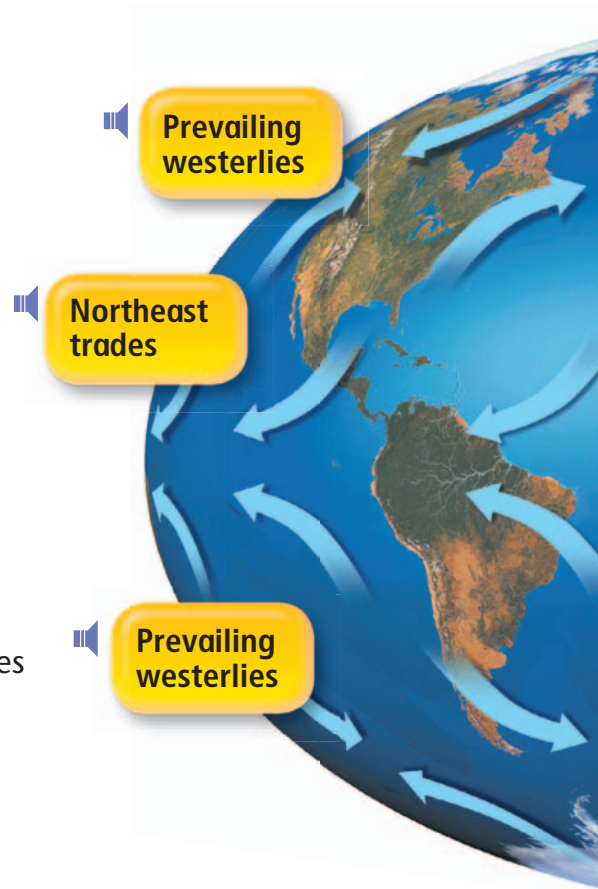
A **prevailing wind** is a global wind. It occurs over a very large part of Earth. It almost always blows from the same direction.

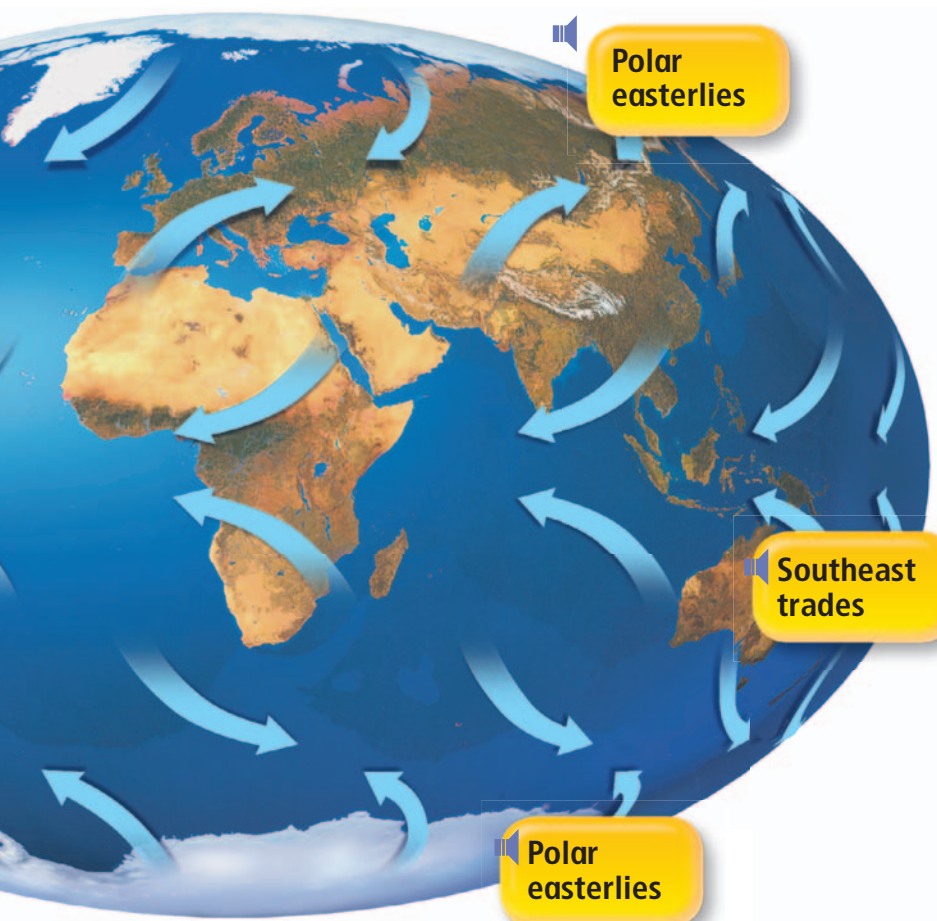
Prevailing winds result from uneven heating of large areas on Earth. Local winds result from uneven heating of a small area.

In the United States, weather is caused mostly by *prevailing westerlies*. These are cooler winds moving south. Prevailing westerlies generally blow from west to east.

The prevailing westerlies help weather forecasters. Weather in California will probably head toward Kansas.

 **What causes the weather to move from west to east across the United States?**





Review



Complete this **main idea** statement.

1. Uneven heating of Earth affects our _____ .

Complete these **detail** statements.

2. The upward and downward movement of air is called a _____ current in the atmosphere.
3. During a hot day, cooler air over the water is more _____ than the warmer air over the land.
4. Local winds move short distances. A _____ wind is a global wind that moves great distances.

VOCABULARY

- current
- humidity
- precipitation

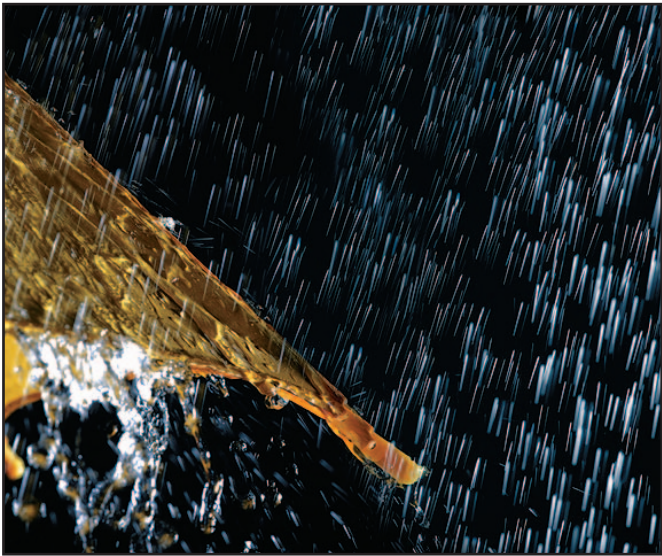
How Do the Oceans and the Water Cycle Affect Weather?



A **current** flows like a river through the ocean.



Active people sweat in high **humidity**.



Precipitation can fall any time of year.



READING FOCUS SKILL

CAUSE AND EFFECT

A **cause** is something that makes another thing happen. An **effect** is the thing that happens.

Look for examples of how the oceans **cause** changes in the weather.



The Oceans Affect Weather

The oceans cover about 70 percent of Earth's surface. You learned that land heats up and cools off faster than water. During summer, oceans absorb less heat from the sun than land. So the oceans and the air over them is cooler.



In winter, oceans are warmer than land. The oceans release heat into the air above them. This keeps the planet warmer. If Earth had no oceans, the temperatures would be more extreme.



Ocean temperatures do not change much during the year. The sun heats different parts of the oceans unevenly. Water on the ocean's surface is pushed forward by winds. The winds cause a **current**. An ocean current is a stream of water that flows like a river. Currents move heat over great distances through the ocean.



The Gulf Stream current flows across the Atlantic Ocean. It begins in the tropics and moves northeast. This current carries warm water toward countries in northern Europe. The warm current causes the weather in those places to be warmer. Without this current, the weather would be much colder in those regions.

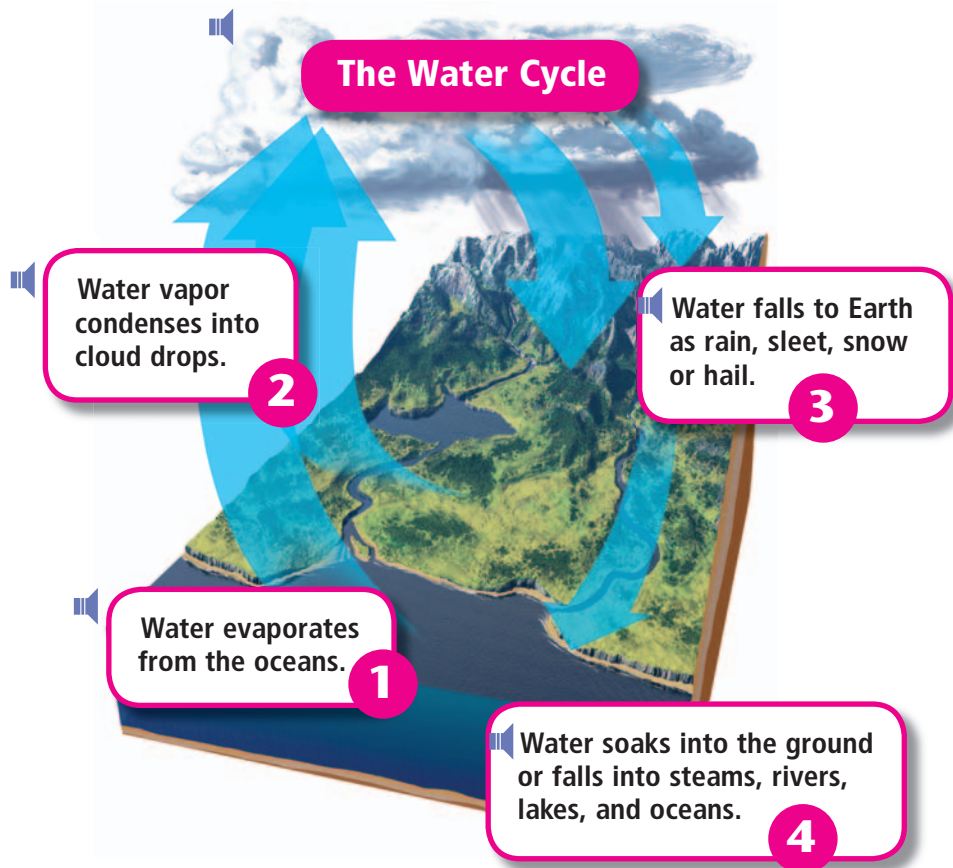
The California Current flows from north to south. It keeps the weather in California cooler.

In most years, wind pushes warm water away from the west coast of South America. The warm water evaporates fast into clouds. As a result, Australia gets warm water currents, clouds, and rain. The west coast of North America stays dry.

Some years, the winds reverse direction. The weather pattern also reverses. This is called an El Niño. Australia gets dry weather and western North America has wetter weather. The changing winds do not blow the warm surface water away from South America's coast. The South American coastal waters remain warm. The warm water makes clouds and storms on the U.S. west coast.



How can a warm water current change the temperature of a region?



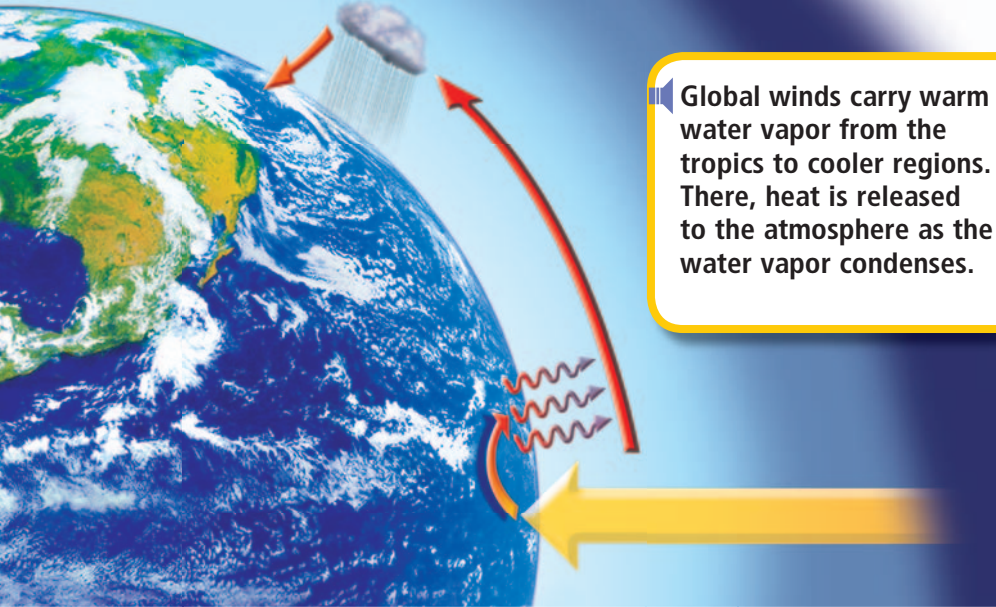
Weather Patterns and the Water Cycle

Water is constantly moving and changing states. It moves from Earth's surface to the atmosphere and back to Earth.

The sun's heat causes convection currents in the atmosphere. It affects currents in the oceans. The sun's heat also causes the movement of the water cycle.

During the water cycle, liquid water is heated by the sun and evaporates. It turns into a gas called water vapor. Water vapor stays a gas as long as it is warm. When water vapor cools, much of it condenses back into a liquid form. The liquid water falls back to Earth. Some of the water soaks into the ground. Some of it runs into streams, rivers, lakes, and oceans. The water cycle starts again as the sun heats the ocean waters.

Heat Transfer Through the Water Cycle

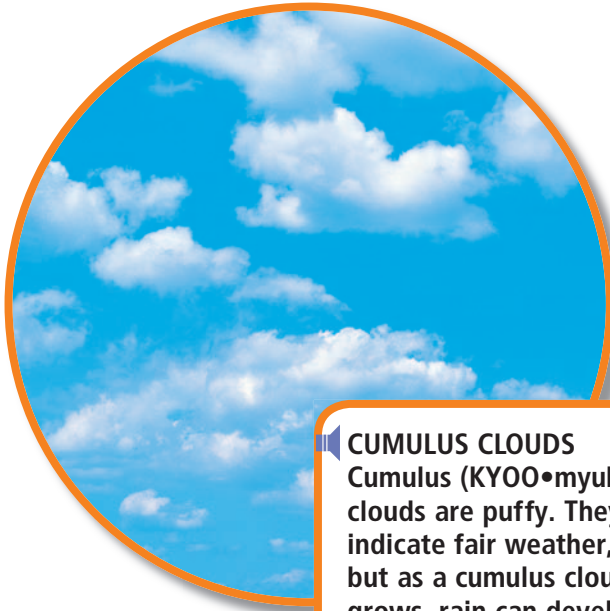


Global winds carry warm water vapor from the tropics to cooler regions. There, heat is released to the atmosphere as the water vapor condenses.

- Air in the atmosphere moves in convection currents. Water evaporates from the oceans near the warm tropics. The evaporated water moves long distances on global winds. If there were no global winds, what would happen? Almost all Earth's rain would fall near the equator.
- Warm air flows from the equator north toward the poles. The warm air carries water vapor. Water vapor carried by global winds contains heat. As the water vapor cools, the vapor condenses back into liquid water. The condensation releases heat energy into the atmosphere. Both heat and water move through the water cycle.
- This process helps balance temperatures in the atmosphere. The tropics lose some heat and water vapor. The cooler regions gain heat and moisture.



How does the water cycle affect weather?



CUMULUS CLOUDS
Cumulus (KYOO•myuh•luhs) clouds are puffy. They indicate fair weather, but as a cumulus cloud grows, rain can develop.

Clouds

Weather is part of the water cycle. Water enters the atmosphere when it evaporates. The amount of water vapor in the air is **humidity**. A lot of water vapor in the air is high humidity. Very little water vapor in the air is low humidity.

 Humidity also depends on the air's temperature. Warm air can have more water vapor in it. Cold air has less water vapor in it.

 Air that has high humidity creates clouds. As warm air is forced up, it cools. Some of the water vapor condenses. It condenses on dust in the air. As more and more water condenses, a cloud forms.

 The water in clouds returns to Earth as rain, snow, or sleet. Water that falls from the atmosphere is **precipitation**.

  **What causes high humidity?**

Precipitation

Precipitation falls as rain, snow, sleet, or hail. Snow forms when water vapor turns directly into ice crystals. Sleet and hail form when liquid water passes through air that is cold enough to freeze water drops.

Fog is a similar weather condition. Fog is water vapor that condenses into small water droplets near the ground.

 **What causes snow to fall?**



Review



Complete these **cause and effect** statements.

1. In the winter, the oceans release heat into the air and this makes the planet _____ .
2. Australia has drier weather and western North America has wetter weather than normal during an _____ .
3. When water droplets in clouds get too heavy, water falls as _____ .
4. Both _____ and water are moved through the water cycle.

GLOSSARY

-  **air pressure** [AIR PRES•er] The weight of the atmosphere pressing down on Earth.
-  **atmosphere** [AT•muhs•fir] The blanket of air surrounding Earth.
-  **convection current** [kuhn•VEK•shuhn KER•uhnt] The upward and downward movement of air in the atmosphere.
-  **current** [KER•uhnt] A stream of water that flows like a river through the ocean.
-  **humidity** [hyoo•MID•uh•tee] A measurement of the amount of water vapor in the air.
-  **local wind** [LOH•kuhl WIND] Wind that results from local changes in temperature.
-  **precipitation** [pree•sip•uh•TAY•shuhn] Water that falls from clouds to the Earth.
-  **prevailing wind** [pree•VAYL•ing WIND] A global wind that blows constantly from the same direction.
-  **weather** [WETH•er] The condition of the atmosphere at a certain place and time.

Think About the Reading

-  1. Which section helps you understand types of wind?
-  2. Do you understand surface currents? Which section should you read again if you want to learn more?

Hands-On Activity

Fill a large container with very warm water. Fill a small cup with very cold water, and add a few drops of food coloring. Use tongs to gently lower the colder cup of water straight down into the warm water. Make sure the rim of cold water goes below the surface of the warm water.

-  1. What happens to the colder water?
-  2. How is this similar to what happens during El Niño?

School-Home Connection

Explain air pressure to a family member. Blow up a balloon and show that air pressure inside the balloon expands in all directions.