

20.3 Severe Storms



Reading Focus

Key Concepts

- What is a thunderstorm?
- What causes a thunderstorm to form?
- What is a tornado?
- How does a tornado form?
- What is a hurricane?
- How does a hurricane form?

Vocabulary

- ◆ thunderstorm
- ◆ tornado
- ◆ hurricane
- ◆ eye wall
- ◆ eye
- ◆ storm surge

Reading Strategy

Identifying Cause and Effect Copy the table and complete it as you read this section.

Severe Storms		
	Causes	Effects
Thunderstorms	a. ___?___	b. ___?___
Tornadoes	c. ___?___	d. ___?___
Hurricanes	e. ___?___	f. ___?___

Severe weather has a fascination that everyday weather does not provide. For example, a thunderstorm with its jagged lightning and booming thunder can be an awesome sight. The damage and destruction caused by these storms, as well as other severe weather, can also be frightening. A single severe storm can cause billions of dollars in property damage as well as many deaths. This section discusses three types of severe storms and their causes.

Thunderstorms

Have you ever seen a small whirlwind carry dust or leaves upward on a hot day? Have you observed a bird glide effortlessly skyward on an invisible updraft of hot air? If so, you have observed the effects of the vertical movements of relatively warm, unstable air. These examples are caused by a similar thermal instability that occurs during the development of a thunderstorm. ➤ **A thunderstorm is a storm that generates lightning and thunder.** Thunderstorms frequently produce gusty winds, heavy rain, and hail. A thunderstorm may be produced by a single cumulonimbus cloud and influence only a small area. Or it may be associated with clusters of cumulonimbus clouds that stretch for kilometers along a cold front.



Figure 16 Lightning is a spectacular and potentially dangerous feature of a thunderstorm.

Section 20.3

1 FOCUS

Section Objectives

- 20.8** Explain the formation of a thunderstorm.
- 20.9** Describe the conditions needed for a tornado to form.
- 20.10** Identify the conditions that must exist for a hurricane to form.

Reading Focus

Build Vocabulary

L2

Venn Diagram Have students create a Venn diagram of hurricanes and tornadoes.

Reading Strategy

L2

- a. warm, humid air rising in an unstable environment
- b. gusty winds, heavy rain, hail
- c. associated with thunderstorms and the development of a mesocyclone
- d. violent windstorm, isolated path
- e. water temperatures warm enough to provide heat and moisture to air
- f. widespread damage as winds can reach 300 km/h

2 INSTRUCT

Thunderstorms

Use Visuals

L1

Figure 16 Ask students to look at the photograph in Figure 16. Ask: **What type of clouds is probably in the area in this photograph?** (*cumulonimbus clouds*)
Visual

Address Misconceptions

L2

Students may have heard or noticed in media photographs that many tornadoes seem to hit trailer parks. It may even seem that trailers attract tornadoes. In reality, there are possibly hundreds of very small tornadoes that touch down in the United States every year, but are not recorded because they do no damage. However, since a trailer flips over so easily in even the weakest tornado, trailers probably act as “mini tornado detectors.” This makes it seem like tornadoes are attracted to trailers, but that is because trailers are some of the only things that reveal the presence of what would otherwise be an unrecorded event.

Logical

Stages in the Development of a Thunderstorm

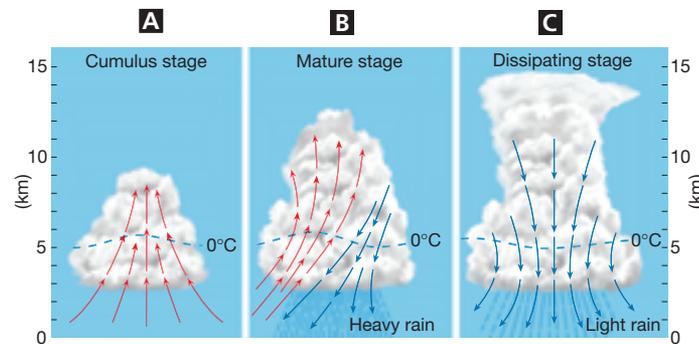


Figure 17 **A** During the cumulus stage, warm, moist air is supplied to the cloud. **B** Heavy precipitation falls during the mature stage. **C** The cloud begins to evaporate during the dissipating stage. **Observing** How do the clouds involved in the development of a thunderstorm vary?

Occurrence of Thunderstorms How common are thunderstorms? Consider these numbers. At any given time, there are an estimated 2000 thunderstorms in progress on Earth. As you might expect, the greatest number occurs in the tropics where warmth, plentiful moisture, and instability are common atmospheric conditions. About 45,000 thunderstorms take place each day. More than 16 million occur annually around the world. The United States experiences

about 100,000 thunderstorms each year, most frequently in Florida and the eastern Gulf Coast region. Most parts of the country have from 30 to 100 storms each year. The western margin of the United States has little thunderstorm activity because warm, moist, unstable maritime tropical air seldom penetrates this region.

Development of Thunderstorms 🌩️ Thunderstorms form when warm, humid air rises in an unstable environment. The development of a thunderstorm generally involves three stages. During the cumulus stage, shown in Figure 17A, strong updrafts, or upward movements of air, supply moist air. Each new surge of warm air rises higher than the last and causes the cloud to grow vertically.

Usually within an hour of the initial updraft, the mature stage begins, as shown in Figure 17B. At this point in the development of the thunderstorm, the amount and size of the precipitation is too great for the updrafts to support. So, heavy precipitation is released from the cloud. The mature stage is the most active stage of a thunderstorm. Gusty winds, lightning, heavy precipitation, and sometimes hail are produced during this stage.

Eventually, downdrafts, or downward movements of air, dominate throughout the cloud, as shown in Figure 17C. This final stage is called the dissipating stage. During this stage, the cooling effect of the falling precipitation and the flowing in of colder air from high above cause the storm to die down.

The life span of a single cumulonimbus cell within a thunderstorm is only about an hour or two. As the storm moves, however, fresh supplies of warm, humid air generate new cells to replace those that are scattering.



Reading Checkpoint Describe the stages in the development of a thunderstorm.

Customize for Inclusion Students

Behaviorally Disordered Have students work in pairs and use index cards to create a set of flashcards. Students can use the cards to support each other in small study groups. Each card should contain information about a characteristic of one of the three types of

storms in this section. One side of the card should contain the term *thunderstorm*, *tornado*, or *hurricane*. The other side should have some fact about the formation of each storm, some factors contributing to each storm, or damage done by each storm.

Tornadoes

Tornadoes are violent windstorms that take the form of a rotating column of air called a vortex. The vortex extends downward from a cumulonimbus cloud. Some tornadoes consist of a single vortex. But within many stronger tornadoes, smaller vortices rotate within the main funnel. These smaller vortices have diameters of only about 10 meters and rotate very rapidly. Smaller vortices explain occasional observations of tornado damage in which one building is totally destroyed, while another one, just 10 or 20 meters away, suffers little damage.

Occurrence and Development of Tornadoes In the United States, about 770 tornadoes are reported each year. These severe storms can occur at any time during the year. However, the frequency of tornadoes is greatest from April through June. In December and January, tornadoes are far less frequent.

Most tornadoes form in association with severe thunderstorms. An important process in the formation of many tornadoes is the development of a mesocyclone. A mesocyclone is a vertical cylinder of rotating air that develops in the updraft of a thunderstorm. The formation of this large vortex begins as strong winds high up in the atmosphere cause winds lower in the atmosphere to roll, as shown in Figure 18A. In Figure 18B, you can see that strong thunderstorm updrafts cause this rolling air to tilt. Once the air is completely vertical (Figure 18C), the mesocyclone is well established. The formation of a mesocyclone does not necessarily mean that a tornado will follow. Few mesocyclones produce tornadoes like the one shown in Figure 19 on page 574.

Formation of a Mesocyclone

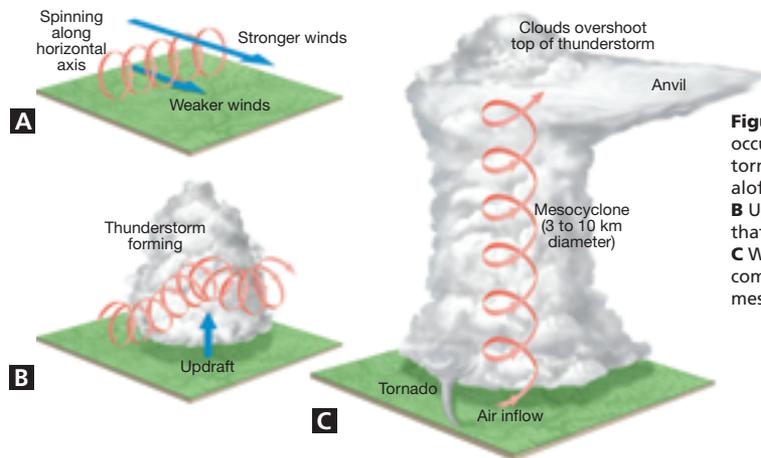


Figure 18 A mesocyclone can occur before the formation of a tornado. **A** First, stronger winds aloft cause lower winds to roll. **B** Updrafts tilt the rolling air so that it becomes nearly vertical. **C** When the rotating air is completely vertical, the mesocyclone is established.

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Facts and Figures

The largest recorded tornado was in the high plains of the Texas panhandle near the town of Gruber on June 9, 1971. At times, the tornado was nearly 4 km wide, with an average width

of about 2 km. This is probably close to the maximum size for tornadoes, but it is possible that larger, unrecorded tornadoes have occurred.



For: Links on fronts and severe weather

Visit: www.SciLinks.org

Web Code: cjn-6203



Q What is the most destructive tornado on record?

A The Tri-State Tornado, which occurred on March 18, 1925, started in southeastern Missouri and remained on the ground over a distance of 352 kilometers, until it reached Indiana. Casualties included 695 people dead and 2027 injured. Property losses were also great, with several small towns almost totally destroyed.

Tornadoes



Homemade Tornado

L2

Purpose Students will observe a visual model of a tornado.

Materials piece of sturdy cardboard; glue; 2 transparency sheets; small hand-held, battery-operated fan; small plastic bowl; clear plastic plant dish, approximately 7" in diameter with a hole cut in the middle; water; dry ice

Procedure Glue the plastic bowl to the center of the cardboard. Glue half of one of the transparency sheets to one side of the bowl. Glue the rest of the sheet in a half circle around the bowl without touching the bowl. Glue the second sheet to the opposite side of the cup in the same manner. The two sheets must overlap but not touch. Pour about half a cup of water in the cup. Using gloves, add a few small pieces of dry ice to the water. Place the plant dish upside down on top of the transparencies. Turn on the fan and place it in the hole, facing up to draw air up.

Expected Outcome Students should see the "smoke" from the dry ice form in a tornado pattern as it flows past the transparency sheets with the air being drawn up.

Kinesthetic, Visual



Download a worksheet on fronts and severe weather for students to complete, and find additional teacher support from NSTA SciLinks.

Answer to . . .

Figure 17 The clouds vary in height, the smallest being the cloud that initiates the storm.



During the cumulus stage, strong updrafts supply moist air that causes the cloud to grow vertically. Usually within about an hour of the initial updraft, heavy precipitation is released from the cloud. Gusty winds, lightning, and sometimes hail also are experienced during this stage. Eventually, downdrafts dominate throughout the cloud and the storm dies down.

Integrate
Social Studies

L2

Storm Warnings Accurate storm predictions and warnings can help to minimize the loss of property and of life. The National Weather Service has created a system to inform the public of the likelihood of a storm event in their area. They use the terms *watch* and *warning* to relay the imminent danger. A hurricane watch means that hurricanes are possible in the area within 36 hours. A hurricane warning means that hurricanes are expected in the area within 24 hours. Also a tornado watch means that conditions are favorable for a tornado in the area. A tornado warning means that a tornado has been sighted or has been seen on radar. Challenge students to devise a plan of action that should be taken during a hurricane watch and warning or a tornado watch and warning. Ask them to present their findings to the class in the form of a poster or an emergency bulletin.

Interpersonal



Figure 19 The tornado shown here descended from the lower portion of a mesocyclone in the Texas Panhandle in May, 1996.

intensity scale, shown in Table 1. Because tornado winds cannot be measured directly, a rating on this scale is determined by assessing the worst damage produced by a storm.

Tornado Safety The Storm Prediction Center (SPC) located in Norman, Oklahoma, monitors different kinds of severe weather. The SPC's mission is to provide timely and accurate forecasts and watches for severe thunderstorms and tornadoes. Tornado watches alert people to the possibility of tornadoes in a specified area for a particular time period. A tornado warning is issued when a tornado has actually been sighted in an area or is indicated by weather radar.

Table 1 Fujita Tornado Intensity Scale

Intensity	Wind Speed Estimates (kph)	Typical Damage
F0	< 116	Light damage. Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
F1	116–180	Moderate damage. Peels surface off roofs; mobile homes pushed off foundations or overturned; moving cars blown off roads.
F2	181–253	Considerable damage. Roofs torn off frame houses; mobile homes demolished; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	254–332	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
F4	333–419	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown some distance; cars thrown; large missiles generated.
F5	> 419	Incredible damage. Strong frame houses lifted off foundations and carried away; automobile-sized missiles fly through the air in excess of 100 m; bark torn off trees.

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Facts and Figures

The deadliest tornado in the United States occurred on March 18, 1925. The so-called Tri-State Tornado killed 695 people as it raced along at 96–117 km/h in a 352 km-long track across parts of Missouri, Illinois, and Indiana,

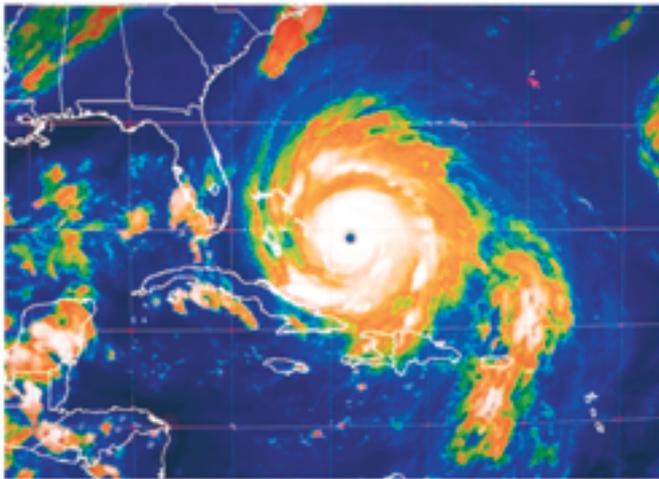
producing F5 damage. This event also holds the known record for most tornado fatalities in a single city or town: at least 234 at Murphysboro, IL.

Hurricanes

If you've ever been to the tropics or seen photographs of these regions, you know that warm breezes, steady temperatures, and heavy but brief tropical showers are the norm. It is ironic that these tranquil regions sometimes produce the most violent storms on Earth. 🌀 **Whirling tropical cyclones that produce winds of at least 119 kilometers per hour are known in the United States as hurricanes.** In other parts of the world, these severe tropical storms are called typhoons, cyclones, and tropical cyclones.

Regardless of the name used to describe them, hurricanes are the most powerful storms on Earth. At sea, they can generate 15-meter waves capable of destruction hundreds of kilometers away. Should a hurricane hit land, strong winds and extensive flooding can cause billions of dollars in damage and great loss of life. Hurricane Floyd, which is shown in a satellite image in Figure 20, was one such storm. In September 1999, Floyd brought flooding rains, high winds, and rough seas to a large portion of the Atlantic coast. More than 2.5 million people evacuated their homes. Torrential rains caused devastating inland flooding. Floyd was the deadliest hurricane to strike the U.S. mainland since Hurricane Agnes in 1972. Most of the deaths caused by Hurricane Floyd were the result of drowning from floods.

Hurricanes are becoming a growing threat because more and more people are living and working near coasts. At the close of the twentieth century, more than 50 percent of the U.S. population lived within 75 kilometers of a coast. This number is expected to increase even more in the early decades of this century. High population density near shorelines means that hurricanes and other large storms place millions of people at risk.



Q Why are hurricanes given names, and who picks the names?

A Actually, the names are given once the storms reach tropical-storm status (winds between 61–119 kilometers per hour). Tropical storms are named to provide ease of communication between forecasters and the general public regarding forecasts, watches, and warnings. Tropical storms and hurricanes can last a week or longer, and two or more storms can be occurring in the same region at the same time. Thus, names can reduce the confusion about what storm is being described.

The World Meteorological Organization creates the lists of names. The names for Atlantic storms are used again at the end of a six-year cycle unless a hurricane was particularly destructive or otherwise noteworthy. Such names are retired to prevent confusion when the storms are discussed in future years.

Figure 20 This satellite image of Hurricane Floyd shows its position off the coast of Florida a few days before the hurricane moved onto land. Floyd eventually made landfall near Cape Fear, North Carolina.

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Hurricanes

Use Visuals

L1

Figure 20 Direct students' attention to the satellite image in the figure. Ask: **What is the direction of air flow in Hurricane Floyd? (counterclockwise)**
Visual

Use Community Resources

L2

Invite students to gather first-hand reports of any significant tornadoes or hurricanes in their area. Help them identify good people to interview, and prepare questions in advance. For example: Have there been any especially severe storms in this area? When did this event occur? What damage did it do? Then have students look for quantitative records of the event's intensity, in terms of the Fujita Scale for tornadoes and the Saffir-Simpson Scale for hurricanes.
Interpersonal

Facts and Figures

Of all the hurricane-prone areas of the United States, Tampa Bay, FL, is considered one of the most vulnerable to severe flooding, damage, and loss of life in a major hurricane. There are several reasons for this. Tampa Bay is located on a peninsula with long stretches of waterfront. This makes the area one of the most densely populated in Florida, and leads to limited evacuation routes. There is also a large population of elderly people in the

area. The evacuation of this segment of the population could prove to be difficult for emergency workers. Tampa Bay's geography could also increase the effects of a storm surge; the Gulf of Mexico has a broad, shallow continental shelf on which a storm surge could build to heights great enough to destroy or damage thousands of homes and businesses. The Tampa Bay area has not received a direct hit from a major hurricane in several decades.

Build Science Skills

L2

Comparing and Contrasting Ask students to explore the similarities and differences of tornadoes and hurricanes by making a chart. They should include in their chart information on location, associated storms, pressures associated with the storm, impact on society, and maximum wind strength.

Logical

Build Reading Literacy

L1

Refer to p. 502D in Chapter 18, which provides the guidelines for visualizing.

Visualize Ask students to read the section under Development of Hurricanes on p. 576. After the first reading, instruct students to close their eyes and think of a hurricane. Have them suppose they are flying through the clouds of a hurricane and note the changes in wind velocity and pressure as they travel from one side to the other. Have students refer to Figure 21 to help them visualize their trip.

Intrapersonal

Occurrence of Hurricanes Most hurricanes form between about 5 and 20 degrees north and south latitude. The North Pacific has the greatest number of storms, averaging 20 per year. The coastal regions of the southern and eastern United States experience fewer than five hurricanes, on average, per year. Although many tropical disturbances develop each year, only a few reach hurricane status. A storm is a hurricane if the spiraling air has winds blowing at speeds of at least 119 kilometers per hour.

Development of Hurricanes A hurricane is a heat engine that is fueled by the energy given off when huge quantities of water vapor condense. 🌪️ **Hurricanes develop most often in the late summer when water temperatures are warm enough to provide the necessary heat and moisture to the air.** A hurricane begins as a tropical disturbance that consists of disorganized clouds and thunderstorms. Low pressures and little or no rotation are characteristic of these storms.

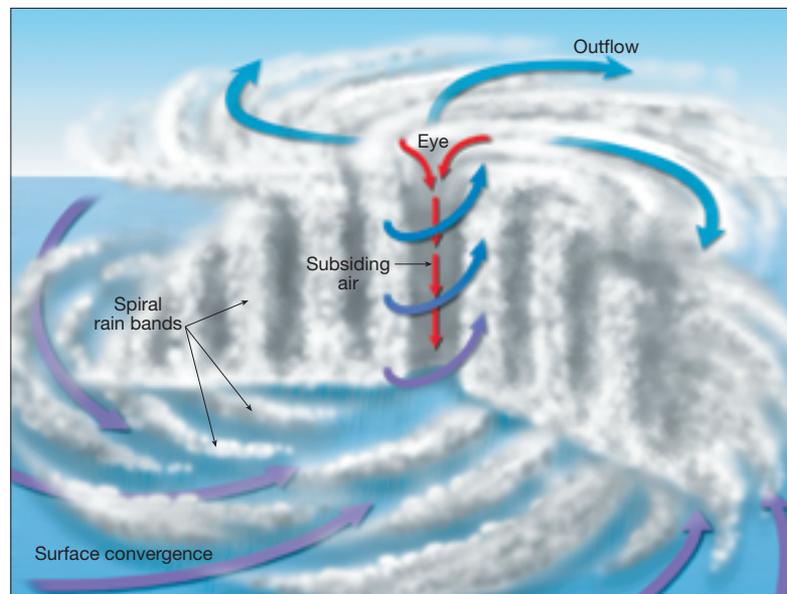
Occasionally, tropical disturbances become hurricanes. Figure 21 shows a cross section of a well-developed hurricane. An inward rush of warm, moist surface air moves toward the core of the storm. The air then turns upward and rises in a ring of cumulonimbus clouds. This doughnut-shaped wall that surrounds the center of the storm is the **eye wall**. Here the greatest wind speeds and heaviest rainfall occur. Surrounding the eye wall are curved bands of clouds that trail away

from the center of the storm. Notice that near the top of the hurricane, the rising air is carried away from the storm center. This outflow provides room for more inward flow at the surface.

At the very center of the storm is the **eye** of the hurricane. This well-known feature is a zone where precipitation ceases and winds subside. The air within the eye gradually descends and heats by compression, making it the warmest part of the storm.

Figure 21 Cross Section of a Hurricane The eye of the hurricane is a zone of relative calm, unlike the eye wall region where winds and rain are most intense.

Describing Describe the airflow in different parts of a hurricane.



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Facts and Figures

Hurricanes in the past were identified using awkward latitude/longitude methods. It became clear that the use of short, distinctive names would be quicker and less subject to error. These advantages are especially important in exchanging detailed storm information between hundreds of widely scattered stations, coastal bases, and ships at

sea. Since 1953, Atlantic tropical storms have been named from lists originated by the National Hurricane Center. The lists featured only women's names until 1979, when men's and women's names were alternated. If a storm is deadly or very costly, the name is never used again.

Hurricane Intensity The intensity of a hurricane is described using the Saffir-Simpson scale shown in Table 2. The most devastating damage from a hurricane is caused by storm surges. A **storm surge** is a dome of water about 65 to 80 kilometers wide that sweeps across the coast where a hurricane's eye moves onto land.

A hurricane weakens when it moves over cool ocean waters that cannot supply adequate heat and moisture. Intensity also drops when storms move over land because there is not sufficient moisture. In addition, friction with the rough land surface causes winds to subside. Finally, if a hurricane reaches a location where the airflow aloft is unfavorable, it will die out.

Table 2 Saffir-Simpson Hurricane Scale

Category	Sustained Wind Speeds (kph)	Typical Damage
1	119–153	Storm surge 1.2–1.5 meters; some damage to unanchored mobile homes, shrubbery, and trees; some coastal flooding; minor pier damage.
2	154–177	Storm surge 1.6–2.4 meters; some damage to buildings' roofs, doors, and windows; considerable damage to mobile homes and piers; moderate coastal flooding.
3	178–209	Storm surge 2.5–3.6 meters; some structural damage to small buildings; some large trees blown over; mobile homes destroyed; some coastal and inland flooding.
4	210–249	Storm surge 3.7–5.4 meters; severe damage to trees and signs; complete destruction of mobile homes; extensive damage to doors and windows; severe flooding inland.
5	> 249	Storm surge >5.4 meters; complete roof failure on many buildings; some complete building failure; all trees and signs blown away; major inland flooding.

Section 20.3 Assessment

Reviewing Concepts

1. What is a thunderstorm?
2. What causes a thunderstorm?
3. What is a tornado?
4. How does a tornado form?
5. What is a hurricane?
6. How does a hurricane form?

Critical Thinking

7. **Formulating Hypotheses** What kind of front is associated with the formation of tornadoes? Explain.

8. **Synthesizing** Explain why a hurricane quickly loses its strength as the storm moves onto land.

Writing in Science

Explanatory Paragraph Examine Tables 1 and 2 to contrast the damage caused by tornadoes and hurricanes. Use the data to explain why even though hurricanes have lower wind speeds, they often cause more damage than tornadoes do.

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ASSESS

Evaluate Understanding

L2

Have students make a game of concentration using the terms in the chapter and their definitions. Have groups of students write each term on separate index cards and the definition of each term on a second set of index cards. To play the game, students should shuffle all the cards together and then lay them face down in a grid. Each student takes turns flipping over two index cards. If the cards match (definition matches the term), the student can remove the cards from the grid. If the cards do not match, the student places the cards face down. After all of the cards are gone, the student who has removed the most cards wins the match.

Reteach

L1

Use Figures 17, 18, and 21 as visual aids to summarize the development of severe storms.

Writing in Science

Hurricanes generally inflict more damage because they are larger and last longer than tornadoes do.

Section 20.3 Assessment

1. A thunderstorm is a severe storm that generates lightning, thunder, gusty winds, heavy rain, and hail.
2. A thunderstorm forms when relatively warm, humid air rises in an unstable environment.
3. A tornado is a violent rotating column of air that extends downward from cumulonimbus clouds.
4. Most tornadoes form in association with severe thunderstorms.

5. A hurricane is a whirling tropical cyclone that produces wind that can reach 300 km/h.
6. A hurricane develops when water temperatures are warm enough to provide the necessary heat and moisture to the air.
7. Tornadoes often form in thunderstorms that develop along cold fronts because air masses on either side of the front have very different temperature and moisture conditions.
8. There is not sufficient moisture. The rough land surface causes winds to subside.

Answer to . . .

Figure 21 Air entering the storm from the surface is moving counterclockwise. Air within the eye region is also moving counterclockwise. Outflow, however, is moving in a clockwise direction.

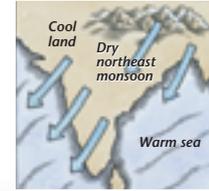


Winds and Storms

The world's atmosphere is forever on the move. **Wind**, or air in motion, occurs because solar radiation heats up some parts of the sea and land more than others. Air above these hot spots becomes warmer and lighter than the surrounding air and therefore rises. Elsewhere, cool air sinks because it is heavier. Winds blow because air squeezed out by sinking, cold air is sucked in under rising, warm air. Wind may move slowly as in a gentle breeze. In extreme weather, wind moves rapidly, creating terrifyingly destructive storms.



Southwest Monsoon
During the early summer, the hot, dry lands of Asia draw in cooler, moist air from the Indian Ocean.



Northeast Monsoon
The cold, dry winter air from Central Asia brings chilly, dusty conditions to South Asia.

MONSOONS

Seasonal winds called monsoons affect large areas of the tropics and subtropics. They occur in South Asia, southern North America, eastern Australia, and other regions of the world. In South Asia, southwest monsoons generally bring desperately needed rain from May until October.

1 FOCUS

Objectives

In this feature, students will

- explain what causes wind and what factors affect wind speed.
- describe the development of the different types of storms.
- summarize the impact of storms.

Reading Focus

Build Vocabulary

L2

Key Terms Write these key terms on the board: *wind, tornado, blizzard, tropical cyclone, typhoon, storm surge*. Ask students to define them. Then have students explain what causes wind and what factors affect wind speed.

2 INSTRUCT

Bellringer

L2

Have students read the feature caption heads that name different types of storms. Ask: **Do any of these kinds of storms occur in your region?** If so, have students estimate how frequently the storms occur. Discuss how location and regional climate account for the frequency of storms.

Verbal, Logical



THUNDERSTORMS

Thunderclouds are formed by powerful updrafts of air that occur along cold fronts or over ground heated very strongly by the sun. Ice crystals and water droplets high in the cloud are torn apart and smashed together with such ferocity that they become charged with electricity. Thunderstorms can unleash thunder, lightning, wind, rain, and hail.

LIGHTNING AND THUNDER

Electricity is discharged from a thundercloud in the form of lightning. A bolt of lightning can heat the air around it to a temperature four times as hot as the sun. The heated air expands violently and sends out a rumbling shock wave that we hear as thunder.

Customize for Inclusion Students

Gifted Explain to students that the term *tropical cyclones* is used to refer to certain hurricanes and typhoons. Have students find out how many tropical cyclones occurred last

year and make a chart with the name, dates, and location (ocean) of each storm. Post the chart in your classroom and discuss whether or not there is a pattern in the chart.

TORNADOES

Tornadoes may strike wherever thunderstorms occur. A **tornado** begins when a column of strongly rising warm air is set spinning by high winds at a cloud's top. A funnel is formed and may touch the ground. With winds that can rise above 419 kph, tornadoes can lift people, cars, and buildings high into the air and then smash them back to the ground.

IMPACT OF TROPICAL STORMS

Tropical storms are often devastating. The strongest winds, with gusts sometimes more than 249 kph, occur at the storm's center, or eye. When a tropical storm strikes land, raging winds can uproot trees and destroy buildings. Vast areas may be swamped by torrential rain, and coastal regions may be overwhelmed by a **storm surge**, a wall of water some 8 m high sucked up by the storm's eye.



These women wade through the streets of Dhaka, Bangladesh, flooded by a tropical cyclone. In 1991, a cyclone killed more than 130,000 Bangladeshis.



A Pacific typhoon struck this ship off the coast of Taiwan in November 2000. Many of the crew members fell victim to the raging sea.



BLIZZARDS

In a **blizzard**, heavy snowfall and strong winds often make it impossible to see. Winds pile up huge drifts of snow. Travel and communication can grind to a halt.

HOW TROPICAL STORMS DEVELOP

Tropical storms begin when water evaporates over an ocean in a hot tropical region to produce huge clouds and thunderstorms. When the storms cluster together and whirl around a low-pressure center, they form a **tropical cyclone**. Tropical cyclones with winds of at least 119 kph are called hurricanes in some regions and **typhoons** in other regions. The sequence below shows satellite images of an Atlantic hurricane.



Stage 1: Thunderstorms develop over the ocean.



Stage 2: Storms group to form a swirl of cloud.



Stage 3: Winds grow and a distinct center forms in the cloud swirl.



Stage 4: Eye forms. The hurricane is now at its most dangerous.



Stage 5: Eye passes over land. The hurricane starts to weaken.

Integrate Social Studies **L2**

Ask students to discuss which kind of storm seems most threatening to their community and why. Then discuss the kinds of emergency services that are in place to help in case of a storm.

Logical

B ASSESS

Evaluate Understanding **L2**

Have students compare and contrast the development of the different types of storms described in the feature (monsoons, thunderstorms, tornadoes, blizzards, and tropical cyclones). Then have students draw diagrams on the board that show how these storms form.

Reteach **L1**

Have students create flash cards for the key terms *wind*, *tornado*, *blizzard*, *tropical cyclone*, *typhoon*, and *storm surge*. Encourage them to use their flash cards to review the definitions of different types of storms.

ASSESSMENT

- Key Terms** Define (a) wind, (b) tornado, (c) blizzard, (d) tropical cyclone, (e) typhoon, (f) storm surge.
- Physical Processes** How do thunderstorms come into being?
- Economic Activities** (a) How can storms have a negative impact on economic activities? (b) How can monsoons benefit economic activities?
- Natural Hazards** How can a tropical cyclone result in the loss of thousands of lives?
- Critical Thinking Developing a Hypothesis** Since 1991, the Bangladeshi government has constructed hundreds of concrete storm shelters in coastal regions of the country. (a) Why do you think the government decided on this policy? (b) How do you think the policy has benefited the country?

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Assessment

- (a) air in motion; (b) a spinning column of air with high winds; (c) a storm with heavy snowfall and strong winds; (d) a cluster of tropical thunderstorms that whirl around a low-pressure center; (e) a tropical cyclone that has winds moving at least 74 mph (f) a wall of water sucked up by a storm's eye
- Thunderstorms are formed by powerful updrafts of air that occur along cold fronts or over heated ground. Ice crystals and

water droplets high in the cloud are torn apart and smashed together so energetically that they become charged with electricity.

3. (a) During a severe storm, economic activities may come to a halt. When property is destroyed, people spend money to replace or rebuild it. (b) Monsoons bring rain to South Asia, and rain is needed to grow crops.

4. Extremely strong winds can destroy buildings, bring torrential rain that results in floods, or cause a storm surge. Any of these can result in loss of life.

5. (a) Bangladesh is located in a region that is subject to tropical storms. The government hopes to offer shelter to the people who are most likely to be affected by the storms. (b) Sample answer: It has provided shelter for people who live in coastal areas.