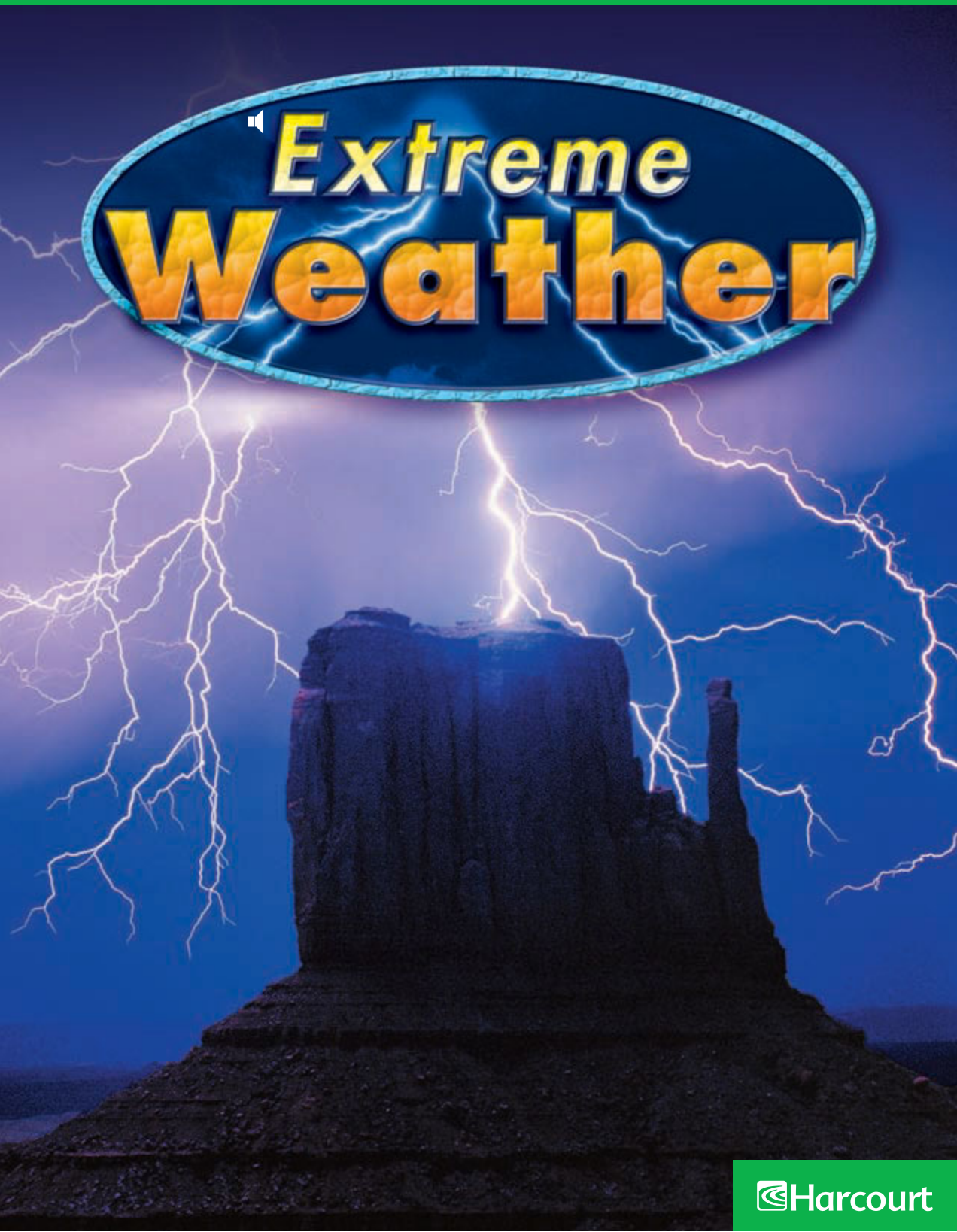

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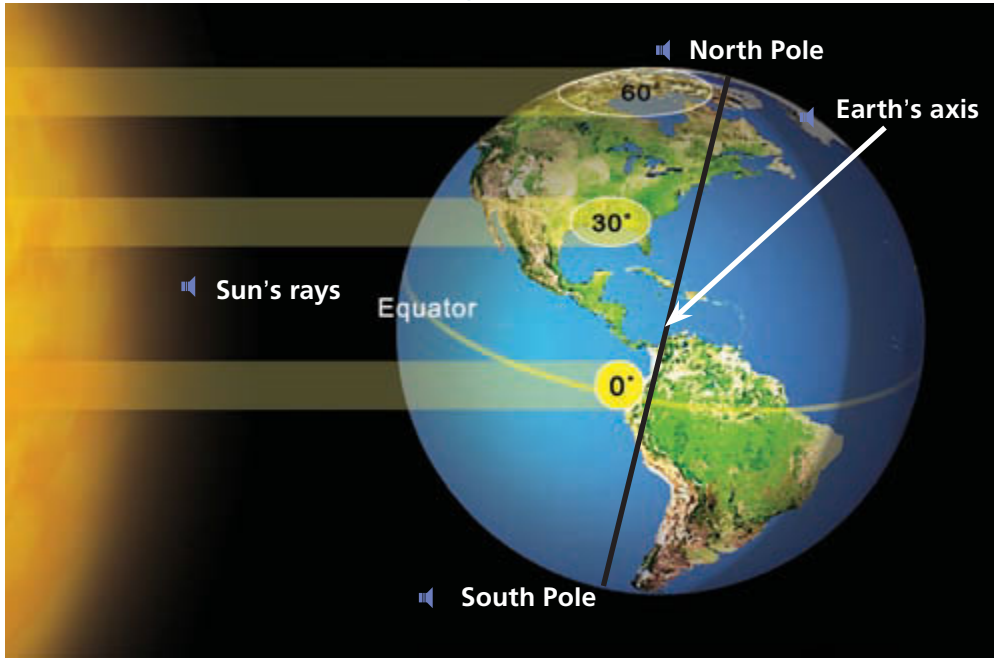
Introduction

How is the weather today? Is it good or bad? Will you have to wear a coat because it's cold or carry an umbrella because it's raining? Perhaps it will be sunny and warm. Whatever the case, the weather will affect the way you dress and the way you plan your day. Sometimes the weather is so extreme that you can't go outside at all.

Weather is the state of the air in the troposphere, the thin blanket of air that surrounds Earth. Weather includes the temperature of this air and the speed and direction with which it moves. Weather includes the amount of moisture in the air and the force with which the air presses down on Earth. Weather also includes the clouds in the sky and the rain, snow, sleet, or hail that might be falling from them.

All of Earth's weather is caused by the sun. The sun heats Earth's curved surface unevenly. Places near the equator have higher temperatures because they receive nearly direct solar energy. Farther from the equator, the sun's energy is spread out over a larger area,

Uneven heating of Earth's surface causes wind. Winds, in turn, cause changes in weather.



and the temperatures are lower. Near Earth's poles, solar energy strikes at very high angles. At the poles, the energy from sunlight is spread out over an even larger area, and this causes the temperatures to be very cold. The cold, dense air near the poles sinks and flows toward the equator. The cold air pushes up the warm air near the equator, causing it to move toward the poles. These global winds are responsible for the changes in weather that we experience nearly every day, as well as for the extreme weather that sometimes occurs on our planet.

Snow!

It's wintertime. You look out the window and see that it's snowing. The snow is falling gently and turning everything a gleaming white. You go outside to build a snowman. While you are outside, it starts snowing more heavily. The wind starts blowing. Then the snow is falling so hard that you can barely see the house across the street. You decide that you had better go indoors.

Some Historical Blizzards in the United States

Year	Storm Location	Some Storm Specifics
1717	New England	Four storms dropped nearly 1.3 meters (4 ft) of snow. Drifts were as high as 8 meters (26 ft).
1857	Much of the east coast of the U.S.	Snowfalls were nearly 0.5 meters (1.5 ft) deep. Temperatures fell to nearly –23°C (–9°F).
1967	Great Lakes area	Chicago was hardest hit. It took more than two weeks to clear snow from roads.
1996	Eastern U.S.	Snow was nearly 0.5 meters (1.5 ft) deep. Some large cities "closed" for a few days.

This is the beginning of a blizzard. A blizzard is a severe winter storm in which much snow falls or is blown around and winds reach 56 kilometers per hour (35 mi per hour) or more. A storm is a blizzard only if it lasts for more than three hours and visibility falls to less than 0.4 kilometer (0.25 mi).

Blizzards, like most extreme weather, pose many dangers. Whiteout, which is caused by falling or blowing snow, often prevents drivers from safely steering their vehicles through the storm. Drifting snow can make even major highways impassable. The cold temperatures that often accompany a blizzard can cause pipes to freeze. The weight of snow and ice can bring down electrical lines and knock out electricity for hours or days.

Another danger of winter weather is wind chill. Wind chill is how cold the air feels when the effects of wind are combined with actual air temperature. Exposure to wind chill can cause frostbite—the freezing of living tissue. If left untreated, frostbite can damage and kill tissue. Wind chill can also cause hypothermia, a condition in which the body's temperature drops too low. Hypothermia, too, can be very dangerous if not treated.

Thunder and Lightning

A thunderstorm is a storm that produces thunder, lightning, high winds, and heavy rain. Thunderstorms are so common that you might not think of them as extreme weather. But thunderstorms can cause a lot of damage, and some are even deadly.

One problem is hail. Hail is ice usually the size of peas or marbles, but some thunderstorms drop hailstones as large as grapefruits. Hailstones are painful if they hit you, and they can also destroy crops.

Floods are another common effect of thunderstorms. Flash flooding occurs when too much precipitation falls within a short period of time. When flash flooding happens, much of the precipitation runs off the land rather than sinking into the ground. This runoff forms streams

in low-lying areas. People can become stranded when they try to drive through these temporary streams. If the rain is heavy enough, it can also cause rivers to overflow their banks.

High winds are another danger of thunderstorms. Winds in the worst storms can move faster than 160 kilometers per hour (100 mi per hour)! If these winds are moving downward, they can cause problems for airplanes. If the winds are moving close to the ground, they can knock down trees and carry soil and other debris for many kilometers.

The loud sound of thunder produced in a thunderstorm is caused by lightning. Lightning occurs when opposite electrical charges build up in a storm cloud and are released. Lightning also occurs when charges build between a storm cloud and the ground, causing electricity to flow between the two areas. As lightning heats surrounding air, the sudden expansion of the air creates the sound of thunder.

Lightning is electrical energy that forms during a thunderstorm. Lightning is very dangerous. It can move within a cloud, from one cloud to another, from a cloud to the ground, or from a cloud to the air.

Because lightning is electrical energy, it is very dangerous. A single bolt of lightning can heat the nearby air many thousands of degrees. This great increase in temperature has caused many fires, especially in the western United States. Fires caused by lightning have destroyed millions of acres of forests and land.

The safest place to be during a thunderstorm is indoors. Stay away from windows. Do not use the phone unless there is an emergency. Avoid using electrical appliances until the storm is over. Do not take a bath or shower during a thunderstorm.

If you are caught outdoors, stay away from water and tall objects. If you are in a wooded area, take cover under the shortest trees. If there is no safe shelter, crouch down and make yourself as small as possible, but do NOT lie down.

Twisters!

A thunderstorm has just passed through. The rain is slackening. You decide to go outside and see whether the water has backed up in the street again. When you get outside, you see that the sky is a strange green color. You hear a sound like a freight train. You know it's time to run inside and get in the basement—a tornado is on the way.

A tornado is a rapidly spinning funnel of air that can form during a thunderstorm. Tornadoes pack the most power of any kind of weather, with winds up to 482 kilometers per hour (300 mi per hour). Fortunately, tornadoes are relatively small and do not last very long. But where they hit, they hit hard, lifting cars into the air, destroying houses, and hurling debris in every direction.

Tornadoes form as the wind in a thunderstorm changes speed and direction. Wind flowing close to the ground in one direction connects with wind that is higher up and flowing in the opposite direction. The air trapped between these winds starts spinning to form a pipe-shaped column of air parallel or nearly parallel to the ground. Then rising air in the thunderstorm tilts the column upright to form a

large vertical column called a mesocyclone. A mesocyclone may be as much as 8 kilometers (5 mi) across. It is too large and too weak to be a tornado. Sometimes the air gets pulled into a tight spin that makes a tornado. Scientists are not sure why this happens in some mesocyclones and not in others.

Tornadoes can be classified by their wind speed and the length of time they last. Most tornadoes are rather small and last for less than ten minutes. These weak storms spin at speeds of less than 176 kilometers per hour (109 mi per hour). Strong tornadoes may last 20 minutes or longer. These storms have wind speeds between about 176 and 328 kilometers per hour (109 and 204 mi per hour). The most violent tornadoes can spin for more than an hour. The wind speed in these storms is greater than 328 kilometers per hour (204 mi per hour).

Tornadoes can occur at any time and in any place, but most tornadoes in the southern United States occur between March and May. In the northern part of the country, most tornadoes form during the summer. Once they form, tornadoes can spread destruction for miles.

3 Stages of Tornado Formation

Like all storms, tornadoes form when air temperatures and pressures have reached certain points. Weather forecasters know these points, but they cannot predict where and when a tornado will form. They also cannot predict how strong a tornado will be or what kind of path it will take. They can predict only when such storms are likely to form.

If a tornado is spotted in your area, take cover immediately. If you are in a building with a basement, go there. If there is no basement, go to a central room. If possible, get under a piece of sturdy furniture. Stay away from windows.

If you are outside in a car, a bus, or another motor vehicle, do not try to outrun the tornado. If possible, leave the vehicle and lie flat in a nearby ditch. Protect your head by covering it with your hands and arms.

The Greatest Storms On Earth

The largest storms on Earth are hurricanes. A hurricane is a violent storm that forms over tropical oceans and usually dies out after it reaches land. Hurricanes are fueled by high humidity, or

Some Recent, Very Destructive Hurricanes

Year	Storm Name	Some Storm Specifics
1989	Hugo	Destroyed many houses, crops, and boats and caused $7 billion in damage
1992	Andrew	Destroyed buildings in south Florida and caused $26.5 billion in damage
1998	Mitch	Killed more than 7000 people in Central America
2004	Charley, Frances, Ivan, Jeanne	Caused as much as $14 billion in damage and nearly three dozen deaths in Florida

moisture in the air. A hurricane begins as a group of thunderstorms over a warm ocean. If conditions are right, winds begin to blow around a central point. Water vapor condenses, causing air pressure to fall. The air around the central point rises, expands, and then cools. As more and more air rises, the temperature in the center of the storm rises. This causes pressures near the center of the storm to fall. At the same time, air pressures near the top of the storm begin to rise. This causes air to flow outward from the center of the storm. If wind speeds reach 119 kilometers per hour (74 mi per hour), the storm is called a hurricane.

The center of a hurricane is called the eye. This area contains sinking air and light winds, but no clouds. The hurricane's eye is the calmest part of the storm. Around this calm center is a ring of severe thunderstorms. This part of the storm is called the eyewall. At the very top of the eyewall, air is forced outward from the storm. The fierce winds and rains associated with a hurricane form in the eyewall.

Hurricane Mitch, shown here, was one of the most destructive hurricanes of the late 1990s.

Hurricanes can cover hundreds of miles and move more slowly than tornadoes. Unlike the path of a tornado, the path of a hurricane can be predicted. If a hurricane is approaching an area, weather forecasters issue a hurricane watch. During a watch, anything that can be carried away by a hurricane's strong winds should be brought indoors. Windows should be covered with shutters or sheets of plywood. People need to prepare for the coming storm by making sure they have fuel for cars and trucks in case they need to evacuate the area. They should buy canned foods and drinking water to have during and after the hurricane. These items should be put in one secure place along with fresh batteries and first aid supplies. During a hurricane watch, be prepared to leave the area if necessary.

When a hurricane is likely to hit your area, a warning is issued. During a warning, listen to the radio for information about what to do. If officials tell people to leave an area, take your supplies and follow the proper route. If you are not advised to leave the area, stay indoors and away from windows. Continue to listen to the radio for official advice.

Remember that the eye is the calm part of a hurricane. As the eye passes over an area, many people incorrectly think that the hurricane has ended. Be aware that the worst part of the storm, which could include tornadoes, is still to come.

Dangerously Dry Droughts

Blizzards, thunderstorms, and hurricanes all mean that too much precipitation is falling in a very short time. The opposite can also happen. If too little precipitation falls, everything can dry out and die from lack of water. Such extremely dry periods are called droughts.

Some droughts last for only one season. These droughts are the result of less than normal amounts of rain. Seasonal droughts usually affect only small parts of a country or continent. Some droughts, however, are permanent. These droughts are common in very dry

A drought is a long, dry period that can cause water shortages for people and other living things.

climates and can affect very large regions. Another type of drought has been called an invisible drought. Invisible droughts occur when the amount of rainfall is normal but the amount of water that evaporates is greater than normal.

During a drought, people do not have enough water to meet their needs. People cannot get enough water for drinking and cooking. Farmers are unable to grow enough crops. Plants and animals also suffer during droughts. Most plants survive drought by slowing down their growth processes. Some plants drop leaves to conserve water. During a drought, some animals rely on eating more food to get the water they need.

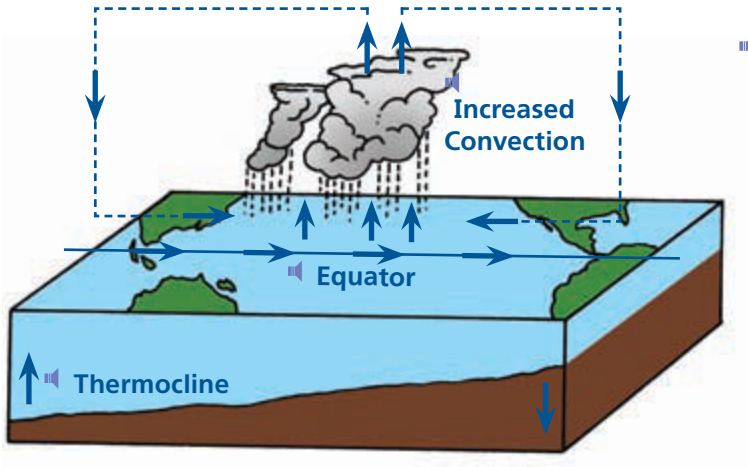
El Niño and La Niña

El Niño is Spanish for "the little boy." This term is used to describe a weather change that occurs every two to seven years in parts of the Pacific Ocean near the equator. This type of weather was first noticed by South American fishers at Christmas time, so they called it El Niño—their name for the Christ child. El Niño is a period during which certain parts of the ocean are warmer than usual. During El Niño, the winds that blow from east to west weaken. This causes ocean currents that normally move to the west to cease. This lack of surface water movement prevents colder water from moving upward through the ocean.

El Niño causes different weather changes in different places. For areas of Africa and Australia, El Niño has caused severe droughts. These droughts have led to a rise in the number of forest fires because the land became very dry. In California and Peru, El Niño has caused heavy rains that resulted in deadly mudslides and flooding. In the northeastern United States, El Niño has brought milder than normal winters. El Niño can also reduce the number of hurricanes that form.

La Niña, as you have probably guessed, is Spanish for "the little girl." Like El Niño, La Niña is a weather change that occurs in some parts of the Pacific Ocean near the equator. Unlike El Niño, La Niña is a period during which parts of the ocean are colder than usual. During La Niña, the winds that blow from east to west are stronger than usual. This causes ocean currents that normally move to the west to strengthen.

Like El Niño, La Niña causes different weather changes in different places. For example, La Niña has caused both winter and summer in western Africa to be cooler than usual. Along the southeastern tip of Africa, La Niña caused cooler winter weather that was also wetter than normal. In parts of India, La Niña has caused some summer weather to be much wetter and cooler than normal. In the United States, La Niña has brought cooler winter weather to the northwest and warmer winter weather to the states along the Gulf of Mexico.



El Niño causes parts of the Pacific Ocean to be warmer than normal.

Think and Respond

1. Explain what causes weather.
2. What is a blizzard?
3. What are the major parts of a hurricane?
4. **Expository Writing** Write a paragraph describing how a tornado forms and what to do if one is spotted in your area.

Hands-On Activity

Weather Collage Make a collage of photographs that show some of the severe weather that has struck your area over the past 50 years. Include a brief caption near each picture that identifies the weather event or its effects and the year of the event or effects.

School-Home Connection

Severe Weather Plan With an adult, prepare a severe weather action plan that will help you and your family be prepared should severe weather strike your area. If you need help, contact the American Red Cross for information on what to do before, during, and after a severe storm or other weather event.

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