

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- What are some types of severe weather?
- How can you stay safe during severe weather?

National Science Education Standards

ES 1i, 1j

What Causes Thunderstorms?

A **thunderstorm** is an intense storm with strong winds, heavy rain, lightning, and thunder. Many thunderstorms happen along cold fronts. However, thunderstorms can also happen in other areas. Two conditions are necessary for a thunderstorm to form: warm, moist air near Earth’s surface and an unstable area of the atmosphere.

The atmosphere is unstable when a body of cold air is found above a body of warm air. The warm air rises and cools as it mixes with the cool air. When the warm air reaches its dew point, the water vapor condenses and forms cumulus clouds. If the warm air keeps rising, the clouds may become dark cumulonimbus clouds.



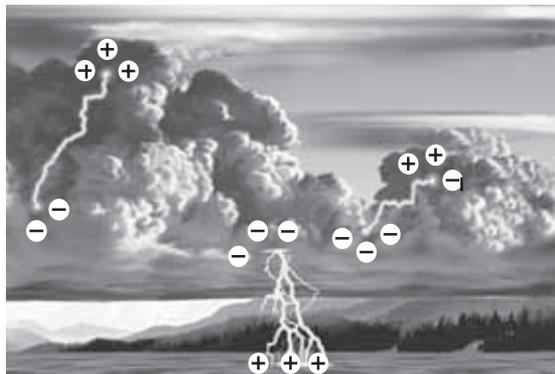
Describe After you read this section, make a flow chart showing how a tornado forms.

Critical Thinking

1. Infer Why does air near the surface have to be moist in order for a thunderstorm to form?

LIGHTNING

As a cloud grows bigger, parts of it begin to develop electrical charges. The upper parts of the cloud tend to become positively charged. The lower parts tend to become negatively charged. When the charges get big enough, electricity flows from one area to the other. Electricity may also flow between the clouds and the ground. These electrical currents are **lightning**. ✓



Different parts of thunderclouds and the ground can have different electrical charges. When electricity flows between these areas, lightning forms.



2. Describe How does lightning form?

SECTION 3 Severe Weather *continued*

THUNDER

You have probably seen large lightning bolts that travel between the clouds and the ground. When lightning moves through the air, the air gets very hot. The hot air expands rapidly. As it expands, it makes the air vibrate. The vibrations release energy in the form of sound waves. The result is **thunder**. ✓

READING CHECK

3. Define What is thunder?

SEVERE THUNDERSTORMS

Severe thunderstorms can cause a lot of damage. They can produce strong winds, hail, flash floods, or tornadoes. Hail can damage crops, cars, and windows. Flash flooding from heavy rain can cause serious property damage. Flash flooding is the leading cause of weather-related deaths. Lightning can start fires and cause injuries and deaths.

How Do Tornadoes Form?

Fewer than 1% of thunderstorms produce tornadoes. A **tornado** can form when a rapidly spinning column of air, called a *funnel cloud*, touches the ground. The air in the center of a tornado has low pressure. When the area of low pressure touches the ground, material from the ground can be sucked up into the tornado. ✓

READING CHECK

4. Explain Why can material be sucked up into a tornado?

A tornado begins as a funnel cloud that pokes through the bottom of a cumulonimbus cloud. The funnel cloud becomes a tornado when the funnel cloud touches the ground. The pictures below show how a tornado forms.



1 Wind moving in opposite directions causes a layer of air in the middle of a cloud to begin to spin.



2 Strong vertical winds cause the spinning column of air to turn into a vertical position.



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



4 The funnel cloud becomes a tornado when it touches down on the ground.

TAKE A LOOK

5. Describe When does a funnel cloud become a tornado?

SECTION 3 Severe Weather *continued***TORNADO FACTS**

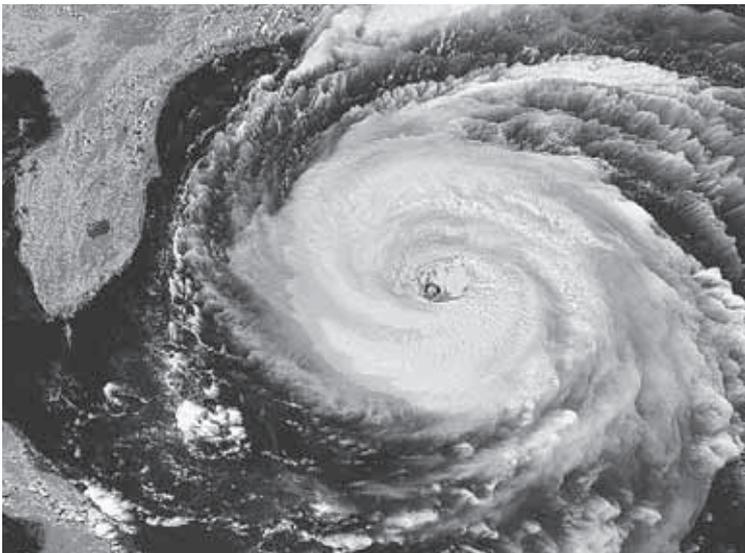
About 75% of the world's tornadoes happen in the United States. Most happen in the spring and early summer. During these times, cold, dry air from Canada meets warm, moist air from the Tropics. This causes the thunderstorms that produce tornadoes.

Most tornadoes last for only a few minutes. However, their strong, spinning winds can cause a lot of damage. An average tornado has wind speeds between 120 km/h and 180 km/h, but some can be much higher. Winds from tornadoes can tear up trees and destroy buildings. They can even be strong enough to lift cars and trailers up into the air. The area damaged by a tornado is usually about 8 km long and 10 to 60 m wide.

How Do Hurricanes Form?

A **hurricane** is a large, rotating tropical weather system. Hurricanes have wind speeds of over 120 km/h. They can be 160 km to 1,500 km in diameter and can travel for thousands of miles. They are the most powerful storms on Earth. Hurricanes are also called typhoons and cyclones.

Most hurricanes form between 5°N and 20°N latitude or between 5°S and 20°S latitude. They form over the warm, tropical oceans found at these latitudes. At higher latitudes, the water is too cold for hurricanes to form. ✓



Hurricanes can be so large that they are visible from space. This photograph of a hurricane was taken by a satellite.

Math Focus

6. Convert What is the average wind speed in a tornado in miles per hour?

1 km = 0.62 mi.

READING CHECK

7. Explain Why don't hurricanes form at high latitudes?

SECTION 3 Severe Weather *continued*

HOW HURRICANES FORM

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

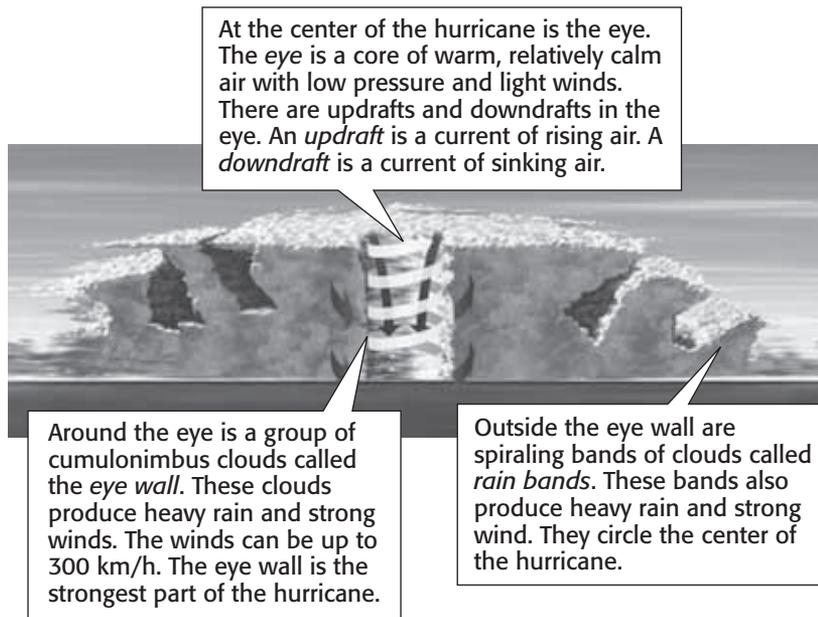
READING CHECK

8. Explain What causes hurricanes to rotate in different directions in the Northern and Southern Hemispheres?

Hurricanes are powered by solar energy. The sun's energy causes ocean water to evaporate. As the water vapor rises in the air, it cools and condenses. A group of thunderstorms form and produce a large, spinning storm. A hurricane forms as the storm gets stronger.

TAKE A LOOK

9. Define What is the eye of a hurricane?



The hurricane will continue to grow as long as it is over warm ocean water. When the hurricane moves over colder waters or over land, the storm loses energy. This is why hurricanes are not common in the middle of continents. The storms lose their energy quickly when they move over land.

SECTION 3 Severe Weather *continued***DAMAGE CAUSED BY HURRICANES**

Hurricanes can cause serious damage when they move near or onto land. The strong winds from hurricanes can knock down trees and telephone poles. They can damage or destroy buildings and homes.

Many people think that the winds are the most damaging part of a hurricane. However, most of the damage from hurricanes is actually caused by flooding from heavy rains and storm surges. A *storm surge* is a rise in sea level that happens during a storm. A storm surge from a hurricane can be up to 8 m high. The storm-surge flooding from Hurricane Katrina in 2005 caused more damage than the high-speed winds from the storm. ✓

How Can You Stay Safe During Severe Weather?

Severe weather can be very dangerous. During severe weather, it is important for you to listen to a local TV or radio station. Severe-weather announcements will tell you where a storm is and if it is getting worse. Weather forecasters use watches and warnings to let people know about some kinds of severe weather. A *watch* means that severe weather may happen. A *warning* means that severe weather is happening somewhere nearby.

The table below gives ways to stay safe during different kinds of severe weather. ✓

| Severe weather | How to stay safe |
|----------------|---|
| Thunderstorms | If you are outside, stay away from tall objects that can attract lightning. If you are in an open area, crouch down. Stay away from water. If you are inside, stay away from windows. |
| Tornadoes | During a tornado warning, find shelter quickly in a basement or cellar. If you cannot get to a basement, go to a windowless room in the center of the building (such as a closet or bathroom). If you are outside, lie down in an open field or a deep ditch. |
| Floods | Find a high place to wait out the flood. Always stay out of floodwaters. |
| Hurricanes | Protect the windows in your home by covering them with wood. Stay inside during the storm. If you are told to leave your home, do so quickly and calmly. |

 **READING CHECK**

10. Define What is a storm surge?

 **READING CHECK**

11. Explain Why should you listen to weather reports during severe weather?

Section 3 Review

NSES ES 1i, 1j

SECTION VOCABULARY

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

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

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

tornado a destructive, rotating column of air that has very high wind speeds and that may be visible as a funnel-shaped cloud

1. **Explain** Why do thunder and lightning usually happen together?

2. **Identify** How can severe thunderstorms cause damage?

3. **Identify** Where do most tornadoes happen?

4. **Explain** Why do most tornadoes happen in the spring and early summer?

5. **Analyze** How does energy from the sun power hurricanes?

6. **Describe** When do hurricanes lose energy?

7. **Identify** Give three ways to stay safe if you are caught outside in a thunderstorm.
