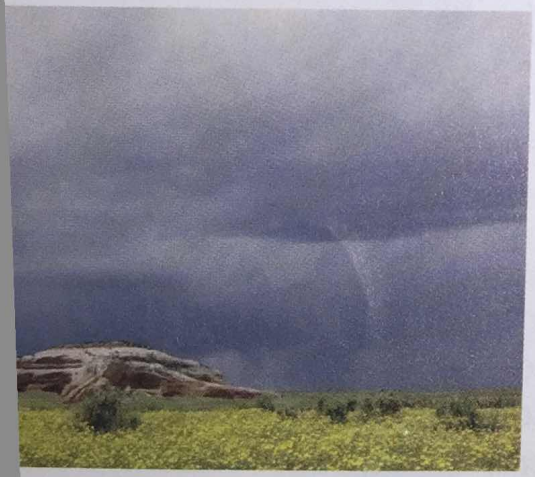
Cirrus clouds

Cumulus clouds

Stratus clouds



Types of Clouds

Clouds come in many different shapes, as shown in Figure 17. **Scientists classify clouds into three main types based on their shape: cirrus, cumulus, and stratus. Clouds are further classified by their altitude.** Each type of cloud is associated with a different type of weather.

Cirrus Clouds Wispy, feathery clouds are known as **cirrus** (SEER us) clouds. *Cirrus* comes from a word meaning a curl of hair. Cirrus clouds form only at high levels, above about 6 kilometers, where temperatures are very low. As a result, cirrus clouds are made of ice crystals.

Cirrus clouds that have feathery "hooked" ends are sometimes called mare's tails. Cirrocumulus clouds, which look like rows of cotton balls, often indicate that a storm is on its way. The rows of cirrocumulus clouds look like the scales of a fish. For this reason, the term "mackerel sky" is used to describe a sky full of cirrocumulus clouds.

Cumulus Clouds Clouds that look like fluffy, rounded piles of cotton are called **cumulus** (KYOO myuh lus) clouds. The word *cumulus* means "heap" or "mass" in Latin. Cumulus clouds form less than 2 kilometers above the ground, but they may grow in size and height until they extend upward as much as 18 kilometers. Cumulus clouds that are not very tall usually indicate fair weather. These clouds, which are common on sunny days, are called "fair weather cumulus." Towering clouds with flat tops, called cumulonimbus clouds, often produce thunderstorms. The suffix *-nimbus* means "rain."

Stratus Clouds Clouds that form in flat layers are called **stratus** (STRAT us) clouds. Recall that *strato* means "spread out." Stratus clouds usually cover all or most of the sky and are a uniform dull, gray color. As stratus clouds thicken, they may produce drizzle, rain, or snow. They are then called nimbostratus clouds.

Reading Checkpoint What are stratus clouds?

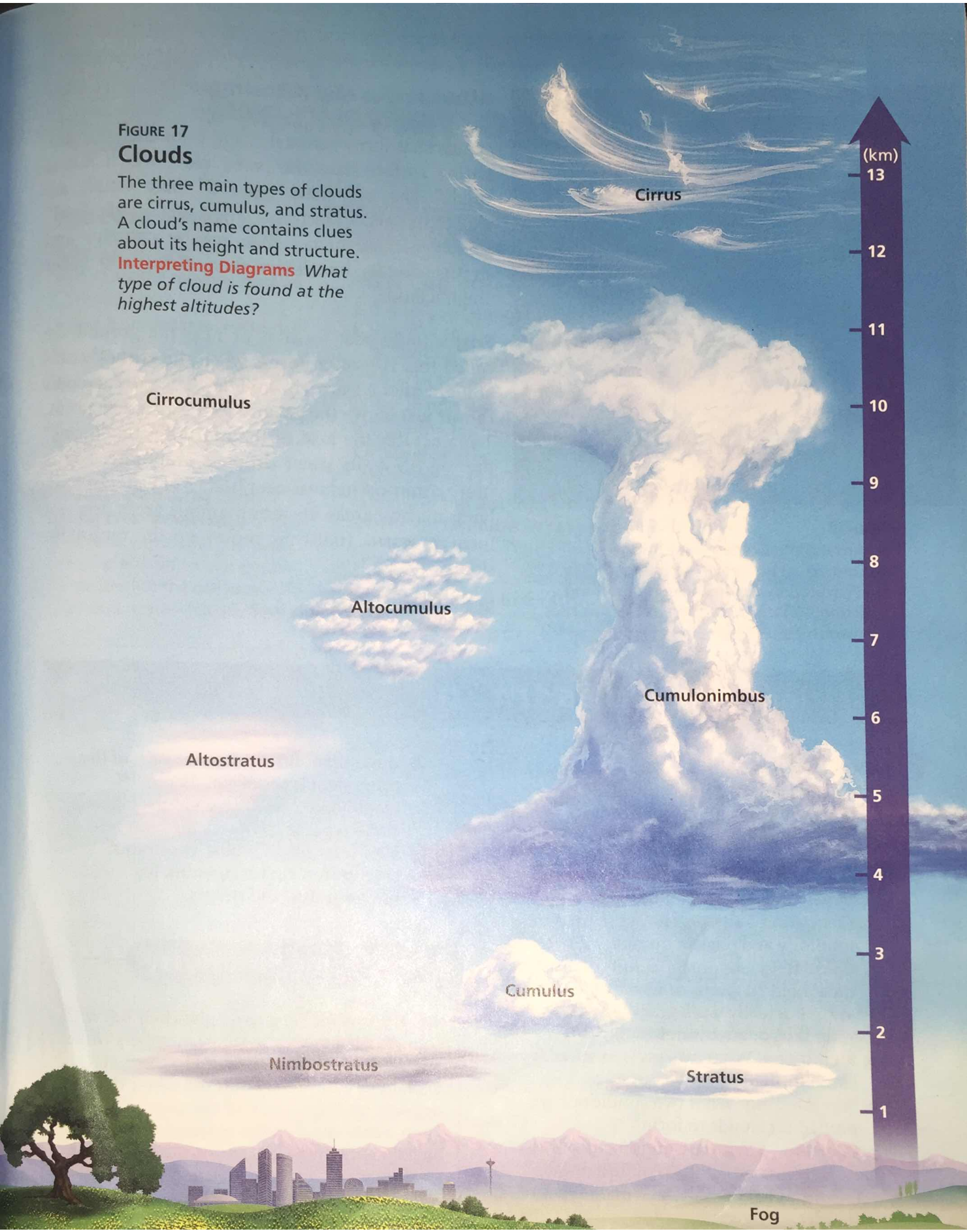


FIGURE 17

Clouds

The three main types of clouds are cirrus, cumulus, and stratus. A cloud's name contains clues about its height and structure.
Interpreting Diagrams *What type of cloud is found at the highest altitudes?*

FIGURE 18
Fog Around the Golden Gate Bridge
The cold ocean water of San Francisco Bay is often covered by fog in the early morning.
Predicting *What will happen as the sun rises and warms the air?*

Altocumulus and Altostratus Part of a cloud's name may be based on its height. The names of clouds that form between 2 and 6 kilometers above Earth's surface have the prefix *alto-*, which means "high." The two main types of these clouds are altocumulus and altostratus. These are "middle-level" clouds that are higher than regular cumulus and stratus clouds, but lower than cirrus and other "high" clouds.

Fog Clouds that form at or near the ground are called fog. Fog often forms when the ground cools at night after a warm, humid day. The ground cools the air just above the ground to the air's dew point. The next day the heat of the morning sun "burns" the fog off as its water droplets evaporate. Fog is more common in areas near bodies of water or low-lying marshy areas. In mountainous areas, fog can form as warm, moist air moves up the mountain slopes and cools.

Reading Checkpoint **What is fog?**

Types of Air Masses

Scientists classify air masses according to two characteristics: temperature and humidity. **Four major types of air masses influence the weather in North America: maritime tropical, continental tropical, maritime polar, and continental polar.**

The characteristics of an air mass depend on the temperatures and moisture content of the region over which the air mass forms. Remember that temperature affects air pressure. Cold, dense air has a higher pressure, while warm, less dense air has a lower pressure. **Tropical,** or warm, air masses form in the tropics and have low air pressure. **Polar,** or cold, air masses form north of 50° north latitude and south of 50° south latitude. Polar air masses have high air pressure.

Whether an air mass is humid or dry depends on whether it forms over water or land. **Maritime** air masses form over oceans. Water evaporates from the oceans, so the air can become very humid. **Continental** air masses form over land. Continental air masses have less exposure to large amounts of moisture from bodies of water. Therefore, continental air masses are drier than maritime air masses.

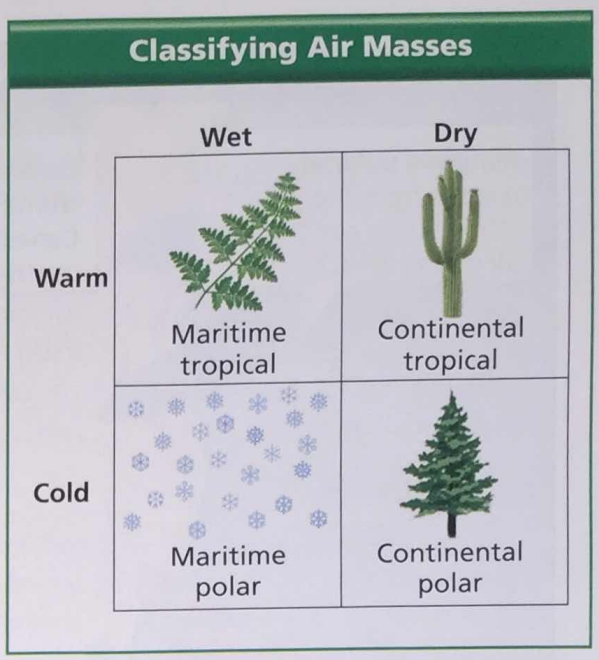
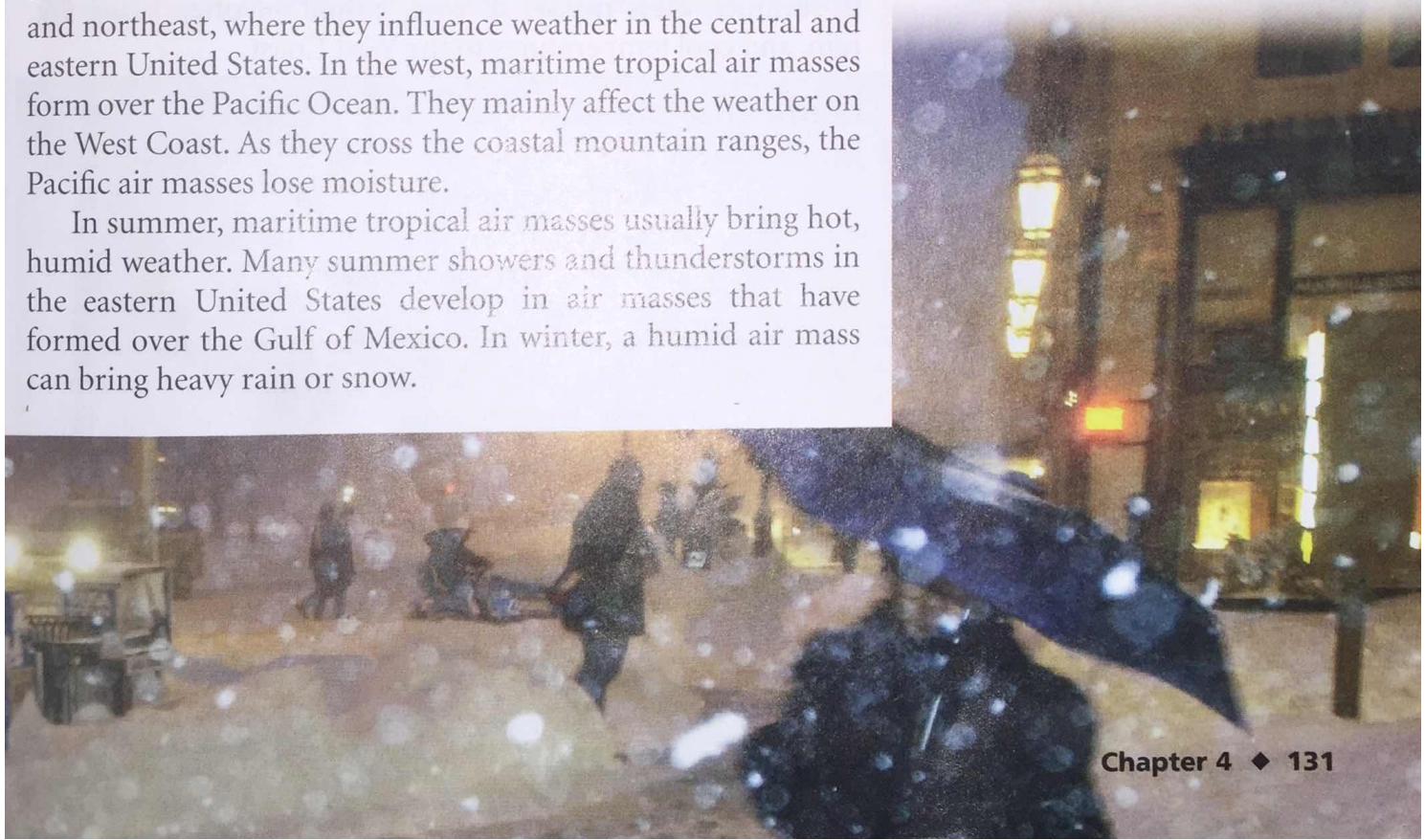


FIGURE 2
Air masses can be classified according to their temperature and humidity. **Identifying** *What type of air mass consists of warm, moist air?*

Maritime Tropical Warm, humid air masses form over tropical oceans. Maritime tropical air masses that form over the Gulf of Mexico and the Atlantic Ocean move first into the southeastern United States. These air masses then move north and northeast, where they influence weather in the central and eastern United States. In the west, maritime tropical air masses form over the Pacific Ocean. They mainly affect the weather on the West Coast. As they cross the coastal mountain ranges, the Pacific air masses lose moisture.

In summer, maritime tropical air masses usually bring hot, humid weather. Many summer showers and thunderstorms in the eastern United States develop in air masses that have formed over the Gulf of Mexico. In winter, a humid air mass can bring heavy rain or snow.



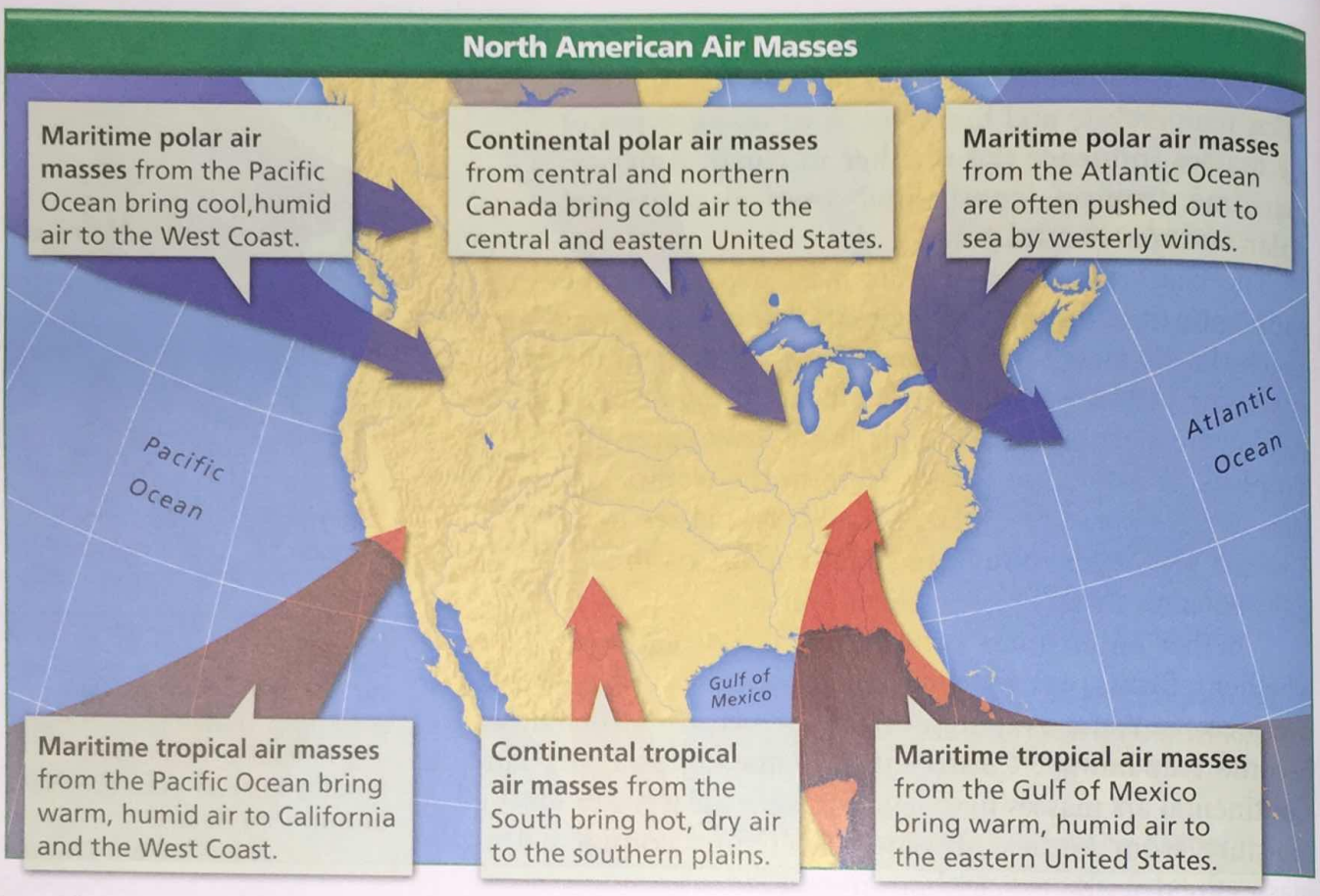


FIGURE 3
Air masses can be warm or cold, and humid or dry. As an air mass moves into an area, the weather changes.

Maritime Polar Cool, humid air masses form over the icy cold North Pacific and North Atlantic oceans. Maritime polar air masses affect the West Coast more than the East Coast. Even in summer, these masses of cool, humid air often bring fog, rain, and cool temperatures to the West Coast.

Continental Tropical Hot, dry air masses form mostly in summer over dry areas of the Southwest and northern Mexico. Continental tropical air masses cover a smaller area than other air masses. They occasionally move northeast, bringing hot, dry weather to the southern Great Plains.

Continental Polar Large continental polar air masses form over central and northern Canada and Alaska, as shown in Figure 3. Air masses that form near the Arctic Circle can bring bitterly cold weather with very low humidity. In winter, continental polar air masses bring clear, cold, dry air to much of North America. In summer, the air mass is milder. Storms may occur when continental polar air masses move south and collide with maritime tropical air masses moving north.

Reading Checkpoint **Where do continental polar air masses come from?**

How Air Masses Move

When an air mass moves into an area and interacts with other air masses, it causes the weather to change. **In the continental United States, air masses are commonly moved by the prevailing westerlies and jet streams.**

Prevailing Westerlies The prevailing westerlies, the major wind belts over the continental United States, generally push air masses from west to east. For example, maritime polar air masses from the Pacific Ocean are blown onto the West Coast, bringing low clouds and showers.

Jet Streams Embedded within the prevailing westerlies are jet streams. Recall that jet streams are bands of high-speed winds about 10 kilometers above Earth's surface. As jet streams blow from west to east, air masses are carried along their tracks.

Fronts As huge masses of air move across the land and the oceans, they collide with each other. But the air masses do not easily mix. Think about a bottle of oil and water. The less dense oil floats on top of the denser water. Something similar happens when two air masses with a different temperature and humidity collide. The air masses do not easily mix. The boundary where the air masses meet becomes a **front.** Storms and changeable weather often develop along fronts, as shown in Figure 4.

Reading Checkpoint In what direction does the jet stream move storms?

Lab zone Skills Activity

Calculating

When planes fly from west to east, they fly with the jet stream, and therefore can fly faster. When traveling from east to west, planes fly against the jet stream, and travel slower. To calculate the rate at which the planes fly, divide the distance traveled by the time it takes.

$$\text{Rate} = \frac{\text{Distance}}{\text{Time}}$$

If a plane flies from Denver, Colorado, to New York City, a distance of about 2,618 kilometers, it takes about 3 hours and 30 minutes. The return flight takes about 4 hours. Calculate the rates of air travel, in km/h, in each direction. How much extra speed does the jet stream add to the west-to-east flight?

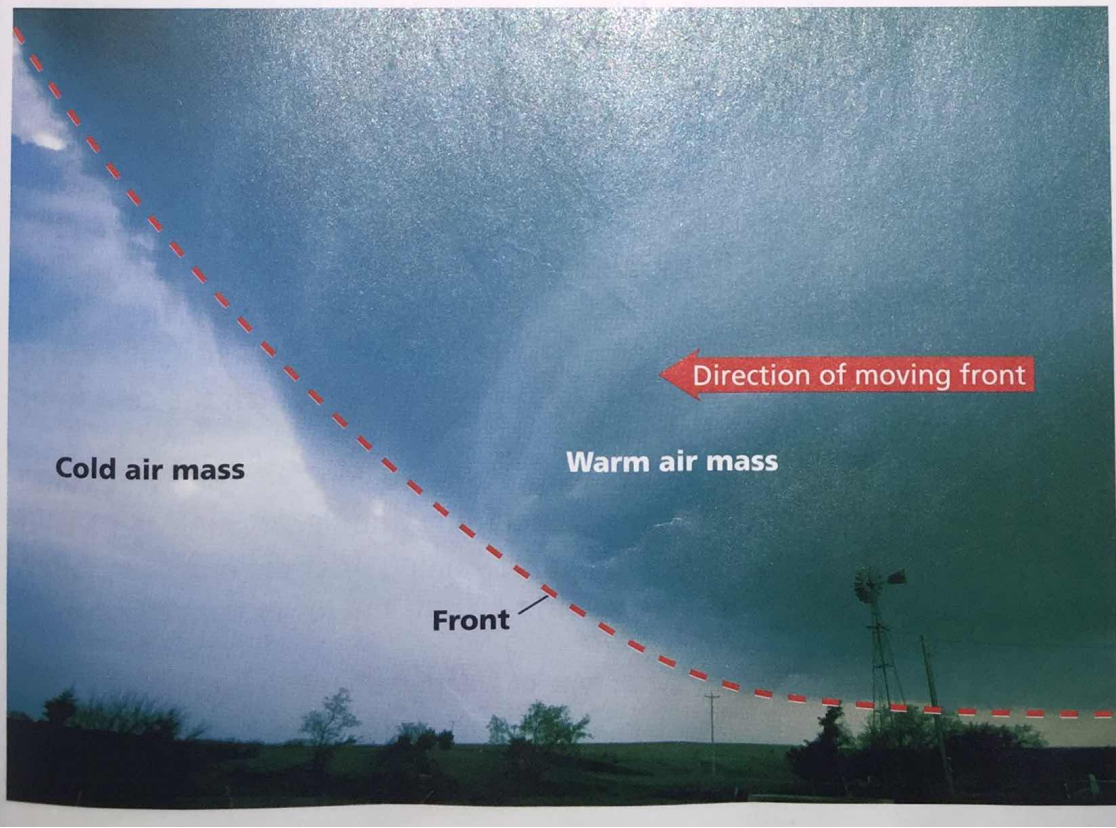
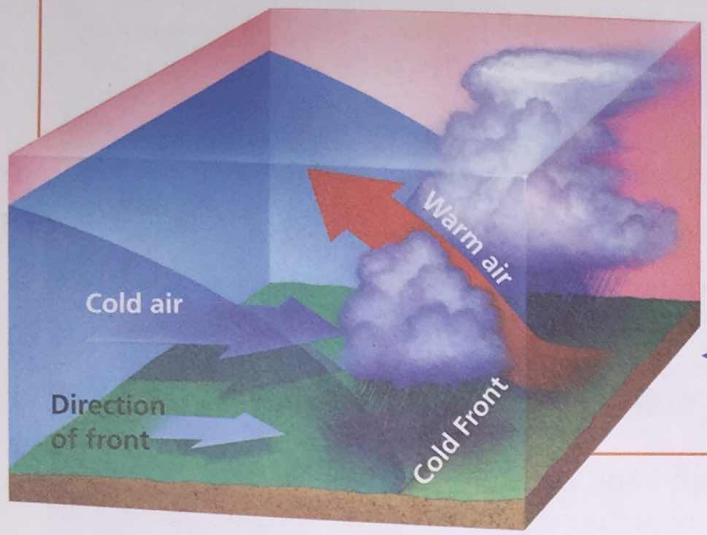


FIGURE 4
How a Front Forms
The boundary where unlike air masses meet is called a front. A front may be 15 to 600 kilometers wide and extend high into the troposphere.

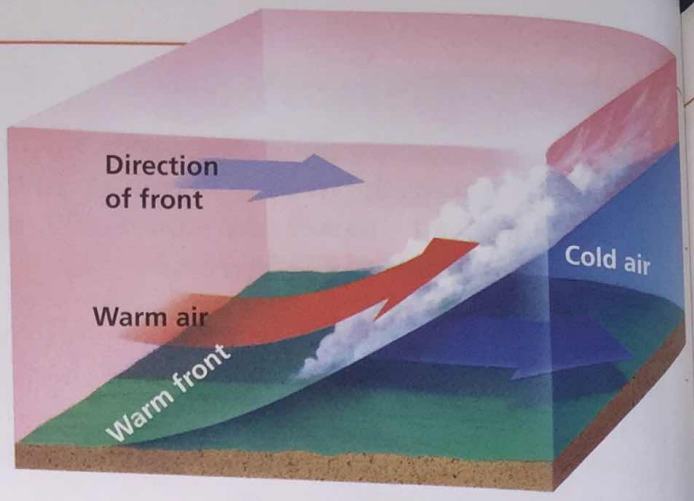
FIGURE 5

Types of Fronts

There are four types of fronts: cold fronts, warm fronts, stationary fronts, and occluded fronts. **Interpreting Diagrams** *What kind of weather occurs at a warm front?*



◀ **Cold Front**
A fast-moving cold air mass overtakes a warm air mass.



▲ **Warm Front**
A warm air mass overtakes a slow-moving cold air mass.

Types of Fronts

Colliding air masses can form four types of fronts: cold fronts, warm fronts, stationary fronts, and occluded fronts. The kind of front that develops depends on the characteristics of the air masses and how they are moving.

Cold Fronts As you have learned, cold air is dense and tends to sink. Warm air is less dense and tends to rise. When a rapidly moving cold air mass runs into a slowly moving warm air mass, the denser cold air slides under the lighter warm air. The warm air is pushed upward along the leading edge of the colder air, as shown in Figure 5. A cold front forms.

As the warm air rises, it expands and cools. Remember that warm air can hold more water vapor than cool air. The rising air soon reaches the dew point, the temperature at which the water vapor in the air condenses into droplets of liquid water or forms tiny ice crystals. Clouds form. If there is a lot of water vapor in the warm air, heavy rain or snow may fall. If the warm air mass contains only a little water vapor, then the cold front may be accompanied by only cloudy skies.

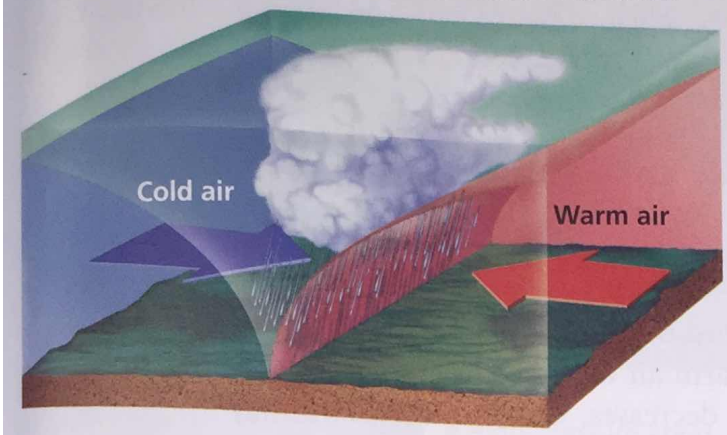
Since cold fronts tend to move quickly, they can cause abrupt weather changes, including thunderstorms. After a cold front passes through an area, colder, drier air moves in, often bringing clear skies, a shift in wind, and lower temperatures.

Reading Checkpoint **What type of weather do cold fronts bring?**

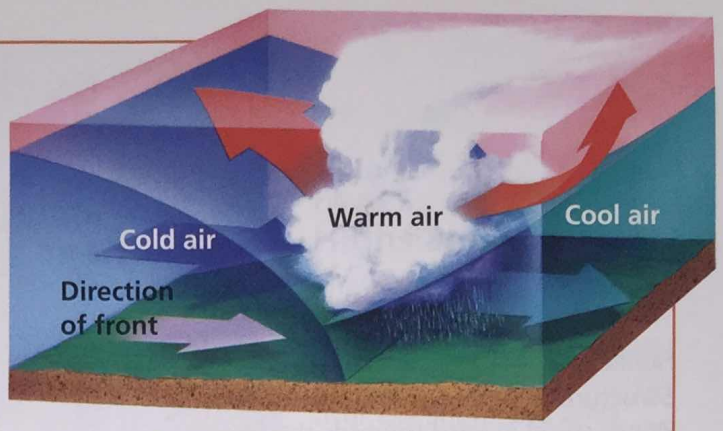
Lab zone Skills Activity

Classifying

At home, watch the weather forecast on television. Make a note of each time the weather reporter mentions a front. Classify the fronts mentioned or shown as cold, warm, stationary, or occluded. What type of weather is predicted to occur when the front arrives? Note the specific weather conditions, such as temperature and air pressure, associated with the front. Is each type of front always associated with the same type of weather?



▼ **Stationary Front**
Cold and warm air masses meet, but neither can move the other.



▲ **Occluded Front**
A warm air mass is caught between two cooler air masses.

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Warm Fronts Clouds and precipitation also accompany warm fronts. At a warm front, a fast-moving warm air mass overtakes a slowly moving cold air mass. Because cold air is denser than warm air, the warm air moves over the cold air. If the warm air is humid, light rain or snow falls along the front. If the warm air is dry, scattered clouds form. Because warm fronts move slowly, the weather may be rainy or cloudy for several days. After a warm front passes through an area, the weather is likely to be warm and humid.

Stationary Fronts Sometimes cold and warm air masses meet, but neither one can move the other. The two air masses face each other in a "standoff." In this case, the front is called a stationary front. Where the warm and cool air meet, water vapor in the warm air condenses into rain, snow, fog, or clouds. If a stationary front remains stalled over an area, it may bring many days of clouds and precipitation.

Occluded Fronts The most complex weather situation occurs at an occluded front, where a warm air mass is caught between two cooler air masses. The denser cool air masses move underneath the less dense warm air mass and push the warm air upward. The two cooler air masses meet in the middle and may mix. The temperature near the ground becomes cooler. The warm air mass is cut off, or **occluded,** from the ground. As the warm air cools and its water vapor condenses, the weather may turn cloudy and rain or snow may fall.

Cyclones and Anticyclones

As air masses collide to form fronts, the boundary between the fronts sometimes becomes distorted. This distortion can be caused by surface features, such as mountains, or strong winds, such as the jet stream. When this happens, bends can develop along the front. The air begins to swirl. The swirling air can cause a low-pressure center to form.

Cyclones If you look at a weather map, you will see areas marked with an *L*. The L stands for "low," and indicates an area of relatively low air pressure. A swirling center of low air pressure is called a **cyclone,** from a Greek word meaning "wheel."

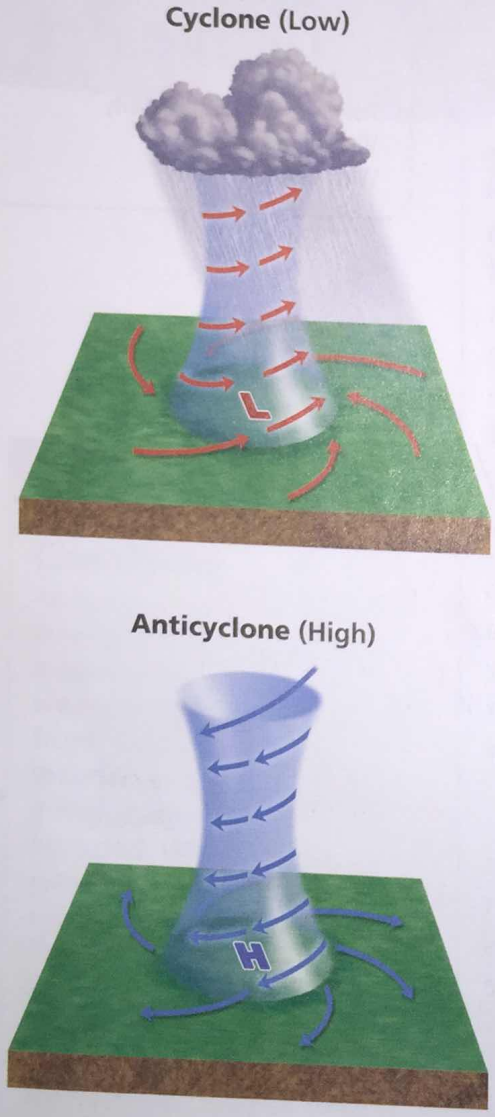
As warm air at the center of a cyclone rises, the air pressure decreases. Cooler air blows toward this low-pressure area from nearby areas where the air pressure is higher. As shown in Figure 6, winds spiral inward toward the center of the system. Recall that, in the Northern Hemisphere, the Coriolis effect deflects winds to the right. Because of this deflection, winds in a cyclone spin counterclockwise in the Northern Hemisphere when viewed from above.

Cyclones play a large part in the weather of the United States. As air rises in a cyclone, the air cools, forming clouds and precipitation. **Cyclones and decreasing air pressure are associated with clouds, wind, and precipitation.**

Anticyclones As its name suggests, an anticyclone is the opposite of a cyclone. **Anticyclones** are high-pressure centers of dry air. Anticyclones are usually called "highs"—*H* on a weather map. Winds spiral outward from the center of an anticyclone, moving toward areas of lower pressure. Because of the Coriolis effect, winds in an anticyclone spin clockwise in the Northern Hemisphere. Because air moves out from the center of the anticyclone, cool air moves downward from higher in the troposphere. As the cool air falls, it warms up, so its relative humidity drops. **The descending air in an anticyclone generally causes dry, clear weather.**

Reading Checkpoint What is an anticyclone?

FIGURE 6
Structure of Cyclones and Anticyclones
Winds spiral inward towards the low-pressure center of a cyclone. Winds spiral outward from the high-pressure center of an anticyclone.
Interpreting Diagrams *Do cyclone winds spin clockwise or counter-clockwise in the Northern Hemisphere?*



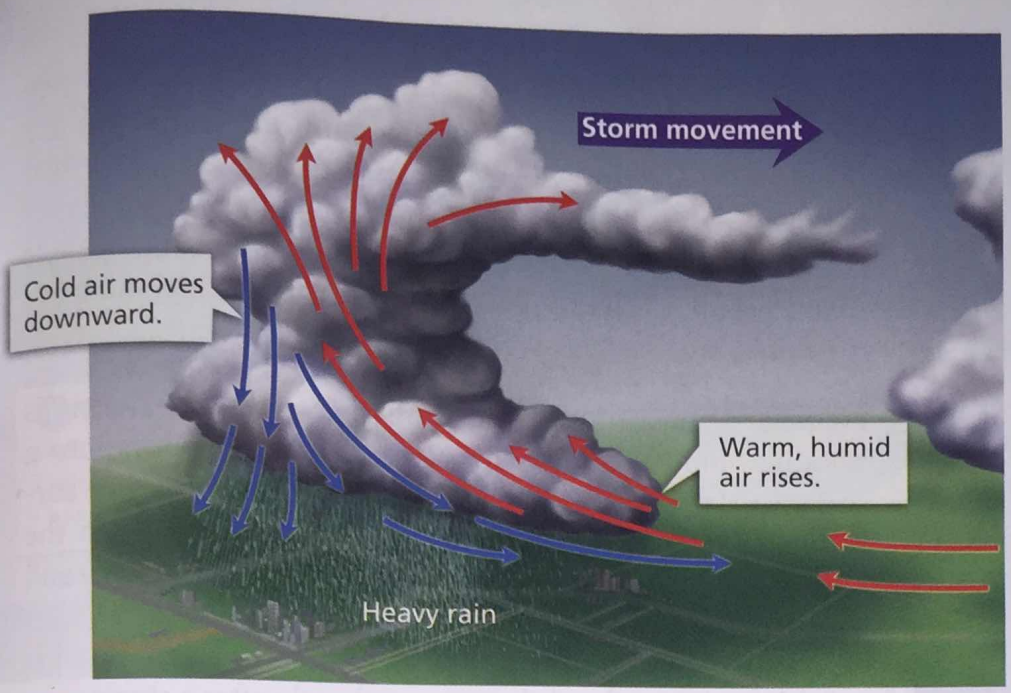


FIGURE 9
Thunderstorm Formation
A thunderstorm forms when warm, humid air rises rapidly within a cumulonimbus cloud.
Applying Concepts *Why do cumulonimbus clouds often form along cold fronts?*

Thunderstorms

Do you find thunderstorms frightening? Exciting? As you watch the brilliant flashes of lightning and listen to long rolls of thunder, you may wonder what caused them.

How Thunderstorms Form A **thunderstorm** is a small storm often accompanied by heavy precipitation and frequent thunder and lightning. **Thunderstorms form in large cumulonimbus clouds, also known as thunderheads.** Most cumulonimbus clouds form on hot, humid afternoons. They also form when warm air is forced upward along a cold front. In both cases, the warm, humid air rises rapidly. The air cools, forming dense thunderheads. Heavy rain falls, sometimes along with hail. Within the thunderhead are strong upward and downward winds—updrafts and downdrafts—as shown in Figure 9. Many thunderstorms form in the spring and summer in southern states or on the Western Plains.

Lightning and Thunder During a thunderstorm, areas of positive and negative electrical charges build up in the storm clouds. **Lightning** is a sudden spark, or electrical discharge, as these charges jump between parts of a cloud, between nearby clouds, or between a cloud and the ground. Lightning is similar to the shocks you sometimes feel when you touch a metal object on a very dry day, but on a much larger scale.

What causes thunder? A lightning bolt can heat the air near it to as much as 30,000°C, much hotter than the sun's surface. The rapidly heated air expands suddenly and explosively. Thunder is the sound of the explosion. Because light travels much faster than sound, you see lightning before you hear thunder.

Lab zone **Try This Activity**

Lightning Distances

Because light travels faster than sound, you see a lightning flash before you hear the clap of thunder. Here's how to calculate your distance from a thunderstorm.
CAUTION: *Only do this activity inside a building.*

1. Count the number of seconds between the moment when you see the lightning and when you hear the thunder.
2. Divide the number of seconds you counted by three to get the approximate distance in kilometers. Example:

$$\frac{15\text{ s}}{3\text{ s/km}} = 5\text{ km}$$

Calculating Wait for another lightning flash and calculate the distance again. How can you tell whether a thunderstorm is moving toward you or away from you?

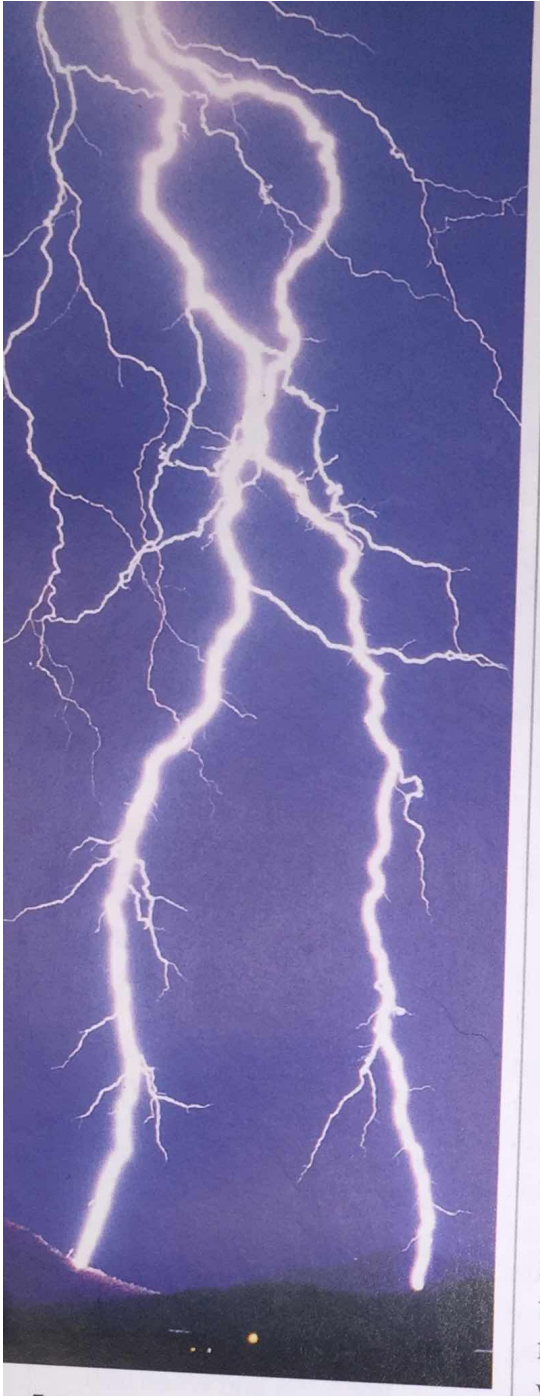


FIGURE 10
Lightning Striking Earth
Lightning occurs when electricity jumps within clouds, between clouds, or between clouds and the ground. Lightning can cause fires or serious injuries.

Thunderstorm Damage Thunderstorms can cause severe damage. The heavy rains associated with thunderstorms can flood low-lying areas. Lightning can also cause damage. When lightning strikes the ground, the hot, expanding air can shatter tree trunks or start forest fires. When lightning strikes people or animals, it acts like a powerful electric shock. Lightning can cause unconsciousness, serious burns, or even heart failure.

Floods A major danger during severe thunderstorms is flooding. Floods occur when so much water pours into a stream or river that its banks overflow, covering the surrounding land. In urban areas, floods can occur when the ground is already saturated by heavy rains. The water can't soak into the water-logged ground or the many areas covered with buildings, roads, and parking lots. A flash flood is a sudden, violent flood that occurs shortly after a storm.

Thunderstorm Safety The safest place to be during a thunderstorm is indoors. If you are inside a house, avoid touching telephones, electrical appliances, or plumbing fixtures, all of which can conduct electricity. It is usually safe to stay in a car with a hard top during a thunderstorm. The electricity will move along the metal skin of the car and jump to the ground. However, do not touch any metal inside the car. **During thunderstorms, avoid places where lightning may strike. Also avoid objects that can conduct electricity, such as metal objects and bodies of water.**

How can you remain safe if you are caught outside during a thunderstorm? It is dangerous to seek shelter under a tree, because lightning may strike the tree and you. Instead, find a low area away from trees, fences, and poles. Crouch with your head down. If you are swimming or in a boat, get to shore and find shelter away from the water.

Reading Checkpoint **How can lightning be dangerous?**

Tornadoes

A tornado is one of the most frightening and destructive types of storms. A **tornado** is a rapidly whirling, funnel-shaped cloud that reaches down from a storm cloud to touch Earth's surface. If a tornado occurs over a lake or ocean, the storm is known as a waterspout. Tornadoes are usually brief, but can be deadly. They may touch the ground for 15 minutes or less and be only a few hundred meters across. But wind speeds in the most intense tornadoes may approach 500 kilometers per hour.

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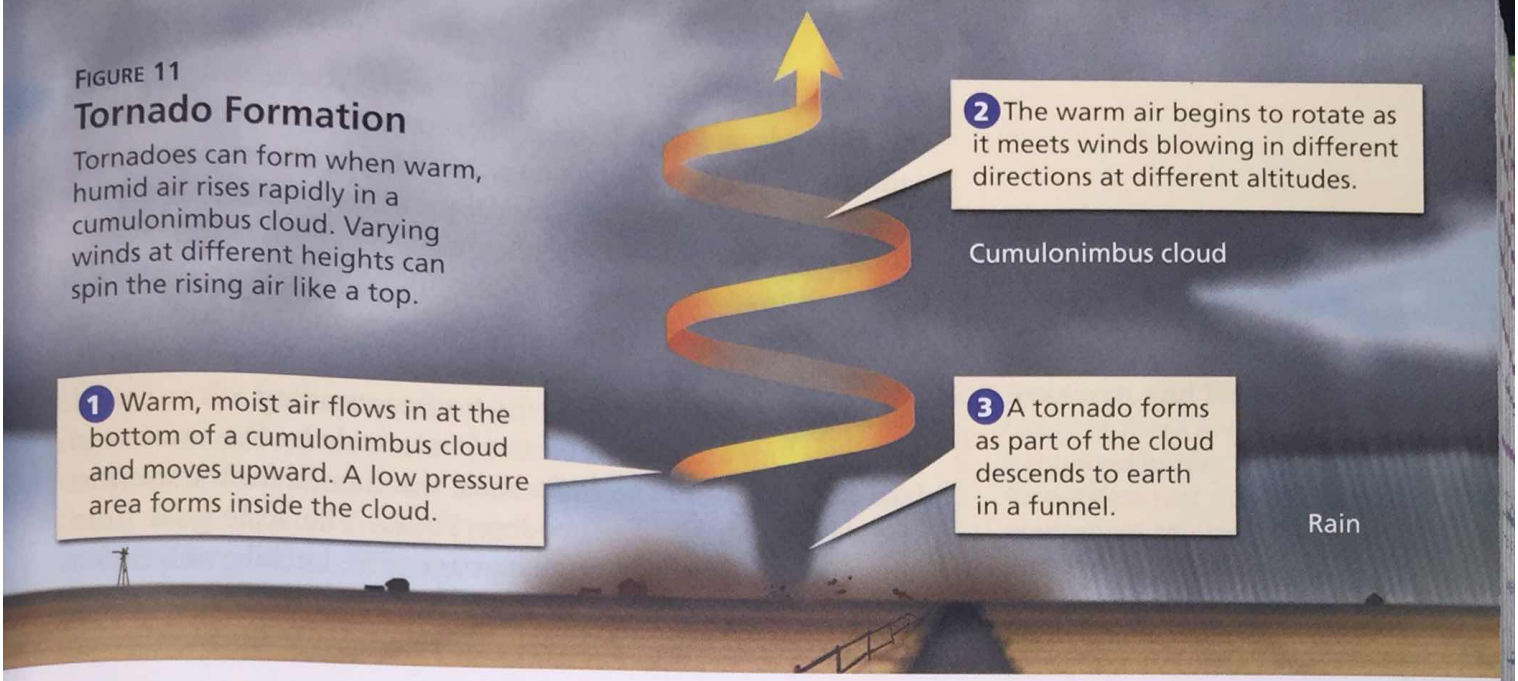
FIGURE 11
Tornado Formation
Tornadoes can form when warm, humid air rises rapidly in a cumulonimbus cloud. Varying winds at different heights can spin the rising air like a top.



How Tornadoes Form Tornadoes can form in any situation that produces severe weather. **Tornadoes most commonly develop in thick cumulonimbus clouds—the same clouds that bring thunderstorms.** Tornadoes are most likely to occur when thunderstorms are likely—in spring and early summer, often late in the afternoon when the ground is warm. The Great Plains often have the kind of weather pattern that is likely to create tornadoes: A warm, humid air mass moves north from the Gulf of Mexico into the lower Great Plains. A cold, dry air mass moves south from Canada. When the air masses meet, the cold air moves under the warm air, forcing it to rise. A squall line of thunderstorms is likely to form, with storms traveling from southwest to northeast. A single squall line can produce ten or more tornadoes.

Tornado Alley Tornadoes occur more often in the United States than in any other country. About 800 tornadoes occur in the United States every year. Weather patterns on the Great Plains result in a "tornado alley," as shown in Figure 12. However, tornadoes can and do occur in nearly every part of the United States.

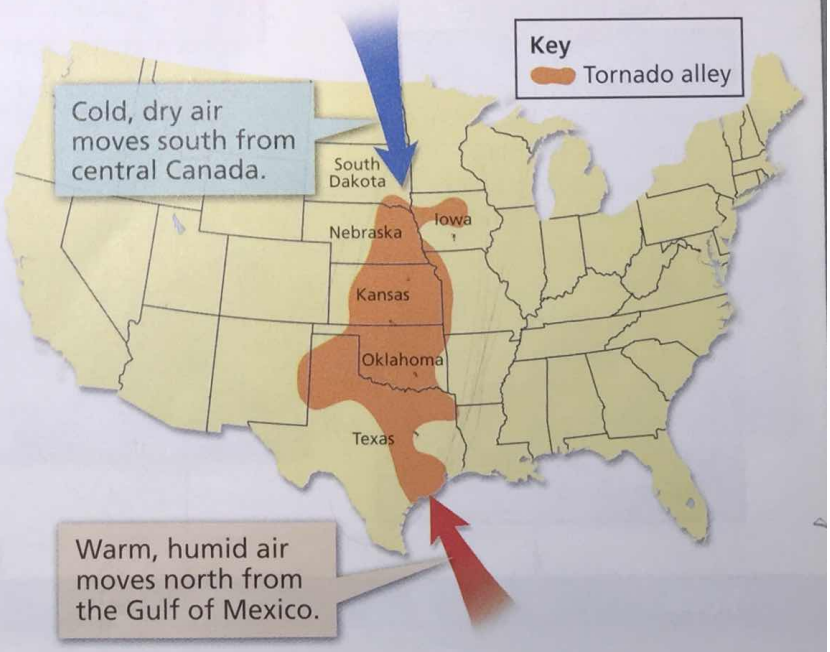


FIGURE 12
Tornado Alley
Tornadoes in the U.S. are most likely to occur in a region known as Tornado Alley. **Interpreting Maps** *Name five states that Tornado Alley crosses.*

Tornado Damage Tornado damage comes from both strong winds and flying debris. The low pressure inside the tornado sucks dust and other objects into the funnel. Tornadoes can move large objects—sheds, trailers, cars—and scatter debris many miles away. One tornado tore off a motel sign in Broken Bow, Oklahoma, and dropped it 30 miles away in Arkansas! One of the reasons that tornadoes are so frightening is that they are unpredictable. A tornado can level houses on one street but leave neighboring houses standing.

Tornadoes are ranked on the Fujita scale by the amount of damage they cause. The Fujita scale was named for the scientist who devised it, Dr. T. Theodore Fujita. The scale goes from light damage (F0) to extreme damage (F5). Luckily, only about one percent of tornadoes are ranked as F4 or F5.

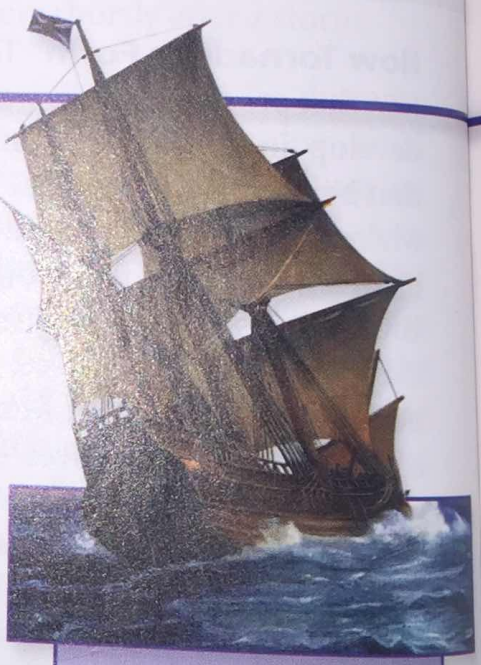
Science and **History**

Weather That Changed History

Unanticipated storms have caused incredible damage, killed large numbers of people, and even changed the course of history.

1281 Japan
In an attempt to conquer Japan, Kublai Khan, the Mongol emperor of China, sent a fleet of ships carrying a huge army. A hurricane from the Pacific brought high winds and towering waves that sank the ships. The Japanese named the storm *kamikaze*, meaning "divine wind."

1588 England
King Philip II of Spain sent the Spanish Armada, a fleet of 130 ships, to invade England. Strong winds in the English Channel trapped the Armada near shore. Some Spanish ships escaped, but storms wrecked most of them.



1620 Massachusetts
English Pilgrims set sail for the Americas in the *Mayflower*. They had planned to land near the mouth of the Hudson River, but turned back north because of rough seas and storms. When the Pilgrims landed farther north, they decided to stay and so established Plymouth Colony.

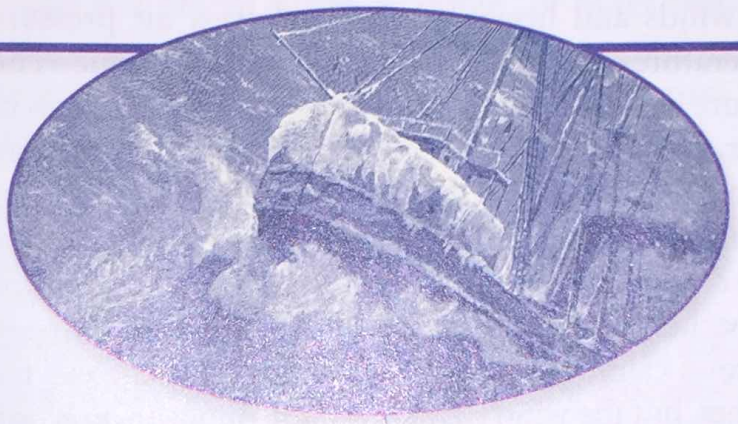
Tornado Safety What should you do if a tornado is predicted in your area? A "tornado watch" is an announcement that tornadoes are possible in your area. Watch for approaching thunderstorms. A "tornado warning" is an announcement that a tornado has been seen in the sky or on weather radar. If you hear a tornado warning, move to a safe area as soon as you can. Do not wait until you actually see the tornado.

The safest place to be during a tornado is in a storm shelter or the basement of a well-built building. If the building you are in does not have a basement, move to the middle of the ground floor. Stay away from windows and doors to avoid flying debris. Lie on the floor under a sturdy piece of furniture, such as a large table. If you are outdoors, lie flat in a ditch.

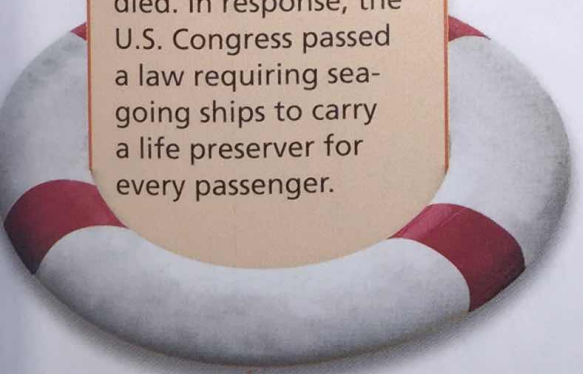
Reading Checkpoint **What is a tornado warning?**

Writing in Science

Research and Write
Many of these events happened before forecasters had the equipment to predict weather scientifically. Research one of the events in the timeline. Write a paragraph describing the event and how history might have been different if the people involved had had accurate weather predictions.

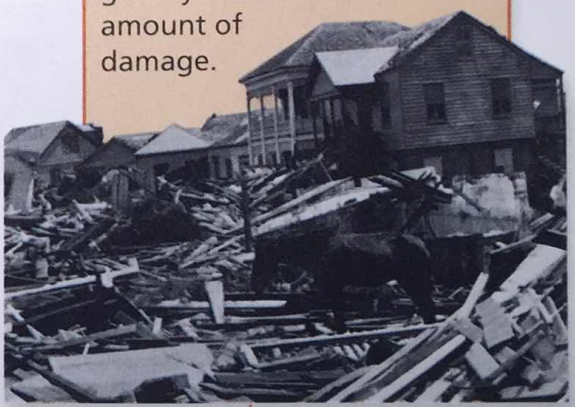


1837 North Carolina
The steamship *Home* sank during a hurricane off Ocracoke, North Carolina. In one of the worst storm-caused disasters at sea, 90 people died. In response, the U.S. Congress passed a law requiring seagoing ships to carry a life preserver for every passenger.



1870 Great Lakes
Learning that more than 1,900 boats had sunk in storms on the Great Lakes in 1869, Congress set up a national weather service, the Army Signal Corps. In 1891 the job of issuing weather warnings and forecasts went to a new agency, the U.S. Weather Bureau.

1900 and 1915 Texas
When a hurricane struck the port city of Galveston in 1900, it killed at least 8,000 people and destroyed much of the city. As a result, a seawall 5 meters high and 16 kilometers long was built. When another hurricane struck in 1915, the seawall greatly reduced the amount of damage.



Discovery CHANNEL SCHOOL

Weather Patterns

Video Preview
▶ Video Field Trip
Video Assessment

Hurricanes

A **hurricane** is a tropical cyclone that has winds of 119 kilometers per hour or higher. A typical hurricane is about 600 kilometers across. Hurricanes form in the Atlantic, Pacific, and Indian oceans. In the western Pacific Ocean, hurricanes are called typhoons.

How Hurricanes Form A typical hurricane that strikes the United States forms in the Atlantic Ocean north of the equator in August, September, or October. **A hurricane begins over warm ocean water as a low-pressure area, or tropical disturbance.** If the tropical disturbance grows in size and strength, it becomes a tropical storm, which may then become a hurricane.

A hurricane draws its energy from the warm, humid air at the ocean's surface. As this air rises and forms clouds, more air is drawn into the system. As with other storm systems, winds spiral inward toward the area of low pressure. Inside the storm are bands of very high winds and heavy rains. The lowest air pressure and warmest temperatures are at the center of the hurricane. The lower the air pressure at the center of a storm, the faster the winds blow toward the center. Hurricane winds may be as strong as 320 kilometers per hour.

Look at Figure 13. Hurricane winds are strongest in a narrow band around the center of the storm. At the center is a ring of clouds, called the eyewall, that enclose a quiet "eye." The wind gets stronger as the eye approaches. When the eye arrives, the weather changes suddenly. The air grows calm and the sky may clear. After the eye passes, the storm resumes, but the wind blows from the opposite direction.

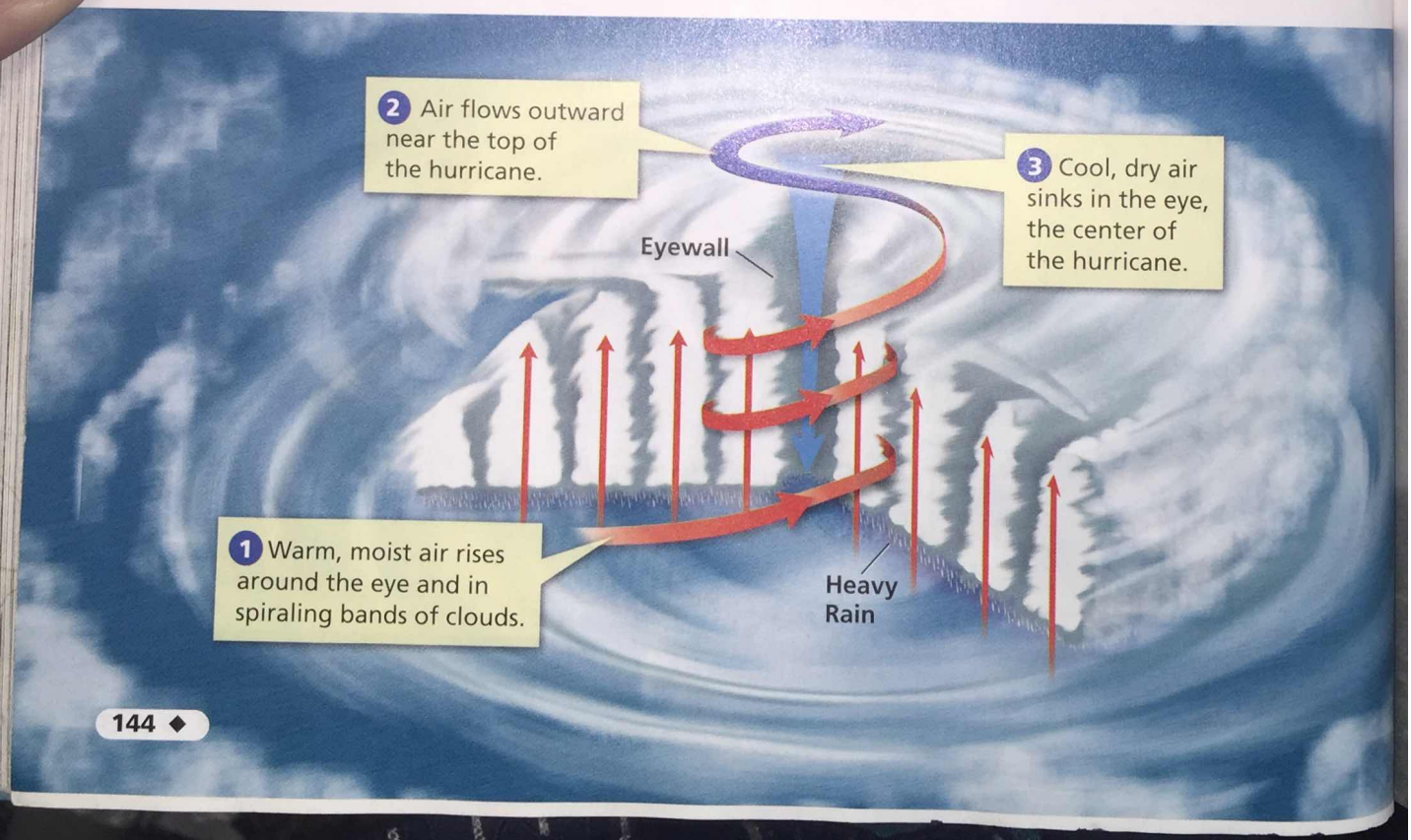


FIGURE 13
Structure of a Hurricane
In a hurricane, air moves rapidly around a low-pressure area called the eye.

How Hurricanes Move Hurricanes last longer than other storms, usually a week or more. During that period, they can travel quite a distance. Hurricanes that form in the Atlantic Ocean are steered by easterly trade winds toward the Caribbean islands and the southeastern United States. After a hurricane passes over land, it no longer has warm, moist air to draw energy from. The hurricane gradually loses strength, although heavy rainfall may continue for several days.

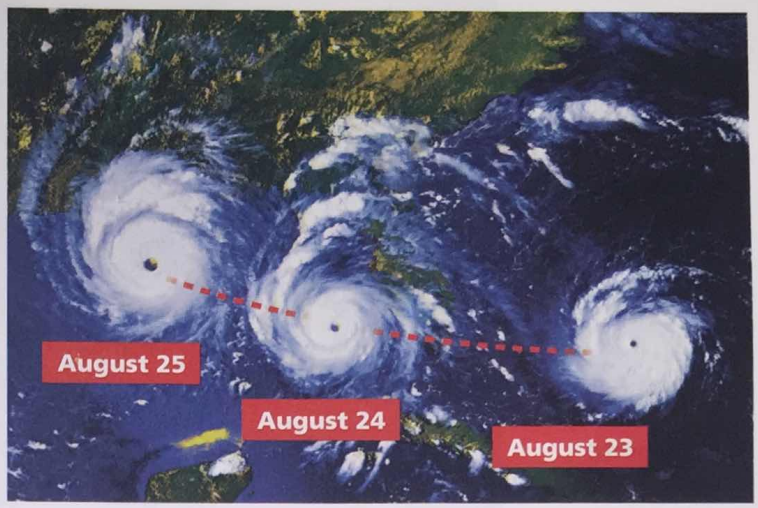


FIGURE 14
Hurricane Andrew
The path of Hurricane Andrew over three consecutive days can be seen in this photo montage.

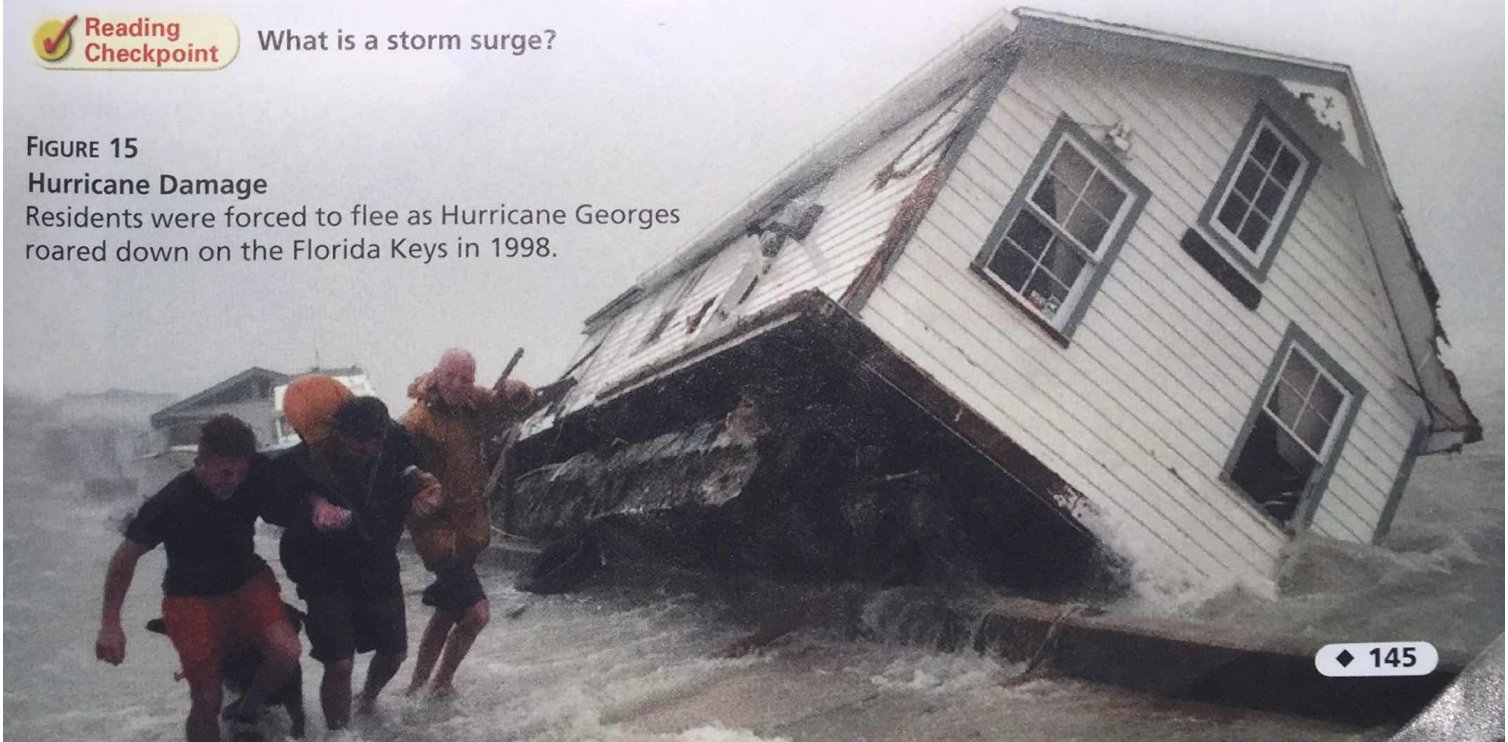
Hurricane Damage When a hurricane comes ashore, it brings high waves and severe flooding as well as wind damage. The low pressure and high winds of the hurricane over the ocean raise the level of the water up to 6 meters above normal sea level. The result is a **storm surge,** a "dome" of water that sweeps across the coast where the hurricane lands. Storm surges can cause great damage, washing away beaches, destroying buildings along the coast, and eroding the coastlines.

Hurricane Safety Until the 1950s, a fast-moving hurricane could strike with little warning. People now receive information well in advance of an approaching hurricane.

A "hurricane watch" indicates that hurricane conditions are possible in an area within the next 36 hours. You should be prepared to **evacuate** (ee VAK yoo ayt), or move away temporarily. A "hurricane warning" means that hurricane conditions are expected within 24 hours. **If you hear a hurricane warning and are told to evacuate, leave the area immediately.** If you must stay in a house, move away from the windows.

Reading Checkpoint What is a storm surge?

FIGURE 15
Hurricane Damage
Residents were forced to flee as Hurricane Georges roared down on the Florida Keys in 1998.



Winter Storms

In the winter in the northern United States, a large amount of precipitation falls as snow. **All year round, most precipitation begins in clouds as snow. If the air is colder than 0°C all the way to the ground, the precipitation falls as snow.** Heavy snowfalls can block roads, trapping people in their homes and making it hard for emergency vehicles to move. Extreme cold can damage crops and cause water pipes to freeze and burst.

Lake-Effect Snow Two of the snowiest cities in the United States are Buffalo and Rochester in upstate New York. On average, nearly three meters of snow falls on each of these cities every winter. Why do Buffalo and Rochester get so much snow?

Study Figure 16. Notice that Buffalo is located east of Lake Erie, and Rochester is located south of Lake Ontario. In the fall and winter, the land near these lakes cools much more rapidly than the water in the lakes. Although the water in these lakes is cold, it is still much warmer than the surrounding land and air.

When a cold, dry air mass from central Canada moves southeast across one of the Great Lakes, it picks up water vapor and heat from the lake. As soon as the air mass reaches the other side of the lake, the air rises and cools again. The water vapor condenses and falls as snow, usually within 40 kilometers of the lake.

FIGURE 16
Lake-Effect Snow
As cold dry air moves across the warmer water, it becomes more humid as water vapor evaporates from the lake surface. When the air reaches land and cools, lake-effect snow falls.
Interpreting Maps *Which two cities on the map receive large amounts of lake-effect snow?*

Snowstorm Safety Imagine being caught in a snowstorm when the wind suddenly picks up. High winds can blow falling snow sideways or pick up snow from the ground and suspend it in the air. This situation can be extremely dangerous because the blowing snow limits your vision and makes it easy to get lost. Also, strong winds cool a person's body rapidly. **If you are caught in a snowstorm, try to find shelter from the wind.** Cover exposed parts of your body and try to stay dry. If you are in a car, the driver should keep the engine running only if the exhaust pipe is clear of snow.

FIGURE 17
Winter Storm Damage
Major winter storms can cause a great deal of damage. Here, utility workers in Maine remove a pole snapped by a fierce winter storm.

Reading Checkpoint How can snowstorms be dangerous?

Section 2 Assessment

Target Reading Skill **Sequencing** Refer to your flowchart about hurricane formation as you answer Question 3.

Reviewing Key Concepts

1. a. **Defining** What is a thunderstorm?
   b. **Listing** List two dangers associated with thunderstorms.
   c. **Describing** What safety precautions should you follow during a thunderstorm?
2. a. **Identifying** What weather conditions are most likely to produce tornadoes?
   b. **Developing Hypotheses** Why do tornadoes occur most often in the area known as "tornado alley"?
3. a. **Defining** What is a hurricane?
   b. **Relating Cause and Effect** How do hurricanes form?
4. a. **Explaining** What is lake-effect snow?
   b. **Inferring** Why doesn't lake-effect snow fall to the north or west of the Great Lakes?
   c. **Describing** What should you do if you are caught in a snowstorm?

Lab zone At-Home Activity

Storm Eyewitness Interview a family member or other adult about a dramatic storm that he or she has experienced. Before the interview, make a list of questions you would like to ask. For example, when and where did the storm occur? Write up your interview in a question-and-answer format, beginning with a short introduction.