

Clouds, Wind, and Storms

A Science A-Z Earth Series

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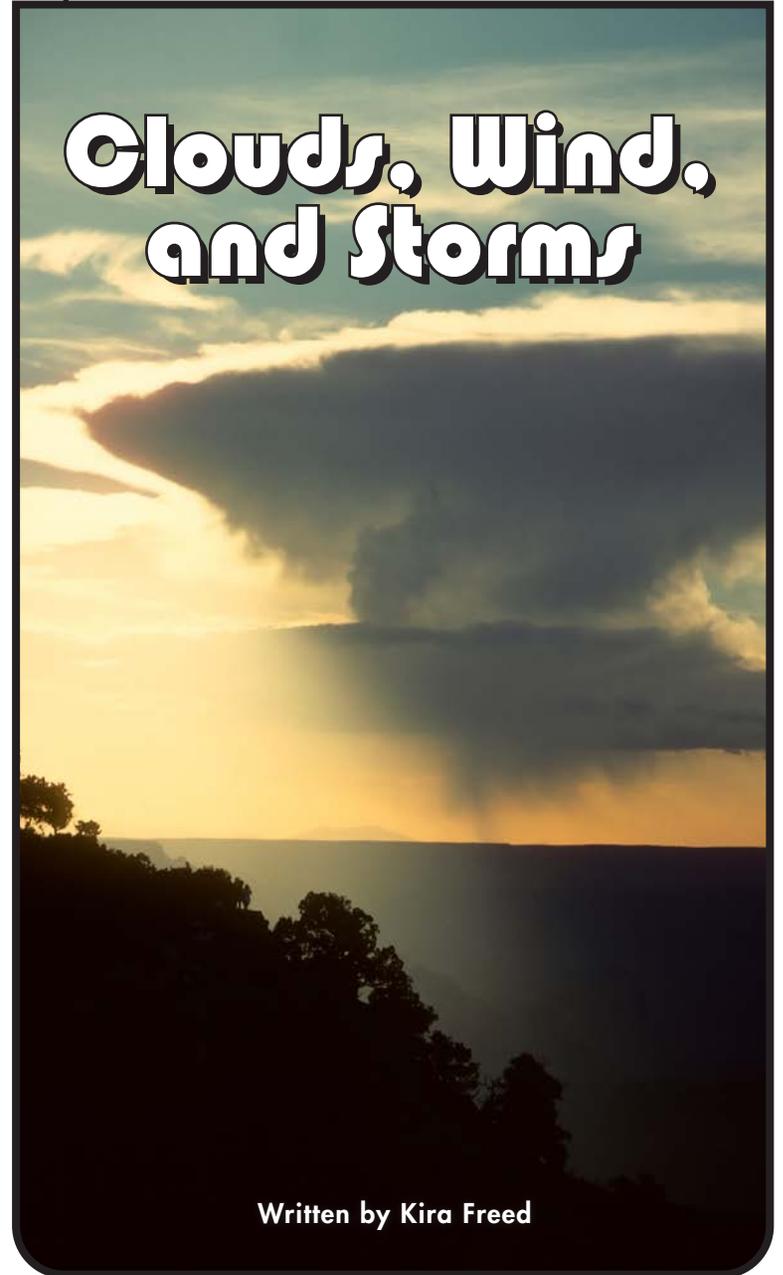
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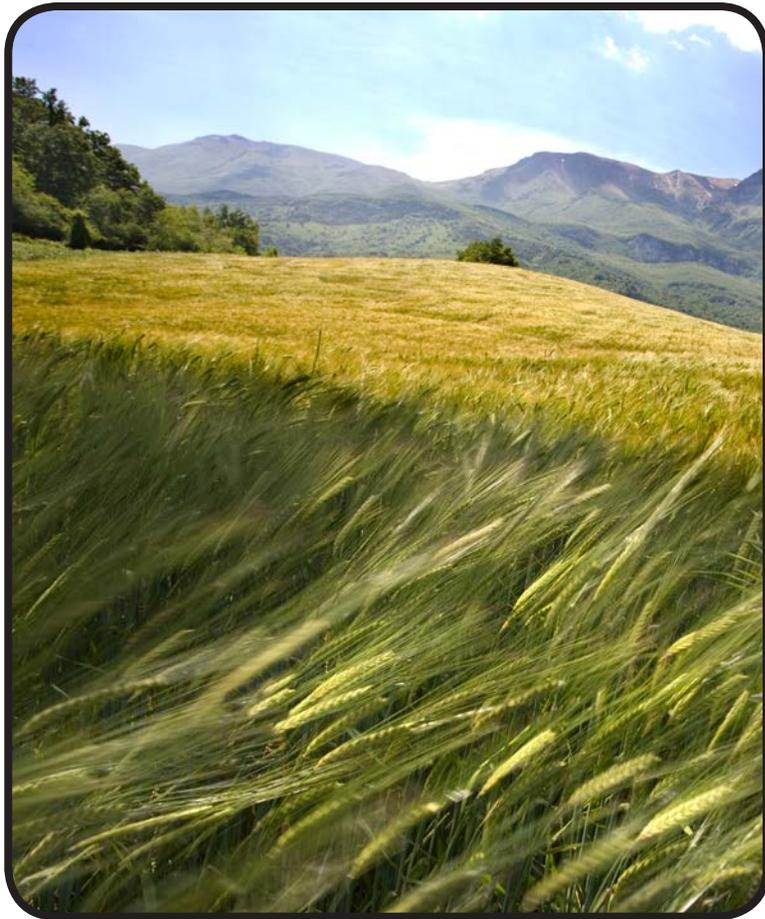
Clouds, Wind, and Storms



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KEY ELEMENTS USED IN THIS BOOK

The Big Idea: Everywhere on Earth, all the time, some type of weather is occurring. Air masses mix to create clouds, wind, and precipitation. It may be clear one day but cloudy the next. It can be snowing in one place while it is warm and sunny elsewhere. Experts are now able to better predict the weather in advance, giving us information we need to plan our activities. We often select activities, clothing, and a place to live based upon weather. Understanding the weather can also prepare us to take precautions that will keep us safe in the event of severe weather.

Key words: air pressure, atmosphere, blizzard, cirrus, cloud, condense, cumulus, evaporate, forecast, front, gas, hail, hurricane, lightning, liquid, precipitation, rain, sleet, snow, solid, stratus, temperature, thermometer, thunderstorm, tornado, water vapor, wind

Key comprehension skill: Main idea and details

Other suitable comprehension skills: Compare and contrast; classify information; cause and effect; identify facts; elements of a genre; interpret graphs, charts, and diagrams

Key reading strategy: Using a glossary and boldfaced words

Other suitable reading strategies: Connect to prior knowledge; ask and answer questions; summarize; visualize; using a table of contents and headings

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Reading Levels

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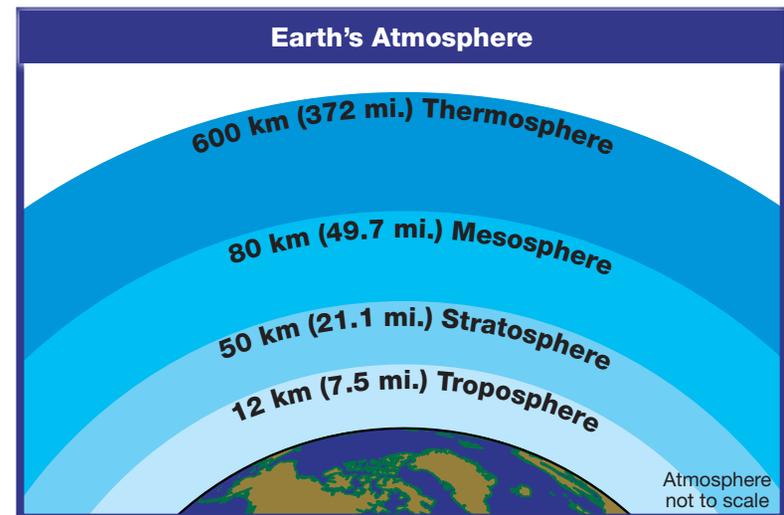
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Introduction

Somewhere on Earth, almost every kind of weather is happening right now. Did you ever wonder what causes all these kinds of weather?

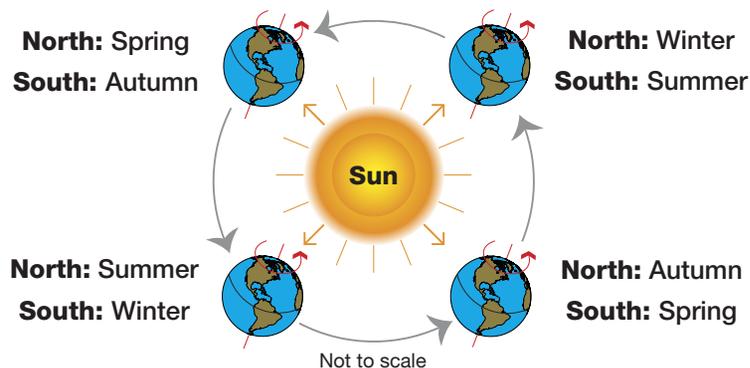
Around Earth is a layer of air called the **atmosphere**. The atmosphere is made of different kinds of air—warm, cold, dry, and wet. When different kinds of air move and mix with each other, it causes **wind, clouds, precipitation, and storms**.



Earth's atmosphere extends 600 kilometers (372 mi.) above the ground. Most weather happens in the lowest layer.

Weather happens in the part of the atmosphere closest to Earth's surface. The Sun's energy hits the ground and turns to heat. Then the air above the ground heats up. Some air becomes warmer than other air. When warm and cool air mix, the result is weather.

Some parts of Earth get more energy than others. The air closer to the equator gets warmer than the air at the poles. Also, dark areas absorb more heat than light areas. Finally, different places get more sunlight than others during different seasons.

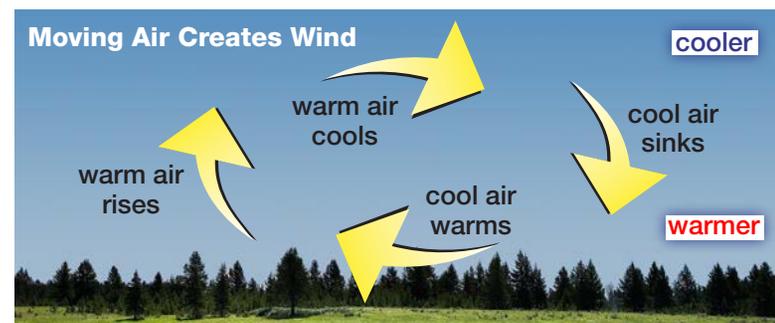


The northern half of Earth is tilted toward the Sun in June, July, and August, which creates summer. The southern half is tilted toward the Sun in December, January, and February. While North Americans and Europeans are enjoying summer, it's winter in Australia.

Wind

Wind is moving air. We can't see it, but we can feel it. And we can see how it moves plants, flags, and other things.

Air moves because warm air is lighter than cold air. Air near the ground gets warmed up by the ground's heat. The warm air gets lighter, so it rises. Then colder, heavier air takes its place near the ground. The air that was warm starts to cool off higher in the atmosphere. Then as the cold air close to the ground becomes warmer, it rises. Now other cold air moves in to take its place. The cycle of heating and cooling of air makes wind.



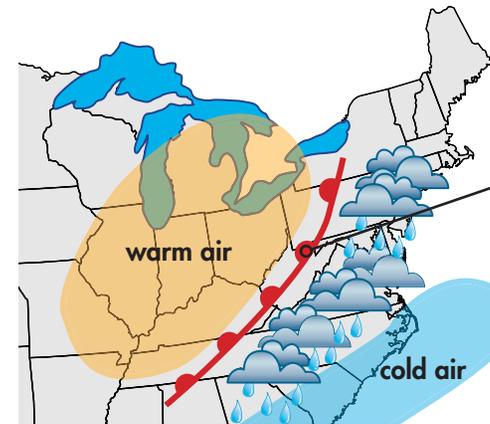


Chicago gets its nickname—the Windy City—from the breezes that blow off Lake Michigan.

Think about Chicago, which is on Lake Michigan. When the Sun shines, the air over land heats up more than the air over water. As warm air over the city rises, cooler air over the lake moves toward the land to take the place of the rising warm air. This causes a breeze from the lake to the land.

Why is wind strong sometimes and just a light breeze at other times? Wind gets stronger as the difference in temperature between warm air and cool air becomes greater.

Changes in weather happen when air of different temperatures meets. The line where the warm and cold air meet is called a **front**. Fronts are where weather changes often start.



Warm Front

A warm front is where warm air meets colder air. Storms often occur along a front.

MEASURING THE WIND

We measure the wind with an anemometer. Why do people measure the wind? Here are some of the reasons.

- Wind speeds help scientists predict the weather.
- Pilots cannot take off or land if the wind is strong.
- Ship captains need safe winds to enter harbors.
- Machines called *wind turbines* change wind into electricity. In some places, the wind is too calm to use wind turbines.





Water (liquid)

Ice (solid)

Water vapor (gas)

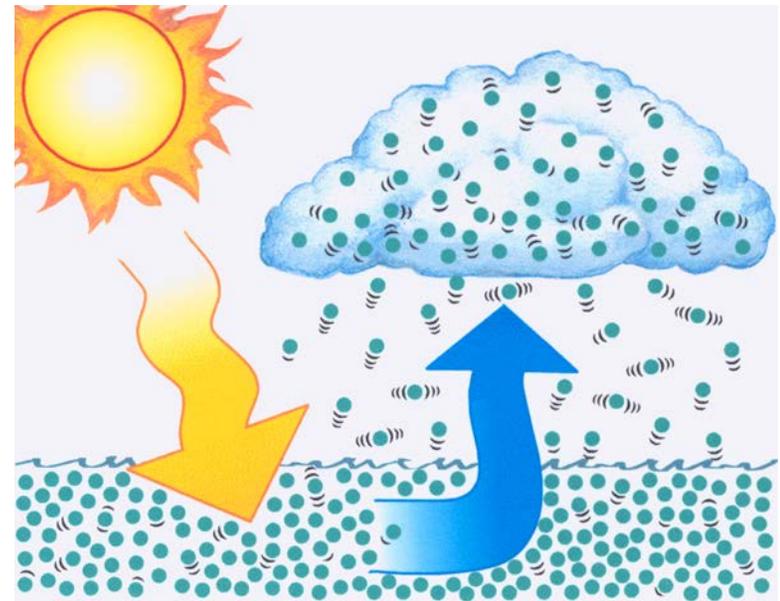
Clouds

Clouds are made up of millions of tiny drops of water and tiny pieces of ice. They are so small and light that they float in the air.

To learn about clouds, let's first learn about the different forms water can take. When we think about water, we usually think about its liquid form. Water also can be a solid, which is called *ice*. And it can be a gas, which is called **water vapor**.

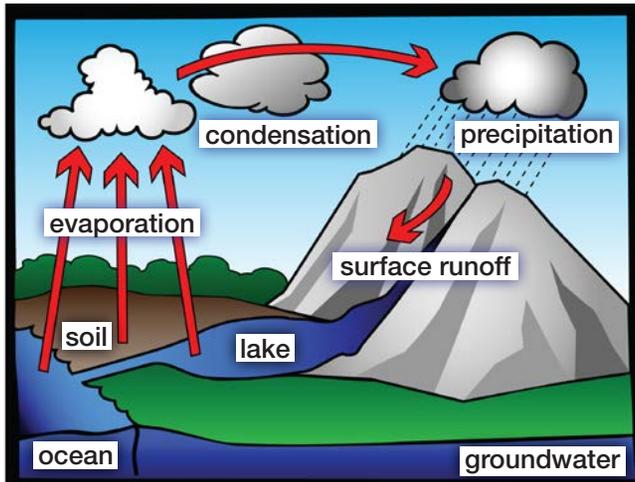
Earth's water is always changing form. If water gets very cold, it freezes and becomes ice. If it gets warm again, the ice melts and becomes a liquid again. Water also changes from a liquid to a gas and back again.

When the Sun shines on a body of water, the energy makes some of the water change to water vapor. This water vapor, which you can't see, rises in the air.



The Sun's energy makes water evaporate into the air. This warm, wet air rises, cools, and forms clouds.

The Water Cycle



As the water vapor rises, it cools. Cool air can't hold as much water vapor as warm air. Some of the water vapor turns back into tiny drops of liquid water. When these tiny drops hit bits of dust and enough of these drops get together, they form a cloud.

All clouds are formed by different kinds of air moving and mixing together. The kind of cloud depends on how high it is and how much water vapor is in the air. Look at the cloud chart on the next two pages.

Cloud Type (Height in Sky)	Description	Forecasting
Cirrus (High)		usually mean nice weather, and the weather will change in 24 hours
Cirrostratus (High)		usually come 12-24 hours before a storm (rain or snow)
Altostratus (Middle)		usually form in front of storms (either rain or snow)
Alto cumulus (Middle)		come before a thunderstorm

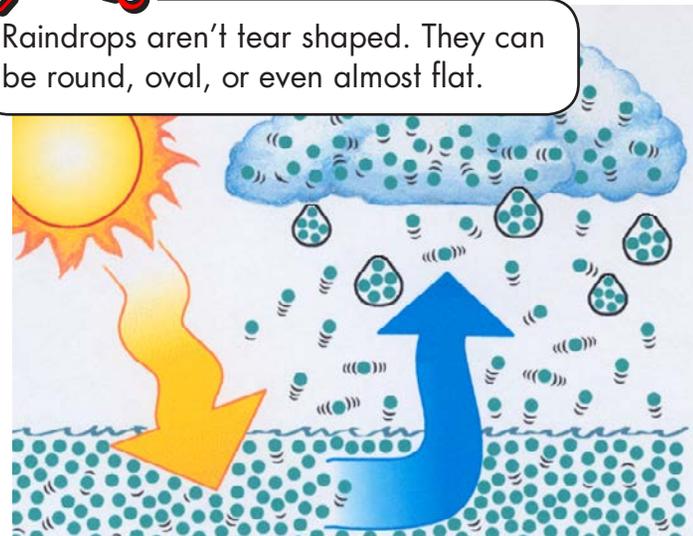
Cloud Type (Height in Sky)	Description	Forecasting
Stratus (Low)	 solid gray; usually cover whole sky	often create light mist or drizzle
Stratocumulus (Low)		
Nimbostratus (Low)	 dark gray blanket of clouds	light to moderate steady rain or snow
Cumulus (Several Heights)		
Cumulonimbus (Several Heights)	 top of tall cumulus cloud that gets flattened by high wind	thunderstorm clouds; can create heavy rain, hail, snow, lightning, and sometimes tornadoes

Precipitation

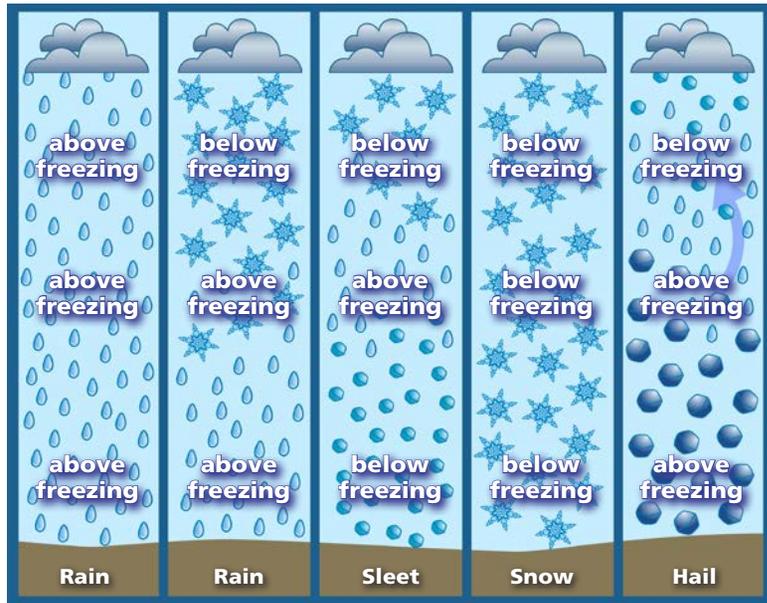
Over time, a cloud can hold more and more tiny drops of water or pieces of ice. Wind and cold temperatures make the drops and pieces bump into each other and group together. They get bigger and heavier until they are too heavy to stay in the cloud. They fall to the ground as rain, snow, hail, or sleet. These are all types of precipitation.



Raindrops aren't tear shaped. They can be round, oval, or even almost flat.



As water droplets in the cloud cool and condense, they form precipitation.



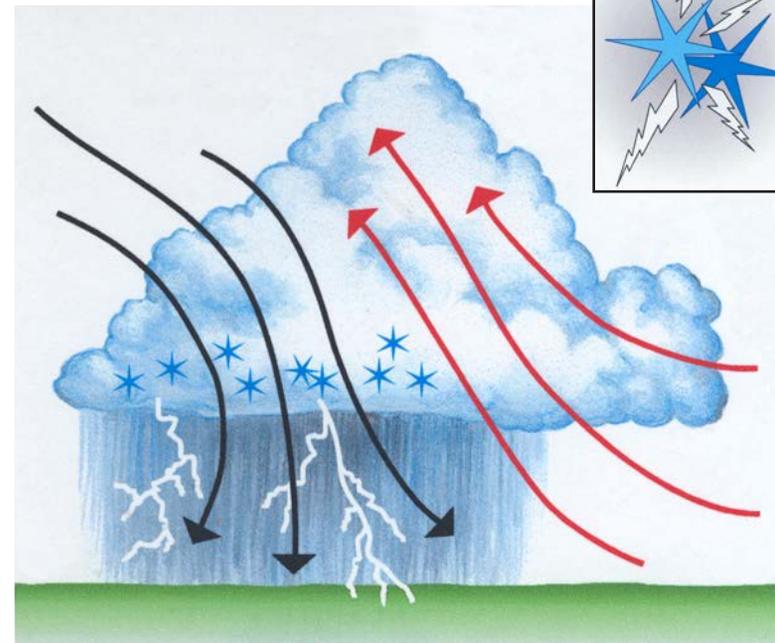
Key: Snow ❄️ Ice ● Rain ● Hail ● Updraft ↻

Different kinds of precipitation form because of different air temperatures. If the air between the cloud and the ground is warm, the precipitation falls as rain. If the rain freezes between the cloud and the ground, it becomes sleet. If the air in the cloud and below it is very cold, the precipitation falls as snow. Hail forms when ice crystals get blown upward inside a cloud over and over. The ice gets bigger each time until it falls.

Storms

Storms are extreme weather. As you read about storms, think about how air moves and mixes to make them.

Thunderstorms are the most common kind of storm. They are caused when warm, wet air hits cold, dry air. The warm, wet air rises fast to form huge clouds.



Warm, moist air rises when it hits cold, dry air. Ice crystals bump into each other, causing lightning.

THUNDERSTORM SAFETY

Lightning is very dangerous. Follow these tips to be safe.

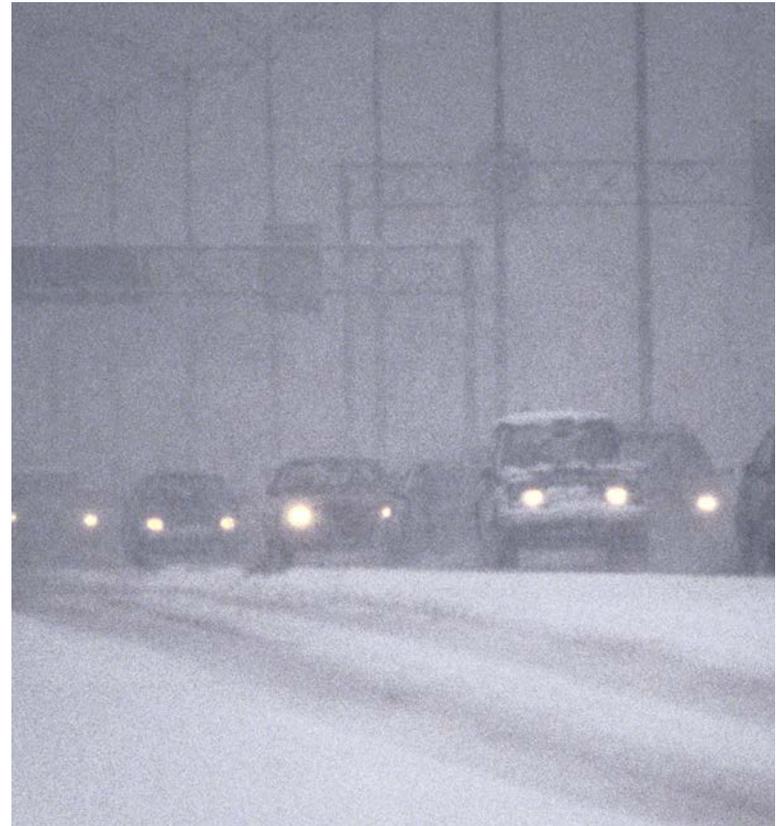
- Look for shelter, such as a building. Never take shelter under a tree. Lightning strikes the tallest thing around.
- If you are outside, crouch down with your head very low. **Never** lie down on the ground. Lightning that hits the ground spreads out after it strikes.
- Stay out of water during a thunderstorm. Do not touch metal. Water and metal both conduct electricity.
- Do not use land-line telephones or anything that uses electricity.



Inside a thunderstorm cloud, many tiny pieces of ice bump into each other. All that movement creates static electricity. After a while, the cloud fills up with electricity and releases it as **lightning**.

Lightning, which is very hot, heats the air around it. The hot air expands very fast. This makes a strong wave of air. When the wave reaches your ears, you hear it as thunder.

The worst winter storm, a **blizzard**, has heavy snow and high winds. Blizzards can dump several feet of snow in a few hours. High winds pile the snow into huge drifts. Heavy snow can cave in buildings, bury cars and trucks, block roads, and knock out power.



Driving is very dangerous during a blizzard, especially on freeways.

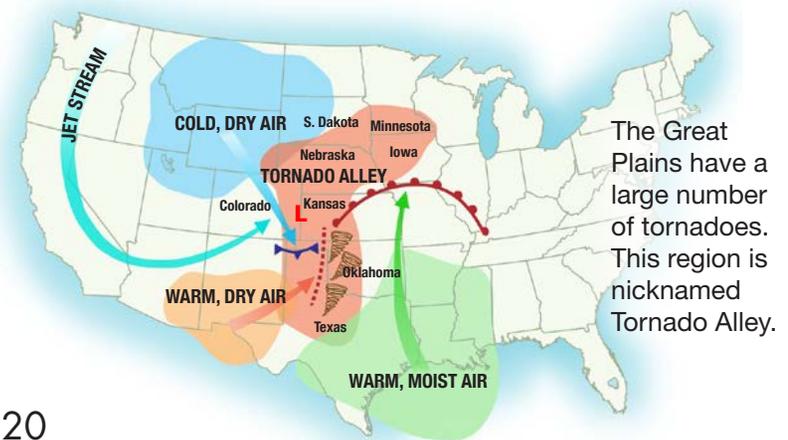


This shot of Hurricane Ivan (2004) was taken by a weather satellite. Hurricanes can measure hundreds of miles across.

During the warm months, huge areas of warm, moist air form over warm parts of the oceans. They begin to spin when cool air moves in to replace the rising warm air. When this happens, huge storms called **hurricanes** form. As the spinning air moves over warm water, the hurricane gets stronger. Hurricanes can cause terrible damage through high winds and flooding. They are measured by the speed of their winds and by how much damage they cause.

Tornadoes are another type of extreme weather. Tornadoes have the strongest winds on Earth. Very severe electrical storms may cause tornadoes. Tornadoes form when very warm, moist air hits very cold, dry air. When this happens, the warm, moist air rises very quickly. A strong current of cold air rushes in to replace the rising warm air. It moves in so fast that it begins to rotate. This rotating wind causes a funnel cloud to form.

Tornadoes usually only last half an hour or less, but they can cause great damage. They can flatten buildings, pick up cars and trucks, and tear out trees by the roots.



TORNADO SAFETY

Follow these safety tips during a tornado.

- Go to a basement, if possible. If not, go to a closet or bathroom. Crouch down under a heavy piece of furniture or climb inside the bathtub. Cover your head with your arms.
- A tornado can lift and move cars and mobile homes. You are safer outside. Lie down in a ditch or a low place in the ground.
- Stay away from doors and windows.



Tornadoes have the strongest winds on Earth.

Tornadoes can form anywhere in the world where warm, moist air meets cold air. But most

tornadoes happen in the United States. Tornadoes are common in the middle of the country. The map on page 20 shows how different kinds of air come together to produce tornadoes.

Conclusion

Scientists know a great deal about how different kinds of air move and mix together. They have many tools to study wind, clouds, precipitation, and storms. They use these tools to predict the weather and try to keep people safe. But nature is full of surprises! Still, we can all keep watching for clues and enjoy the many kinds of weather in our world.

WEATHER INSTRUMENTS

These are some tools that help scientists predict the weather.

- Thermometers measure temperature.
- Anemometers measure wind speed.
- Weather vanes and wind socks measure wind direction.
- Barometers measure air pressure, which indicates fair or stormy weather.
- Radar detects precipitation.
- Airplanes take photographs of clouds.
- Satellites observe Earth's weather from space.



anemometer



wind sock



satellite

Glossary

atmosphere	a layer of gases surrounding a planet, star, or moon (p. 4)
blizzard	a severe snowstorm with cold temperatures, high winds, and heavy snows (p. 18)
clouds	visible groups of water or ice particles in the atmosphere from which rain and other precipitation can fall (p. 4)
front	the line where two air masses meet (p. 8)
hurricanes	strong, spinning rainstorms with high winds that start over an ocean (p. 19)
lightning	a flash in the sky made when electricity passes from one cloud to another or between a cloud and the ground (p. 17)

precipitation	water that falls from clouds in the form of rain, snow, sleet, or hail (p. 4)
thunderstorms	storms with thunder, lightning, heavy precipitation, and sometimes hail (p. 16)
tornadoes	fast-spinning, funnel-shaped clouds that touch Earth's surface (p. 20)
water vapor	the gaseous state of water (p. 9)
wind	moving air (p. 4)

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