



# Weather

Lessons 3–4

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Printed in the United States of America

ISBN-13: 978-0-15-349195-5

ISBN-10: 0-15-349195-7

1 2 3 4 5 6 7 8 9 10 179 15 14 13 12 11 10 09 08 07 06

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# Weather

## Lesson 3–4

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# How Is Weather Predicted?

## VOCABULARY

- meteorology
- barometer
- anemometer
- hygrometer
- air mass
- front



- Scientists who study **meteorology** use weather stations and maps.



- A **barometer** can help people decide what to wear. Low pressure means a chance of rain.



▶ This **anemometer** can tell how fast the wind is blowing.



▶ People in tropical climates might use a **hygrometer** to measure the humidity.



▶ A wet, tropical **air mass** brings warm, humid weather.



▶ Sometimes, you can locate a **front** by watching the clouds.



#### READING FOCUS SKILL

#### MAIN IDEA AND DETAILS

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

**Details** tell more about the main idea

Look for **details** about how weather is predicted.



## Measuring Weather

The study of weather is **meteorology**. A scientist who studies weather is a *meteorologist*. A meteorologist uses many different instruments to measure the weather. Four of these are thermometer, barometer, anemometer, and hygrometer. They can be used to predict weather. People who predict weather are making a *forecast*.



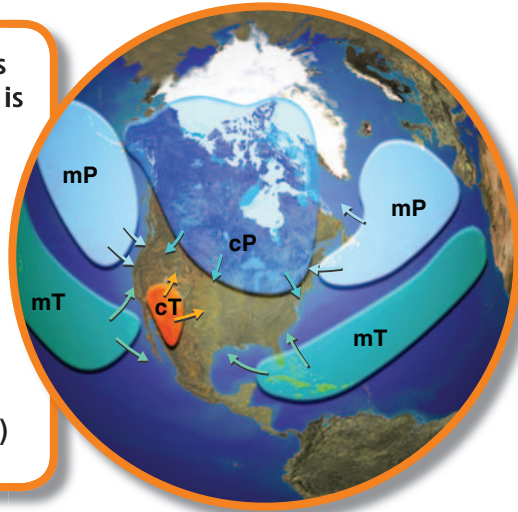
A barometer measures air pressure. When a barometer is rising, air pressure is increasing. Higher air pressure means cooler weather. Cold air usually has less water vapor than warm air. A rising barometer means less humidity. Less humidity means a lower chance of rain. When a barometer is rising, you can forecast cool weather with a low chance of rain. A falling barometer reading often means more humidity is in the air. More humidity means a higher chance of rain.

When making weather predictions, wind must be considered. Anemometers measure wind speed. *Windsocks* and *wind vanes* measure wind direction. Changes in wind speed and wind direction tell more about the weather. Say it is winter, and the wind begins to blow from the south. You can predict that the weather will become warmer.

 **How does rising air pressure help people predict the weather?**

| Weather Instrument                                                                                                                                                                               | Measures                                                                                                                                                             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p> <b>Thermometer</b></p>    | <p>A thermometer measures air temperature. If the air cools down during the day or warms up in the evening, the change is a sign that rain may fall soon.</p>        |
|  <p> <b>Barometer</b></p>    | <p>A barometer measures air pressure. This is also called <i>barometric pressure</i>. A rapid change in air pressure often means the weather is about to change.</p> |
|  <p> <b>Anemometer</b></p> | <p>An anemometer measures wind speed. Like a change in air pressure, a change in wind speed may mean that the weather is about to change.</p>                        |
|  <p> <b>Hygrometer</b></p> | <p>A hygrometer measures humidity. An increase in humidity often means it is about to rain.</p>                                                                      |

- ▶ A *continental* air mass forms over land, so it is dry. (c)
- ▶ A *maritime* air mass forms over water, so it is humid. (m)
- ▶ A *polar* air mass forms over a cold area, so it is cold. (P)
- ▶ A *tropical* air mass forms over a warm area, so it is warm. (T)



## ▶ Air Masses

The sun heats Earth's atmosphere, land, and water. Some air is warm and some air is cool. The uneven heating causes the air to move. Air moves in a large, regular mass. An **air mass** is a large body of air that has the same temperature and humidity.

▶ An air mass is similar to the region where it forms. An air mass that forms over the ocean near the equator is humid and warm. An air mass that forms over northern Canada is dry and cold.

▶ Four kinds of air masses affect weather in our country. *Continental polar* air masses bring cool, dry weather. *Continental tropical* air masses bring hot, dry weather. *Maritime polar* air masses bring cold, humid weather. *Maritime tropical* air masses bring warm, humid weather. When weather changes in a region, the air mass changes too. A changing air mass produces winds. Air masses usually move from west to east across the United States.



**What kind of air mass makes cold, humid weather?**

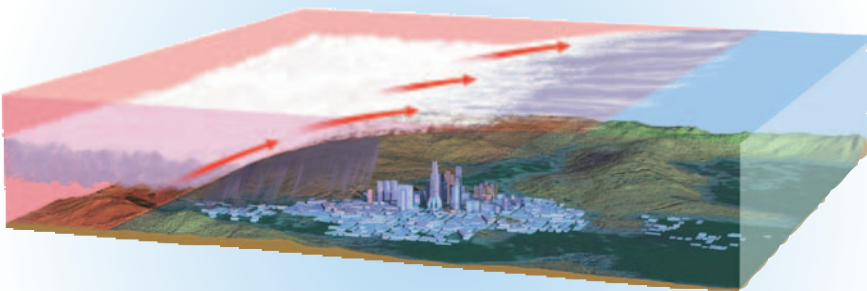
## Fronts

The border where two air masses meet is a **front**. Most weather changes occur along fronts.

The two main kinds of fronts are cold fronts and warm fronts. A cold front forms when a cold air mass moves under a warm air mass. The warm air mass is less dense. It is forced up quickly and begins to cool. When a warm, moist air mass cools, its water vapor condenses. This fast cooling and condensation causes heavy rain, thunderstorms, or snow. Cold fronts usually move quickly, so the storms do not last long.

 A warm front develops differently. A warm air mass moves behind and then over a cold air mass. As the warm air slowly slides up and over the cold air, clouds form ahead of the front. The clouds produce rain or snow that can last for hours.

  **What kind of front brings heavy rains and thunderstorms that do not last long?**



 After a cold front passes through an area, the weather is cooler and drier.

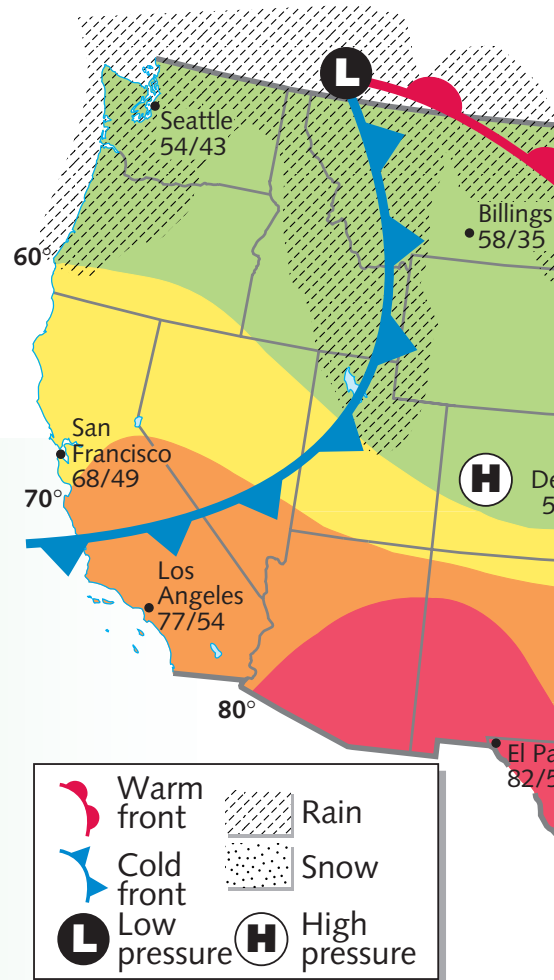
## Weather Maps

People use weather maps to learn about the weather in an area. Weather maps use symbols to show different types of weather. A sun symbol means sunny weather. The symbol of a cloud with rain means rainy weather.

 Fronts are shown on weather maps. The symbol for a warm front is a red line with half circles. A blue line with triangles shows a cold front.

If a warm front is moving east, the half circles are on the right side of the line. This shows the direction the front is moving. If a warm front is moving south, the triangles are on the bottom of the blue line.

 Temperature is given on a weather map. Temperatures can be shown by a special color code on the map. Weather maps might also show wind speed and wind direction.





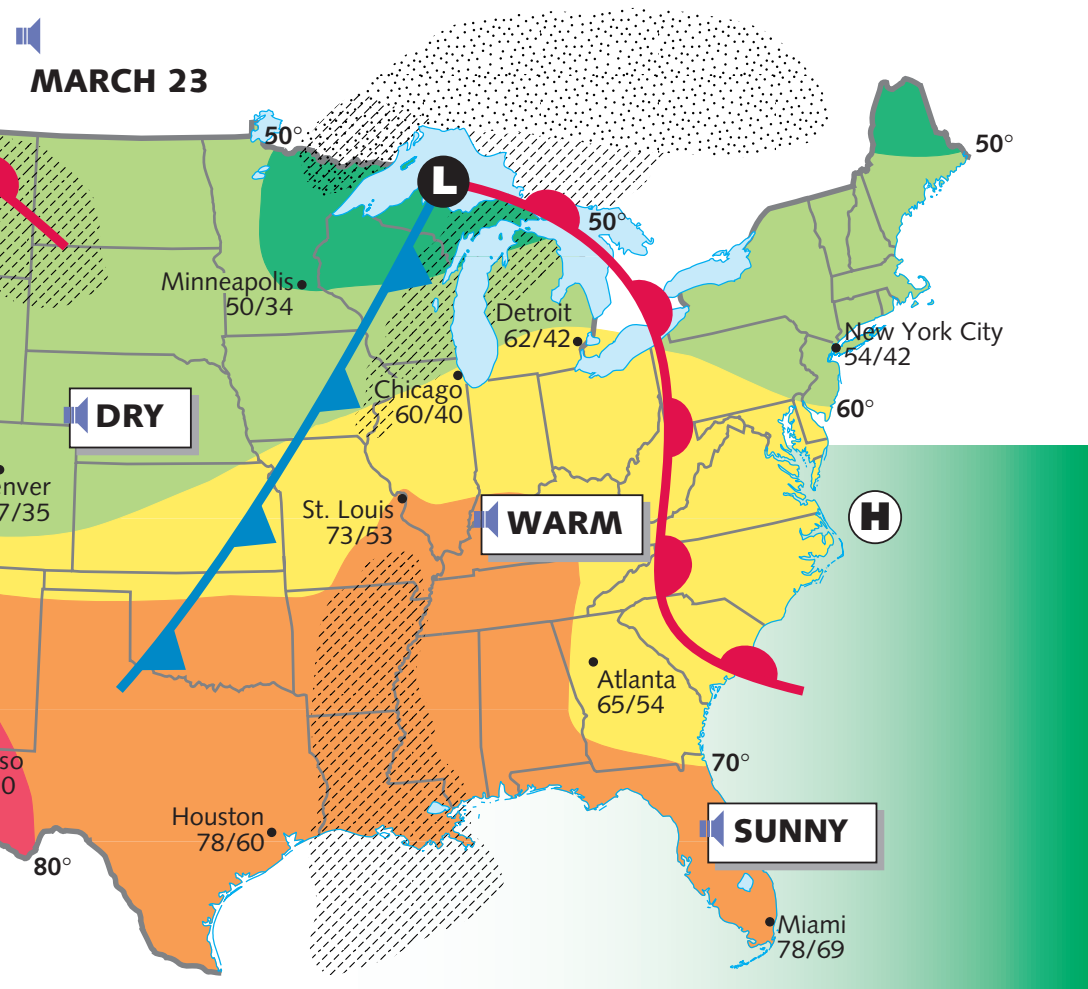
High and low-pressure systems may be indicated on a weather map. A high-pressure system is noted with an *H*. A high-pressure system is an area of cool, dense air. It is surrounded on all sides by warmer low-pressure air.

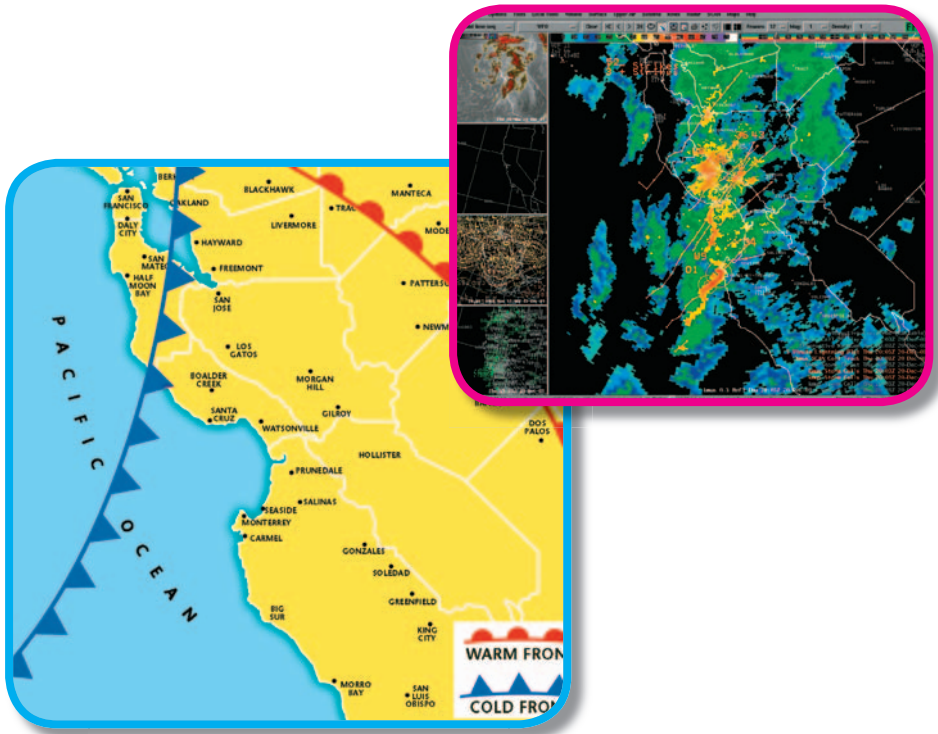


A low-pressure system is noted with an *L*. A low-pressure system forms when an area of warm, less-dense air is surrounded by cooler, high-pressure air.



**Look at the weather map. What kind of front is moving past Nevada?**





## Forecasting Weather

Weather stations collect information about the weather. Different instruments are used in weather stations. Meteorologists use information from weather stations to make forecasts. They also use images from weather satellites. A *forecast* is a prediction about the weather.

Studying wind direction and air pressure can help people forecast weather.

Let's say that wind is blowing from the north. You can predict the weather by looking on a weather map. Find the type of weather that is north of you. If the weather north of you is cool, the wind will probably be blowing cooler weather to your area.



Air pressure is another way to predict weather. A low-pressure system on a weather map forecasts stormy weather. A high-pressure system on the weather map means the weather will probably be fair.



Weather predictions for the next few days are usually accurate. It is difficult to predict weather farther into the future. Small changes in temperature and air pressure can cause big changes in weather. Scientists cannot accurately predict the weather more than a few days ahead.



**What does a meteorologist need to predict the weather?**



## Review



Complete this **main idea** statement.

- 1. Weather maps can help you predict, or \_\_\_\_\_, weather for the near future.

Complete these **detail** statements.

- 2. Air pressure is measured with a \_\_\_\_\_ .
- 3. A continental tropical \_\_\_\_\_ hot, dry weather.
- 4. Most weather changes occur along \_\_\_\_\_ .

# What Are the Causes and Effects of Severe Weather?

## VOCABULARY

- monsoon
- hurricane
- thunderstorm
- tornado



A **monsoon** can bring heavy rains.



I am not afraid of **thunderstorms**. I like to hear the rain and thunder. The lightning is exciting.



A **tornado** can cause a great deal of damage.



A **hurricane** can pull trees out of the ground.



## 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.



## Pacific Storms

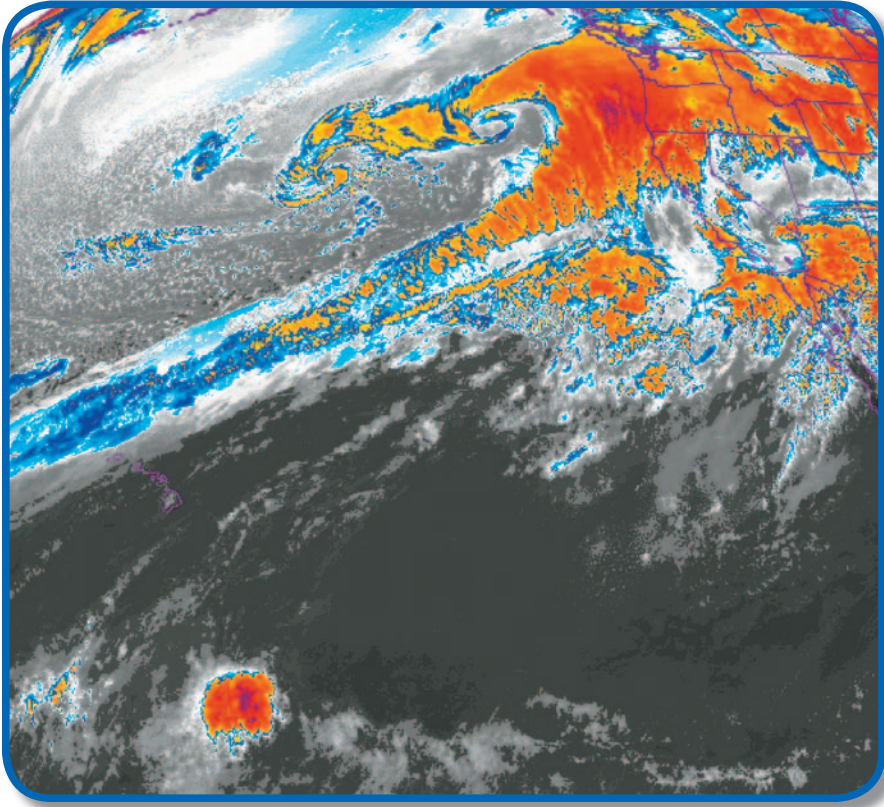
In North America, weather usually moves from west to east. Because the Pacific Ocean is west of California, the ocean affects California's weather. California has a monsoon pattern because of the Pacific. A **monsoon** is a wind system that reverses its direction with the seasons.



When the land cools in the winter, the air above it cools too. The cooler dense air over land moves toward the Pacific. It forces the ocean's warmer air to rise. Because the wind comes from the land, it is dry. The Santa Ana winds are part of the dry phase of southern California's monsoon.



During the summer, the opposite effect happens. The Pacific waters are cooler than the land. The cool air from the Pacific is humid. When the humid air reaches the warm land, the air warms up. The air becomes less dense and is forced upward. As the humid, warm air rises, it cools and clouds form.



■ A cyclone is another type of Pacific weather pattern that affects California. A *cyclone* is an air mass that is turning rapidly.

Because of the Earth's rotation wind does not blow in straight lines. The air curves as it blows. The warm less-dense air rotates and rises over the cooler low-pressure area. A circular wind storm forms.

■ Winter storms come in from the Pacific Ocean. They can bring heavy rains to the coast and heavy snows to the mountains.

■  **What is one reason it rains during the summer in California?**

## Hurricanes and Other Cyclones

A type of cyclone that begins over warm ocean water is a hurricane. A **hurricane** is a large rotating tropical storm. It has wind speeds of at least 119 km/hr (74 m/h).

 A hurricane is first called a *tropical depression*. This is because the air pressure is low, or depressed. Winds rotate around the low-pressure center of the tropical depression. When the winds reach 63 km/hr (39 m/h), the tropical depression becomes a *tropical storm*. A tropical storm is given a name. As the storm grows stronger, it becomes a hurricane.

 The eye of a hurricane is a calm center. It is dry, cool air that the storm pulls down. Around the eye is the eye wall. The eye wall is the most intense part of the storm.

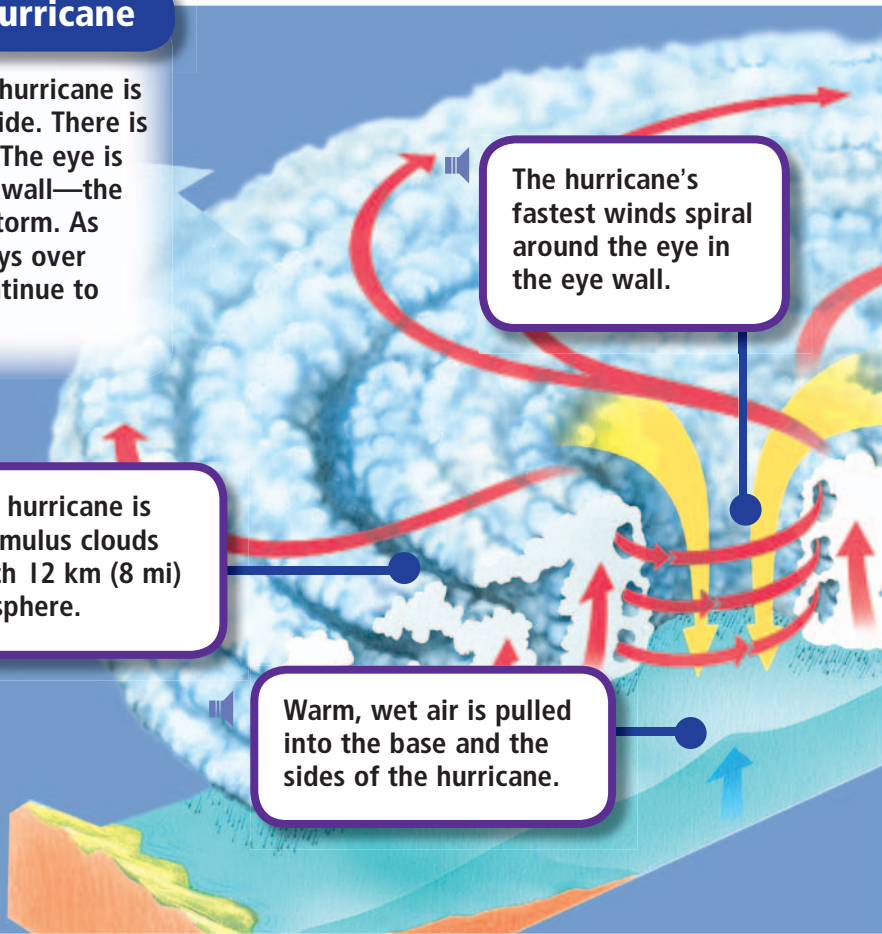
### Anatomy of a Hurricane

The eye of an average hurricane is about 20 km (12 mi) wide. There is no rain inside the eye. The eye is surrounded by the eye wall—the strongest part of the storm. As long as a hurricane stays over warm water, it can continue to strengthen.

 The spiral of a hurricane is made up of cumulus clouds that can stretch 12 km (8 mi) into the atmosphere.

 Warm, wet air is pulled into the base and the sides of the hurricane.

The hurricane's fastest winds spiral around the eye in the eye wall.





Water vapor that is carried up condenses into rain. Condensation releases heat. Heat and moisture increase the energy of the storm.

The storm pushes the ocean's surface. This causes the ocean surface to rise. These rises are *storm surges*. Other hurricane dangers include high winds, heavy rains, flooding, and tornadoes.



The word *hurricane* is not used everywhere. In the North Pacific Ocean, near Japan or China, this kind of storm is called a *typhoon*.



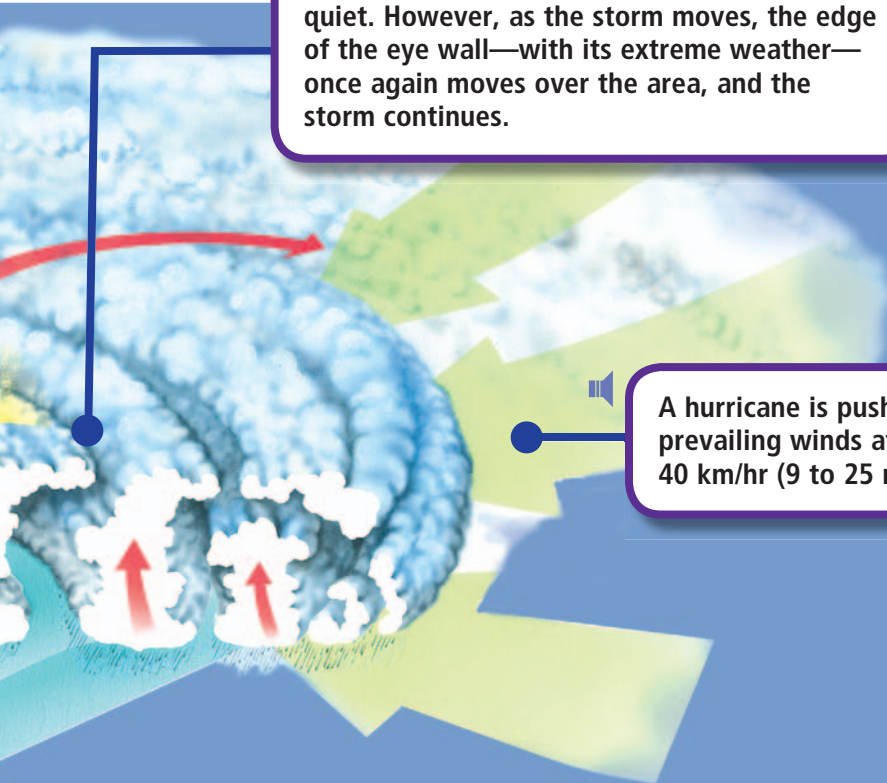
**What can cause a hurricane to get stronger?**



The hurricane's eye is a place of calm and quiet. However, as the storm moves, the edge of the eye wall—with its extreme weather—once again moves over the area, and the storm continues.



A hurricane is pushed by prevailing winds at 15 to 40 km/hr (9 to 25 mi/hr).



## **Thunderstorms and Tornadoes**

A **thunderstorm** is a storm with rain, wind, lightning, and thunder. Sometimes, a thunderstorm produces hail. About 45,000 thunderstorms occur on Earth every day! A thunderstorm begins to form when warm, humid air moves upward quickly.

 The sun heats an area on Earth's surface. This creates a warm air mass above the land. A cold front may push under the warm air mass, or wind may force it up.

The warm air cools as it rises. The water vapor in it condenses and forms clouds. Soon rain begins to fall. The falling rain pulls cool air down with it. Winds blow both upward and downward in the cloud.

 Electric charges build up in the bottom of the cloud. The charges travel through the air. The charge is the lightning you see. The air along the lightning bolt is very hot. The heat expands the air around the lightning bolt. The expanding air makes a sudden sound wave. You hear thunder!



Whenever meteorologists discover a strong thunderstorm, they look for something else. They look for another severe weather event called a tornado. A **tornado** is a violently rotating column of air.

A tornado forms when winds spin in a column of air. The column grows out of the bottom of a cloud. Warm, humid air is pulled into the funnel-shaped column. The humid air spins up and curves around the center. Low pressure in the center of the funnel makes nearby air rush in.

The path of a tornado is usually very narrow. It can last from a few minutes to a few hours. Tornadoes are more difficult to predict than other storms. Meteorologists issue warnings so people have time to take cover.

 **What sound does expanding air inside a thunderstorm cause?**



## Review



Complete these **cause and effect** statements.

1. The \_\_\_\_\_ Ocean affects much of California's weather.
2. In the summer, a \_\_\_\_\_ will cause a layer of clouds to hang over the coast of California.
3. The eye of a \_\_\_\_\_ is a calm center, caused by dry, cool air that is pulled down.
4. A \_\_\_\_\_ forms when winds spin in a column of air that grows out of the bottom of a cloud.

## **GLOSSARY**

-  **air mass** [AIR MAS] A large body of air that has similar temperature and humidity throughout.
-  **anemometer** [an•uh•MAHM•uht•er] An instrument for measuring wind speed.
-  **barometer** [buh•RAHM•uht•er] An instrument for measuring air pressure.
-  **front** [FRUHNT] A place where two air masses meet.
-  **hurricane** [HER•ih•kayn] A large, rotating tropical storm system with wind speeds of at least 119 km/hr (74 mi/hr).
-  **hygrometer** [hy•GRAHM•uht•er] An instrument for measuring humidity.
-  **meteorology** [meet•ee•uh•RAHL•uh•jee] The study of weather.
-  **monsoon** [mahn•SOON] A large wind system that reverses direction seasonally.
-  **thunderstorm** [THUHN•der•stawrm] A strong storm with rain, lightning, hail, and thunder.
-  **tornado** [tawr•NAY•doh] A violently spinning column of air that touches the ground.

## **Think About the Reading**

-  **1.** If you wanted to study the weather, how would the instruments on page 5 help you?
-  **2.** What section would you read again if you wanted to learn more about hurricanes?

## **Hands-On Activity**

Fill one 2-liter plastic soda bottle with water. Stand by a sink or a bucket. Turn the bottle upside down and immediately begin to swirl the water by moving the bottle in a clockwise motion. Keep swirling while the water pours out.

-  **1.** Did you see the tornado shape in the bottle? Did the water pour out quickly?
-  **2.** Repeat the experiment, but this time do not swirl the water. Did the water flow out faster or slower?

## **School-Home Connection**

Explain a weather map to a family member. Find a weather map in a newspaper, TV weather report, or online news service. Explain the high pressure areas, low pressure areas, fronts, and other symbols.