

READING WARM-UP

Objectives

- Describe how lightning forms.
- Describe the formation of thunderstorms, tornadoes, and hurricanes.
- Describe the characteristics of thunderstorms, tornadoes, and hurricanes.
- Explain how to stay safe during severe weather.

Terms to Learn

thunderstorm tornado
lightning hurricane
thunder

READING STRATEGY

Reading Organizer As you read this section, create an outline of the section. Use the headings from the section in your outline.

thunderstorm a usually brief, heavy storm that consists of rain, strong winds, lightning, and thunder

Severe Weather

CRAAAACK! BOOM! What made that noise? You didn't expect it, and it sure made you jump.

A big boom of thunder has probably surprised you at one time or another. And the thunder was probably followed by a thunderstorm. A thunderstorm is an example of severe weather. *Severe weather* is weather that can cause property damage and sometimes death.

Thunderstorms

Thunderstorms can be very loud and powerful. **Thunderstorms**, such as the one shown in **Figure 1**, are small, intense weather systems that produce strong winds, heavy rain, lightning, and thunder. Thunderstorms can occur along cold fronts. But thunderstorms can develop in other places, too. There are only two atmospheric conditions required to produce thunderstorms: warm and moist air near Earth's surface and an unstable atmosphere. The atmosphere is unstable when the surrounding air is colder than the rising air mass. The air mass will continue to rise as long as the surrounding air is colder than the air mass.

When the rising warm air reaches its dew point, the water vapor in the air condenses and forms cumulus clouds. If the atmosphere is extremely unstable, the warm air will continue to rise, which causes the cloud to grow into a dark, cumulonimbus cloud. Cumulonimbus clouds can reach heights of more than 15 km.

Figure 1 A typical thunderstorm, such as this one over Dallas, Texas, generates an enormous amount of electrical energy.



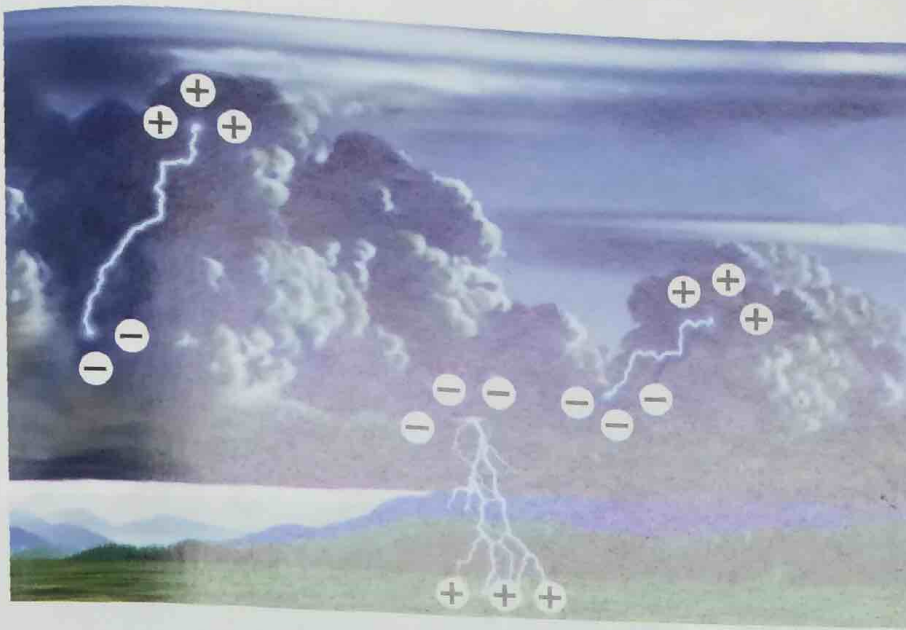


Figure 2 The upper part of a cloud usually carries a positive electric charge, while the lower part of the cloud carries mainly negative charges.

Lightning

Thunderstorms are very active electrically. **Lightning** is an electric discharge that occurs between a positively charged area and a negatively charged area, as shown in **Figure 2**. Lightning can happen between two clouds, between Earth and a cloud, or even between two parts of the same cloud. Have you ever touched someone after scuffing your feet on the carpet and received a mild shock? If so, you have experienced how lightning forms. While you walk around, friction between the floor and your shoes builds up an electric charge in your body. When you touch someone else, the charge is released.

When lightning strikes, energy is released. This energy is transferred to the air and causes the air to expand rapidly and send out sound waves. **Thunder** is the sound that results from the rapid expansion of air along the lightning strike.

Severe Thunderstorms

Severe thunderstorms can produce one or more of the following conditions: high winds, hail, flash floods, and tornadoes. Hailstorms damage crops, dent the metal on cars, and break windows. Flash flooding that results from heavy rains causes millions of dollars in property damage annually. And every year, flash flooding is a leading cause of weather-related deaths.

Lightning, as shown in **Figure 3**, happens during all thunderstorms and is very powerful. Lightning is responsible for starting thousands of forest fires each year and for killing or injuring hundreds of people a year in the United States.

✓ Reading Check What is a severe thunderstorm? (See the Appendix for answers to Reading Checks.)

lightning an electric discharge that takes place between two oppositely charged surfaces, such as between a cloud and the ground, between two clouds, or between two parts of the same cloud

thunder the sound caused by the rapid expansion of air along an electrical strike

Figure 3 Lightning often strikes the tallest object in an area, such as the Eiffel Tower in Paris, France.



Tornadoes

tornado a destructive, rotating column of air that has very high wind speeds, is visible as a funnel-shaped cloud, and touches the ground

Tornadoes happen in only 1% of all thunderstorms. A **tornado** is a small, spinning column of air that has high wind speeds and low central pressure and that touches the ground. A tornado starts out as a funnel cloud that pokes through the bottom of a cumulonimbus cloud and hangs in the air. The funnel cloud becomes a tornado when it makes contact with Earth's surface. **Figure 4** shows how a tornado forms.

Figure 4 How a Tornado Forms



- 1** Wind moving in two directions causes a layer of air in the middle to begin to spin like a roll of toilet paper.



- 2** The spinning column of air is turned to a vertical position by strong updrafts of air in the cumulonimbus cloud. The updrafts of air also begin to spin.



- 3** The spinning column of air moves to the bottom of the cumulonimbus cloud and forms a funnel cloud.



- 4** The funnel cloud becomes a tornado when it touches the ground.



Figure 5 The tornado that hit Kissimmee, Florida, in 1998 had wind speeds of up to 416 km/h.

Twists of Terror

About 75% of the world's tornadoes occur in the United States. Most of these tornadoes happen in the spring and early summer when cold, dry air from Canada meets warm, moist air from the Tropics. The size of a tornado's path of destruction is usually about 8 km long and 10 to 60 m wide. Although most tornadoes last only a few minutes, they can cause a lot of damage. Their ability to cause damage is due to their strong spinning winds. The average tornado has wind speeds between 120 and 180 km/h, but rarer, more violent tornadoes can have spinning winds of up to 500 km/h. The winds of tornadoes have been known to uproot trees and destroy buildings, as shown in **Figure 5**. Tornadoes are capable of picking up heavy objects, such as mobile homes and cars, and hurling them through the air.

hurricane a severe storm that develops over tropical oceans and whose strong winds of more than 120 km/h spiral in toward the intensely low-pressure storm center

Hurricanes

A large, rotating tropical weather system that has wind speeds of at least 120 km/h is called a **hurricane**, shown in **Figure 6**. Hurricanes are the most powerful storms on Earth. Hurricanes have different names in different parts of the world. In the western Pacific Ocean, hurricanes are called *typhoons*. Hurricanes that form over the Indian Ocean are called *cyclones*.

Most hurricanes form in the areas between 5° and 20° north latitude and between 5° and 20° south latitude over warm, tropical oceans. At higher latitudes, the water is too cold for hurricanes to form. Hurricanes vary in size from 160 to 1,500 km in diameter and can travel for thousands of kilometers.

Reading Check What are some other names for hurricanes?



Figure 6 This photograph of Hurricane Fran was taken from space.

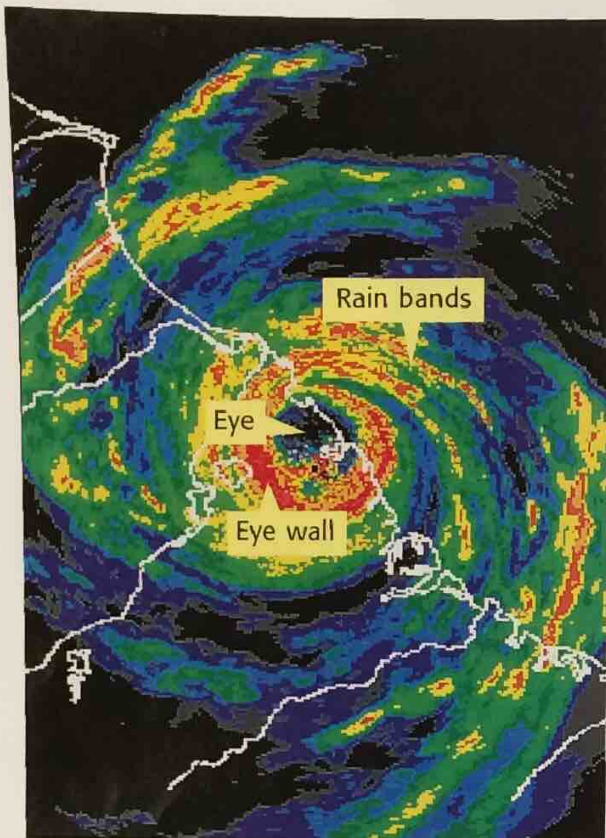


Figure 7 The photo above gives you a bird's-eye view of a hurricane.

How a Hurricane Forms

A hurricane begins as a group of thunderstorms moving over tropical ocean waters. Winds traveling in two different directions meet and cause the storm to spin. Because of the Coriolis effect, the storm turns counterclockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere.

A hurricane gets its energy from the condensation of water vapor. Once formed, the hurricane is fueled through contact with the warm ocean water. Moisture is added to the warm air by evaporation from the ocean. As the warm, moist air rises, the water vapor condenses and releases large amounts of energy. The hurricane continues to grow as long as it is over its source of warm, moist air. When the hurricane moves into colder waters or over land, it begins to die because it has lost its source of energy. **Figure 7** and **Figure 8** show two views of a hurricane.

Reading Check Where do hurricanes get their energy?

Figure 8 Cross Section of a Hurricane

Surrounding the eye is the **eye wall**—a group of cumulonimbus clouds that produce heavy rains and strong winds. The winds can reach speeds of 300 km/h. The eye wall is the strongest part of the hurricane.

At the center of the hurricane is the **eye**—a core of warm, relatively calm air with low pressure and light winds.

Beyond the eye wall, spiraling bands of clouds called **rain bands** circle the center of the hurricane. The rain bands produce heavy rains and high winds. Within this area of the hurricane, wind speed decreases as the distance from the eye wall increases.

Updraft

Downdraft



Figure 9 A hurricane's storm surge can cause severe damage to homes near the shoreline.

Damage Caused by Hurricanes

Hurricanes can cause a lot of damage when they move near or onto land. Wind speeds of most hurricanes range from 120 to 150 km/h. Some can reach speeds as high as 300 km/h. Hurricane winds can knock down trees and telephone poles and can damage and destroy buildings and homes.

While high winds cause a great deal of damage, most hurricane damage is caused by flooding associated with heavy rains and storm surges. A *storm surge* is a wall of water that builds up over the ocean because of the strong winds and low atmospheric pressure. The wall of water gets bigger as it nears the shore, and it reaches its greatest height when it crashes onto the shore. Depending on the hurricane's strength, a storm surge can be 1 to 8 m high and 65 to 160 km long. Flooding causes tremendous damage to property and lives when a storm surge moves onto shore, as shown in **Figure 9**.

Severe Weather Safety

Severe weather can be very dangerous, so it is important to keep yourself safe. One way to stay safe is to turn on the radio or TV during a storm. Your local radio and TV stations will let you know if a storm has gotten worse.

Thunderstorm Safety

Lightning is one of the most dangerous parts of a thunderstorm. Lightning is attracted to tall objects. If you are outside, stay away from trees, which can get struck down. If you are in the open, crouch down. Otherwise, you will be the tallest object in the area! Stay away from bodies of water. If lightning hits water while you are in it, you could be hurt or could even die.

SCHOOL to HOME

Natural Disaster Plan

WRITING SKILL Every family should have a plan to deal with weather emergencies. With a parent, discuss what your family should do in the event of severe weather. Together, write up a plan for your family to follow in case of a natural disaster. Also, make a disaster supply kit that includes enough food and water to last several days.

ACTIVITY

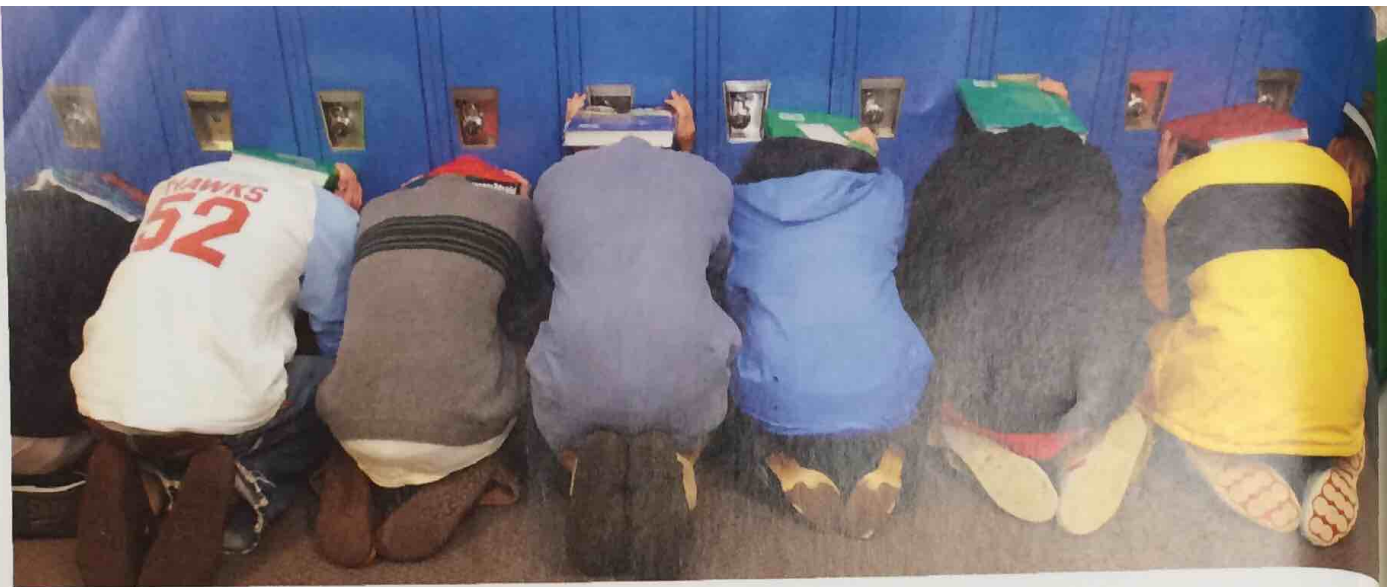


Figure 10 During a tornado warning, it is best to protect yourself by crouching against a wall and covering the back of your head and neck with your hands or a book.

Tornado Safety

Weather forecasters use watches and warnings to let people know about tornadoes. A *watch* is a weather alert that lets people know that a tornado may happen. A *warning* is a weather alert that lets people know that a tornado has been spotted.

If there is a tornado warning for your area, find shelter quickly. The best place to go is a basement or cellar. Or you can go to a windowless room in the center of the building, such as a bathroom, closet, or hallway, as **Figure 10** shows. If you are outside, lie down in a large, open field or a deep ditch.

Flood Safety

An area can get so much rain that it begins to flood. So, like tornadoes, floods have watches and warnings. However, little warning can usually be given. A flash flood is a flood that rises and falls very suddenly. The best thing to do during a flood is to find a high place to wait out the flood. You should always stay out of floodwaters. Even shallow water can be dangerous if it is moving fast.

Figure 11 These store owners are boarding up their windows to protect the windows from strong winds during a hurricane.



Hurricane Safety

If a hurricane is in your area, your local TV or radio station will keep you updated on its condition. People living on the shore may be asked to evacuate the area. If you live in an area where hurricanes strike, your family should have a disaster supply kit that includes enough water and food to last several days. To protect the windows in your home, you should cover them with plywood, as shown in **Figure 11**. Most important, you must stay indoors during the storm.