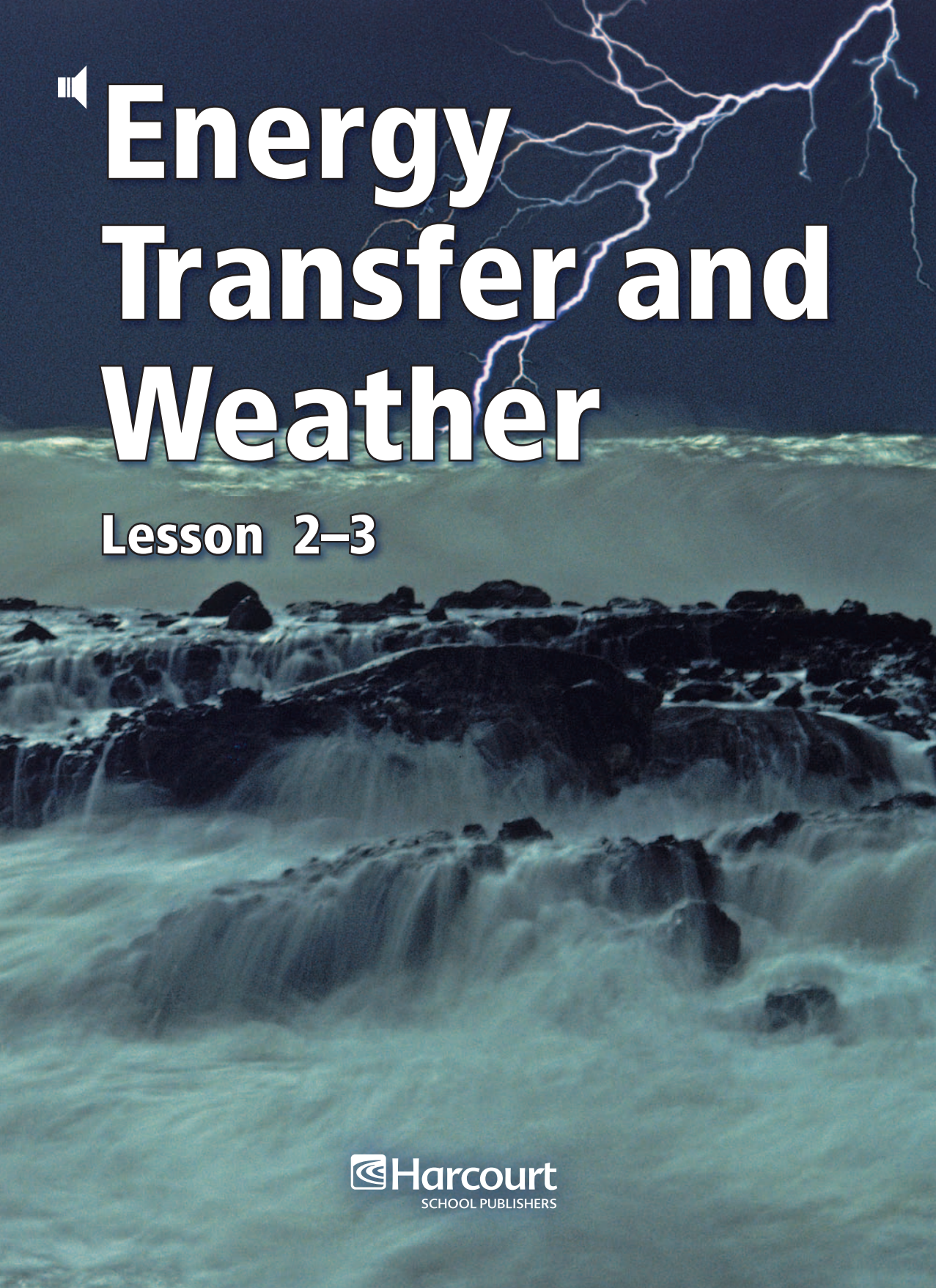

Energy Transfer and Weather

Lesson 2–3

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Energy Transfer and Weather

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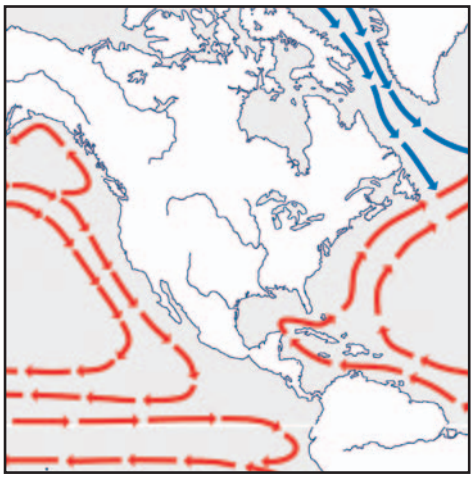
Lesson 2

How Does Convection Affect Earth's Processes?

VOCABULARY

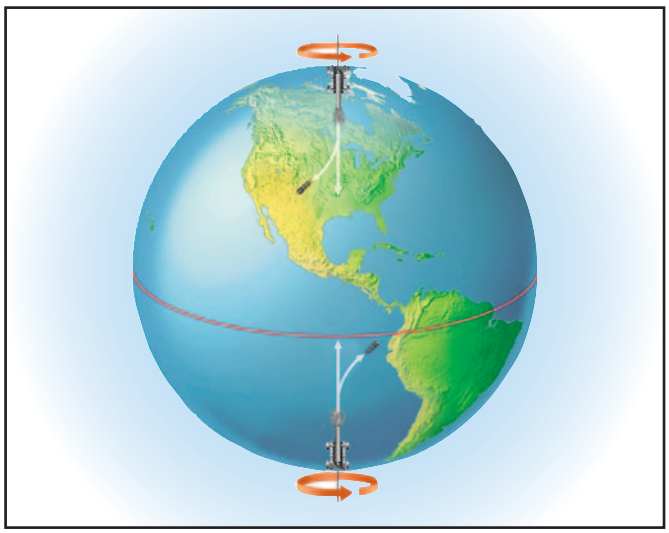
- current
- thermal gradient
- air pressure
- Coriolis effect



The California Current is an ocean **current**. It picks up cold water near the North Pole. Then it flows south along the west coast of North America.

I can use a thermometer to measure a gradual increase in temperature. This is a **thermal gradient**.

Sometimes, the **air pressure** in a car tire goes down. The tire becomes flat.



The **Coriolis effect** helps explain why winds curve to the right across the Northern Hemisphere.

Focus Skill

READING FOCUS SKILL

MAIN IDEA AND DETAILS

The **main idea** is what the text is mostly about. The **details** tell more about the main idea.

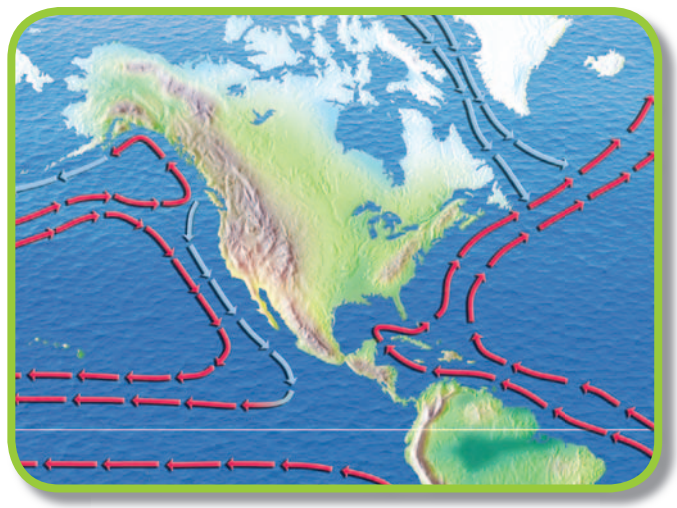
The **main idea** is all about convection. Look for **details** about how convection occurs in the oceans, the atmosphere, and under Earth's surface.

Ocean Currents and Convection

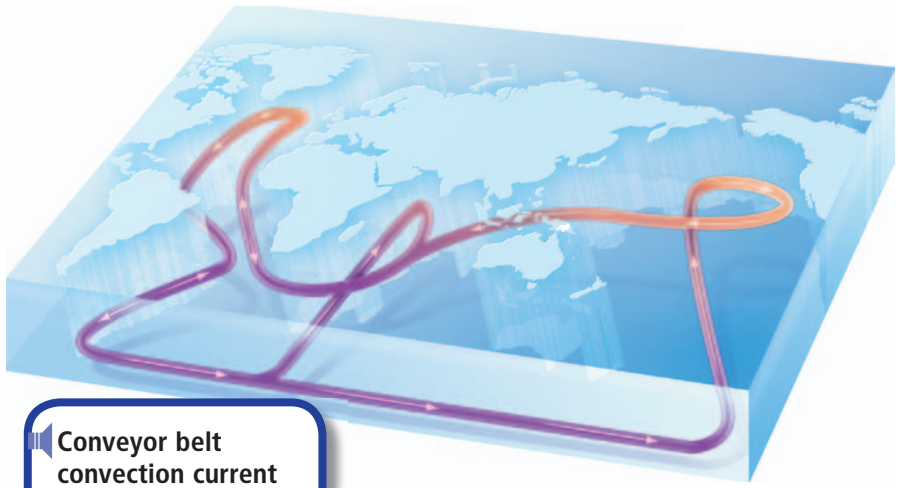
Ocean currents carry large amounts of water through the oceans. A **current** is a steady, stream-like movement of matter in one direction. There are many different water currents. Warm water currents from the equator run toward the poles. Cooler water returns in currents that run to the equator.

Surface currents affect the world's climate. The California Current picks up cold water near the North Pole. It then flows south along the west coast of North America. This current keeps weather cooler on the West Coast.

The Gulf Stream is a surface current. It picks up warm water from near the equator. The current flows northeast across the Atlantic. It moves to the west coast of Europe. The Gulf Stream brings warmer weather to Europe.



The Ocean Conveyor Belt



Ocean water currents operate like a giant conveyor belt. Ocean water contains dissolved salts. Salt water is denser than fresh water. Cold water is denser than warm water. Cold, salty water in the North Atlantic sinks and flows toward the equator under warmer waters that flow north from the equator.

When water is heated, it becomes less dense. The warmer water rises and moves above cooler water. When it reaches the surface, the water loses heat energy to the atmosphere. The water becomes cooler and begins to sink. This sinking completes the vertical convection current. This current is constantly moving slowly around the globe like a giant conveyor belt.

Focus Skill **How is the ocean's water like a giant conveyor belt?**

Convection in the Atmosphere

Energy from the sun drives convection in the atmosphere. Thermal air currents are convection currents in Earth's atmosphere.

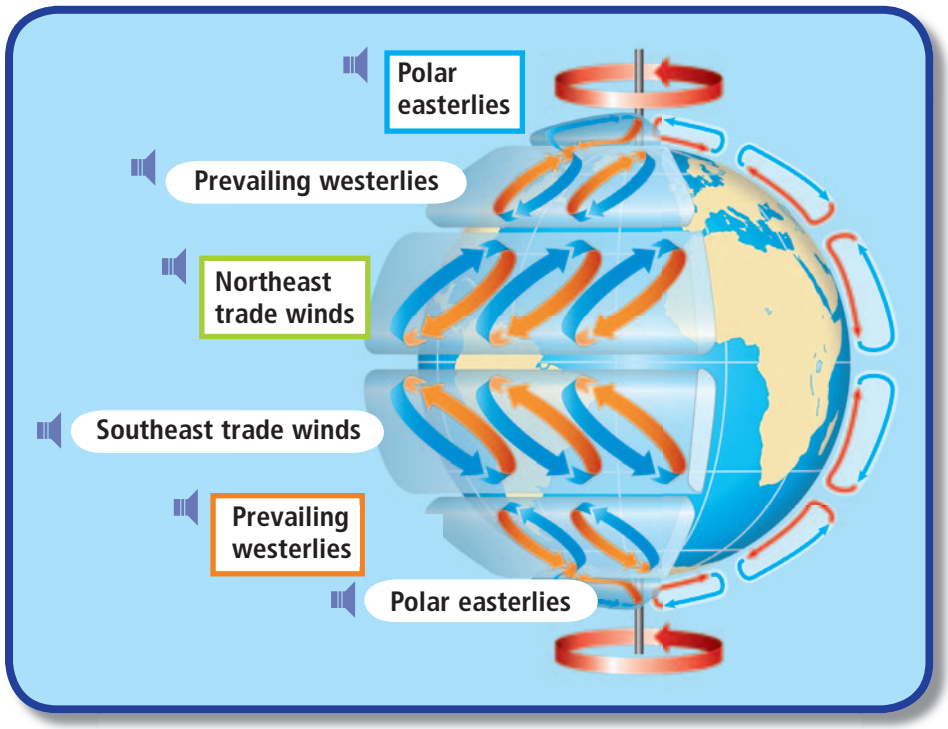
As you move from the equator to the poles, the air temperature gets colder. A gradual increase or decrease in temperature over a distanceis called a **thermal gradient**.

Air pressure is the force of the weight of air pressing down on a unit of area on Earth. Warmer air is less dense, so it rises from Earth's surface. It leaves an area of low pressure. Cooler air is more dense. It moves to this low pressure area. When air moves horizontally from areas of high pressure to areas of low pressure, the movement is called *wind*.

Many things affect the movement of convection currents in the atmosphere. Temperature, geography, and the Earth's rotation affect this movement.

Focus Skill

What drives convection in the atmosphere?



Curving Wind

The **Coriolis effect** is an apparent change in direction of a freely moving object. The change of direction is caused by Earth's rotation. Because of this, winds do not blow in a straight line from the equator to the poles. The winds curve to the right in the Northern Hemisphere. The winds curve to the left in the Southern Hemisphere. This is because Earth rotates at a different speed from that of the winds.

Winds traveling north from the equator move faster than the ground below them. They seem to be pushed. The Coriolis effect is responsible for the circular motion of many weather systems.

Focus Skill

How does the Earth's rotation cause winds to curve to the right in the Northern Hemisphere?

Coriolis effect

The Coriolis effect causes freely moving matter, such as air and water, to seem to curve to the right in the Northern Hemisphere and to the left in the Southern Hemisphere.

Convection in Earth's Mantle

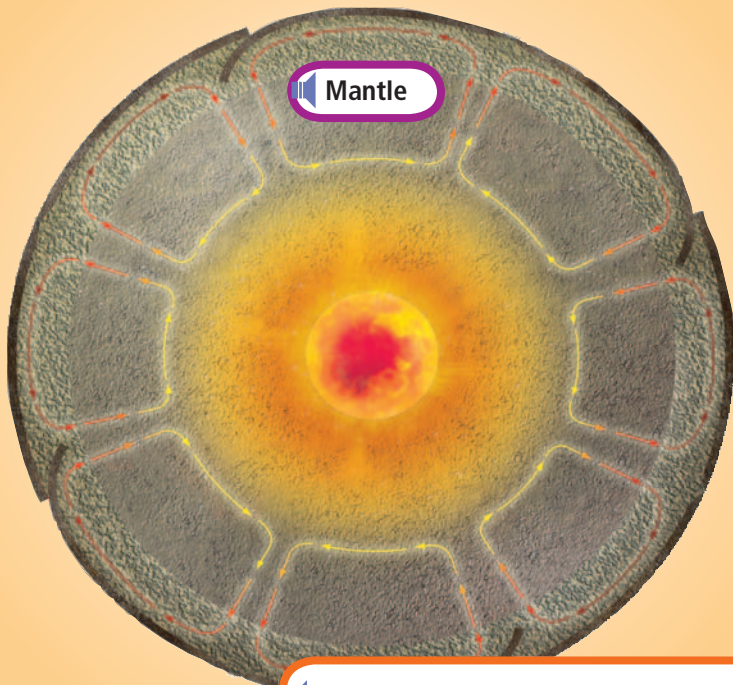
Rock in Earth's asthenosphere moves through convection currents. Hot rock is less dense than the cooler rock above it. Hot rock rises through the asthenosphere. When it reaches the lithosphere, the rock slowly spreads out. The rock begins to cool. Then the cooler, denser rock sinks back down into the asthenosphere. The upward part of the convection cycle goes on.

The convection currents in the mantle control the motion of Earth's plates. The plates are made up of lithosphere. They can move toward each other. They can move past one another. Earth's plates can also move away from each other.

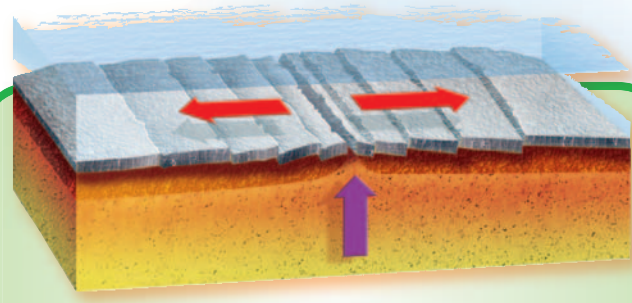
Focus Skill

How does rock move through convection currents inside Earth?

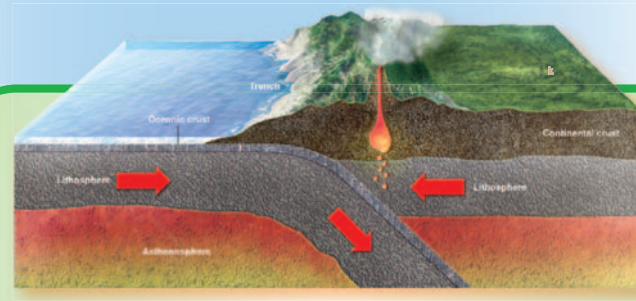
Plate Movement



Convection currents within the mantle move Earth's tectonic plates.



Where convection currents move away from one another, new material is pushed between the oceanic plates, spreading them apart.



Where an oceanic plate and a continental plate collide, the oceanic plate slips under the continental plate. The reason for this is that the oceanic plate is denser.

Review

Focus Skill

Complete these main idea and detail statements.

1. _____ currents occur in the oceans, in the atmosphere, and in the mantle.
2. Surface _____ affect weather and climate.
3. The _____ effect explains why winds curve to the left in the Southern Hemisphere.
4. Rock in the layer called the _____ flows mostly by convection currents.

Lesson 3

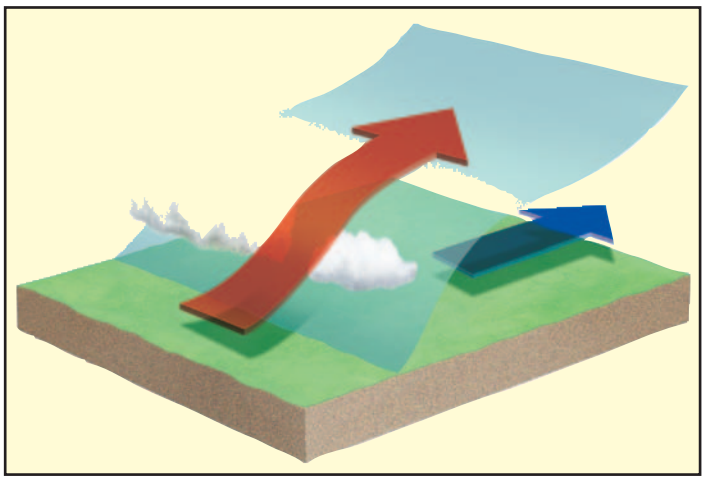
What Causes Weather Changes?

VOCABULARY

- condensation
- relative humidity
- front

On a hot day, water appears on a cold bottle. Water vapor goes through the process of **condensation**. The gas changes into liquid water.

A weather station can measure **relative humidity** with a hygrometer.



A weather map shows that a warm air mass is moving toward cooler air. The boundary between the two air masses is a warm **front**.

READING FOCUS SKILL

CAUSE AND EFFECT

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

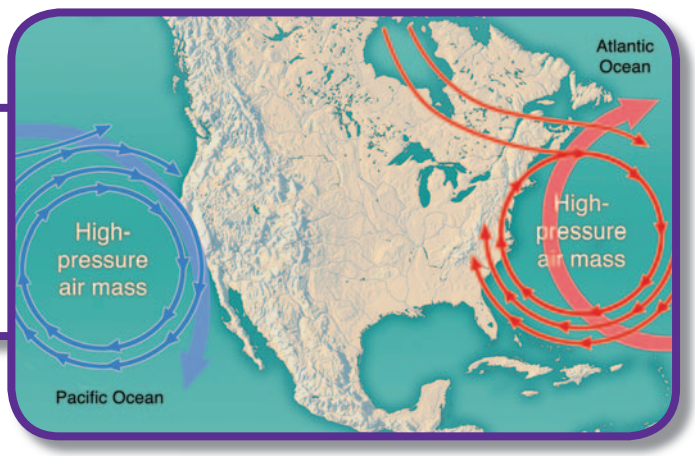
Look for examples of **cause** and **effect** while you read about the factors that influence weather.

Weather Changes

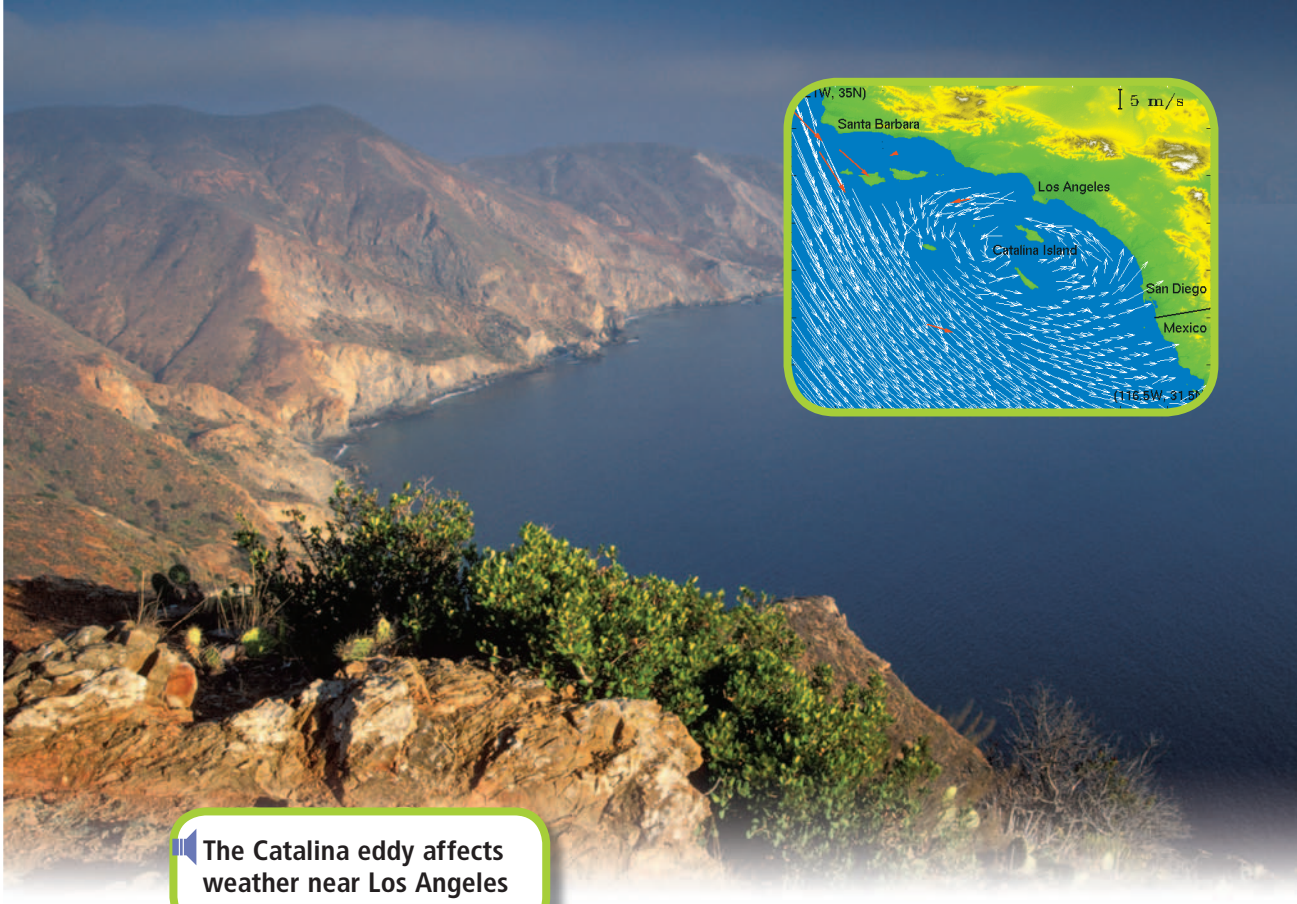
The world's climates are almost constant and changes happen slowly. Unlike climate, weather can change quickly. The exchange of energy between air and ocean currents causes weather changes. These changes include thunderstorms and hurricanes.

Thunderstorms begin over water or land the sun has heated. The air becomes warm from the sun's energy. The air also becomes less dense. The warm air rises, carrying water vapor high in the air. The water vapor cools and condenses. It turns into water droplets. **Condensation** is the process of water vapor changing to liquid water. The condensing water forms clouds. The water droplets gather and become heavy. They fall to the ground as rain.

General Summer Air Circulation Patterns



▲ **Cold ocean currents are shown in blue, and warm currents are red. Which state do you think has warmer summer weather, California or Florida?**



The Catalina eddy affects weather near Los Angeles

Warm air is less dense, so it rises. Cooler, denser air sinks to the ground. The rising warm air and the falling cooler air causes strong winds.

Air currents can affect weather. One type of air current is an atmospheric eddy. An *eddy* is a circular current. It flows the opposite way from the general current.

Near Los Angeles, many summer days are cool and cloudy. An atmospheric eddy called the *Catalina eddy* causes this weather. The air pressure over the ocean is different from the air pressure of the dry southwestern United States. The difference causes the air to spin in a *counterclockwise* direction. The eddy brings humidity, fog, rain, and cool days to the California coast.

Focus Skill

How do low and high pressure systems cause strong winds?

Rain, Rain—Go Away!

An air mass is a large body of air. It has about the same temperature and amount of water vapor throughout. A polar air mass is cold. A tropical air mass is warm.

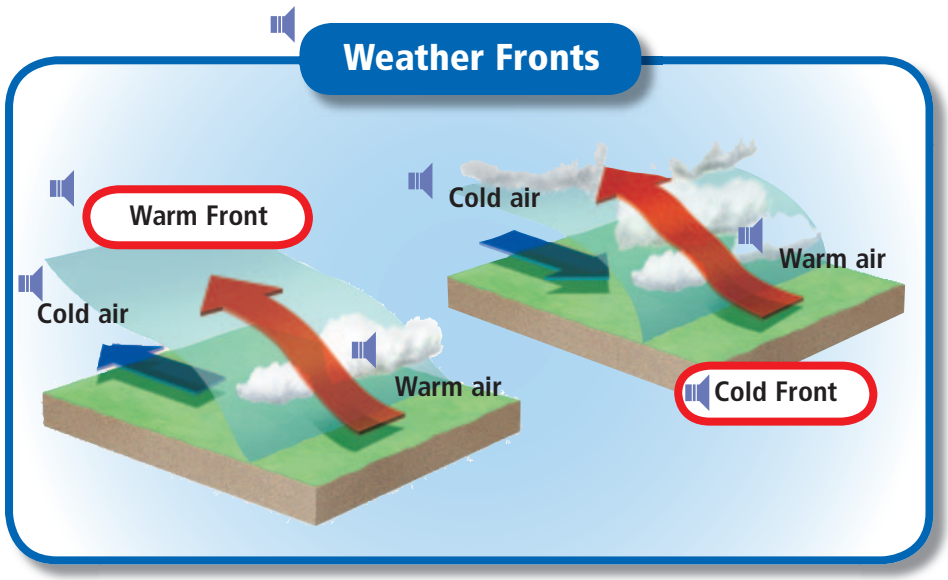
Warm air masses are less dense than cold air masses. They have lower air pressure than cold air masses. A change in air pressure means that a new air mass is moving into an area. This will cause a change in the weather.

Some air masses cause humidity to increase. Humidity is the amount of water vapor in the air. **Relative humidity** compares the actual amount of water vapor in an air mass to the total amount air could contain at that temperature. Warm air masses can hold more moisture than cold air masses.

Air masses form a boundry between them called a **front**. A warm air mass can move toward cooler air. Their boundary is called a warm front. A warm front usually brings steady rain.

When a cold air mass moves toward warmer air, the boundary is called a cold front. Cold fronts usually bring heavy rains.

Focus Skill **What kind of weather does a warm front cause?**



Local Weather

The physical features of California affect the climate and the local weather. During the winter, the eastern mountains form a barrier. They protect most of California from very cold temperatures. Winds carry clouds from the ocean. The clouds rise and cool. As a result, the western side of the Sierra Nevada gets snow and rain. Very little moisture remains in the clouds after they pass the Sierra Nevada. The areas east of these mountains are hot and dry. Death Valley and the Mojave Desert are the hottest and driest areas in California.

Focus Skill

How do clouds crossing the Sierra Nevada affect California's weather?

Death Valley

Review

Focus Skill

Complete these cause and effect statements.

1. An _____ can cause high humidity, fog, rain, and cool days to the coastal areas of California.
2. An air _____moving into an area will cause a change in the weather.
3. Heavy rains are caused by _____ fronts.
4. A mountain range forms a barrier that causes California to have _____ temperatures in the winter.

GLOSSARY

air pressure [AIR PRESH•er] The force of a volume of air pressing down on a unit of area.

condensation [kahn•duhn•SAY•shuhn] The process of water vapor changing to water droplets.

Coriolis effect [kawr•ee•OH•lis eh•FEKT] An apparent change in the direction of a freely moving object, caused by Earth's rotation.

current [KER•uhnt] A steady, stream-like movement of matter in one direction.

front [FRUHNT] The boundary between two air masses that collide.

relative humidity [REL•uh•tiv hyoo•MID•uh•tee] The ratio of the actual amount of water vapor in air to the total amount of water vapor the air could contain at that temperature.

thermal gradient [THER•muhl GRAY•dee•uhnt] A gradual increase or decrease in temperature over a distance.

Think About the Reading

1. How does the illustration on page 5 help you understand convection currents in the ocean?
2. Which section should you read again to learn more about the local weather in California?

Hands-On Activity

Add a small amount of very cold water to a plastic or glass dish. Add one drop of food coloring at one end of the dish. At the opposite end, add very hot water.

1. How does the coloring move through the water?
2. How does this experiment change if you use only cold water?

School-Home Connection

There are several coastal eddies near the coast of southern California. Research a coastal eddy with a family member. Find out about the different animals that are found near coastal eddies. Talk about any areas your family has visited or any you would like to visit.