

CAN IT RAIN CATS AND DOGS?

**Questions and Answers
About Weather**

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MELVIN AND GILDA BERGER • ILLUSTRATED BY RO

CAN IT RAIN CATS AND DOGS?

Questions and Answers
About Weather

BY MELVIN AND GILDA BEER
ILLUSTRATED BY ROBERT SULLIVAN



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KEY TO ABBREVIATIONS

cm = centimeter/centimetre

cm² = square centimeter/centimetre

g = gram

kg = kilogram

km = kilometer/kilometre

km² = square kilometer/kilometre

m = meter/metre

mm = millimeter/millimetre

t = tonne

°C = degrees Celsius

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Expert Reader: Dr. Keith L. Seitter, Associate Executive Director,
American Meteorological Society, Boston, Massachusetts

To Marian and Martin, friends for all sea

—M. AND G. BERGER

To Kerry and Danie
my true loves, my true inspir

—R. SULLIVAN

Introduction

Why read a question-and-answer book?

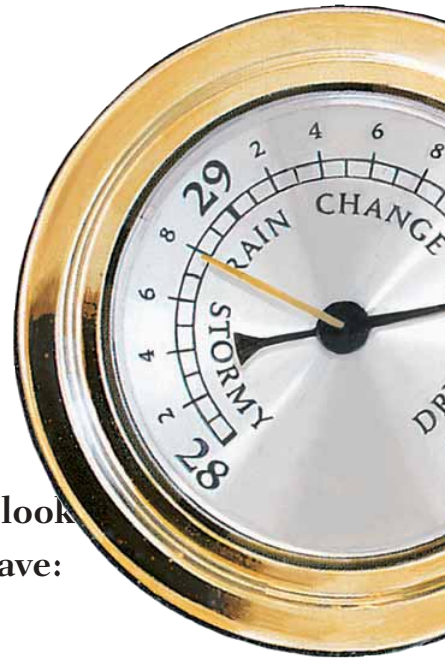
Because you're a kid! And kids are curious.

It's natural—and important—to ask *questions* and look

This book answers many questions that you may have:

- Why does the weather keep changing?
- What happens to puddles after it rains?
- Can you smell rain?
- Can lightning grow hair?
- Can groundhogs predict the weather?

Many of the answers will surprise and amaze you. We hope they'll tickle your imagination. Maybe they will lead you to ask *more questions* calling for *more answers*. That's what being curious is all about!



Malcolm Berger

Gusta Berger

SUN, AIR, AND WIND

Can it rain cats and dogs?

No—but it can rain frogs and fishes! In the United States, frogs fell on Tennessee in October 1946 and on Arkansas in January 1973. Fish fell on Glamorgan, Wales, in 1859, on Frankston, Australia, in 1935, and on Louisiana in 1947—each during the month of October. Every time, rainstorms swept up the animals, which then came down with the rain.

People like to say, “It’s raining cats and dogs” when it is raining very hard. The saying comes from an old belief that cats bring rain and dogs bring wind. But don’t believe it. While it can rain frogs and fishes, it can’t rain cats and dogs!

What makes the weather?

The air. Planet Earth is surrounded by an ocean of air called the atmosphere. The layer closest to Earth is the troposphere. Here is where you find all of the weather—rain, snow, clouds, frost, winds, and so on.

The troposphere is only about 6 miles (10 km) deep. But it contains 80 percent of all the air. Above the troposphere the air gradually gets thinner and thinner to a height of a few hundred miles (kilometers).

Why does the weather keep changing?

Because the sun heats the earth unevenly. Places around the equator—called the tropics—get lots of heat. The air in the tropics is always warm. Places near the North Pole and South Pole—called the polar regions—get very little heat. The air in the polar regions is always cold.

In general, air moves from where it is cold—the polar regions—to where it is warm—the tropics. The moving air creates the winds that make the weather change.



How does the tilt of Earth affect the weather?

It changes the amount of heat we get from the sun. When our part of Earth is slanted toward the sun, we get more heat. The temperature is generally high. It is summer.

When our part of Earth tilts away from the sun, we get less heat. The temperature is generally low. It is winter.

What makes the tropics hotter than the polar regions?

The direction of the sun's rays. The sun shines straight down on the tropics. The rays are very strong, making it very hot.

The rays from the sun strike the polar regions at a sharp angle. This spreads the rays over a large area. It brings less warmth to the North and South Poles, leaving them very chilly, indeed.

How does air move?

Mostly in large blocks called air masses. Air masses move slowly from place to place. Wherever they go, they bring a change in the weather.

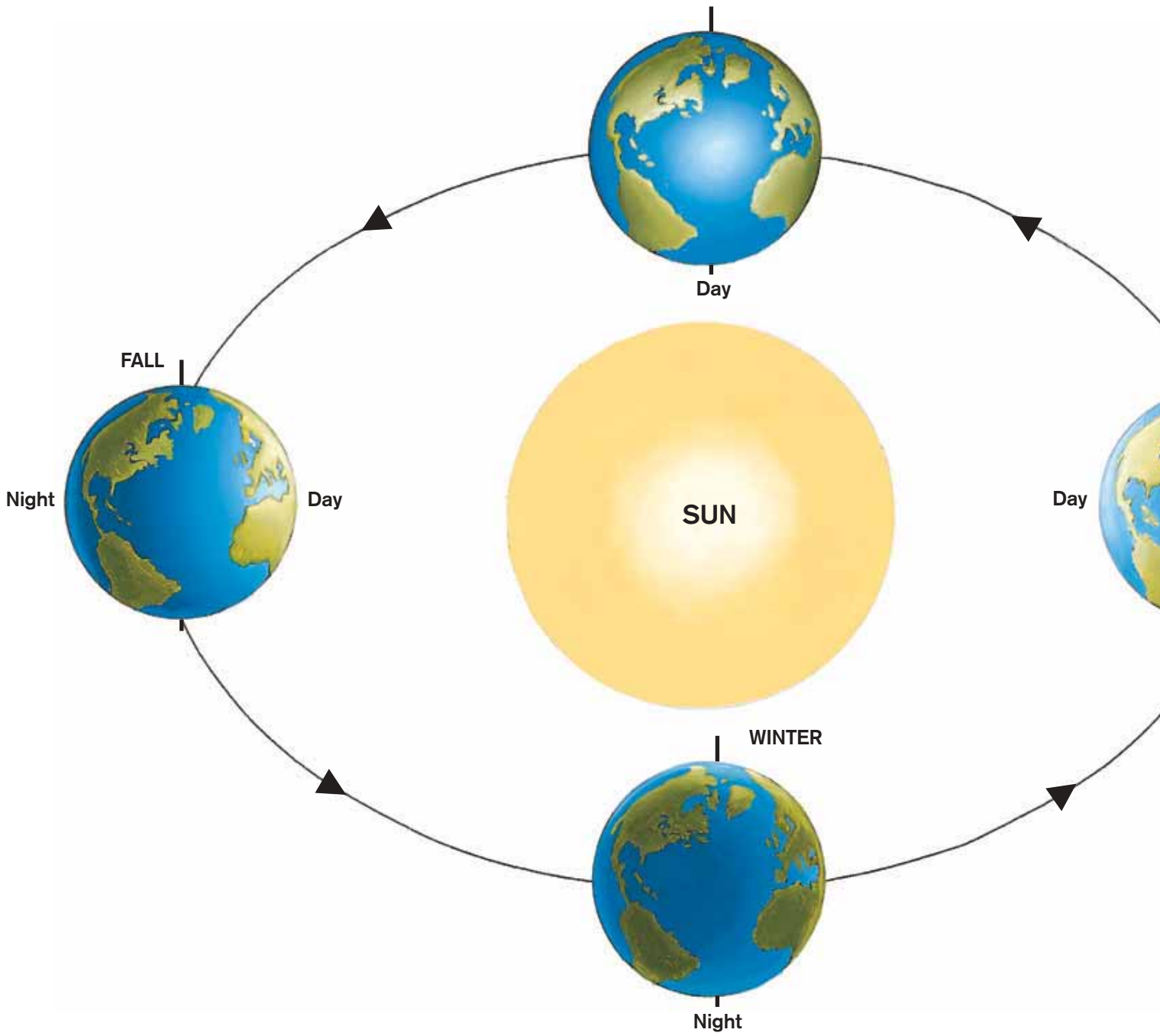
Cold, dry air masses form over cold land areas and generally move toward the equator. They usually bring clear, dry weather.

Cold, moist air masses form over cold ocean waters and also generally move toward the equator. They usually bring rain or snow.

Warm, dry air masses form over tropical lands and generally move away from the equator. They usually bring hot, dry weather.

Warm, moist air masses form over warm bodies of water and also move away from the equator. They usually bring clouds and rain showers.

SUMMER IN THE NORTHERN HEMISPHERE



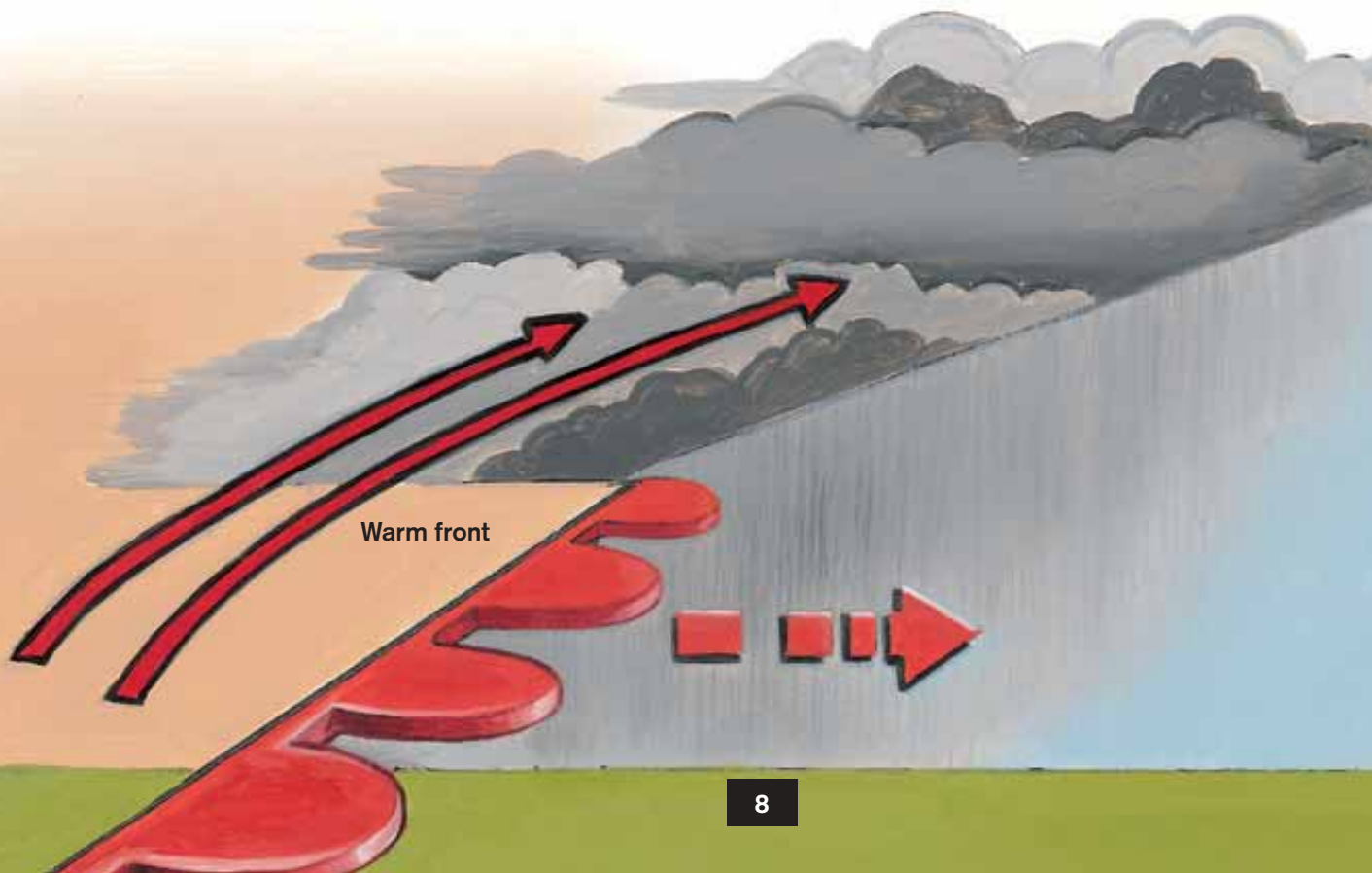
What happens when air masses bump into each other?

They form a front. Most changes in the weather happen along fronts.

You can see the moving fronts on a weather map. A line with red bumps shows a warm front, which often signals bad weather. A line with blue spikes shows a cold front. A cold front will cause bad weather as it passes, but good weather is often just behind it.

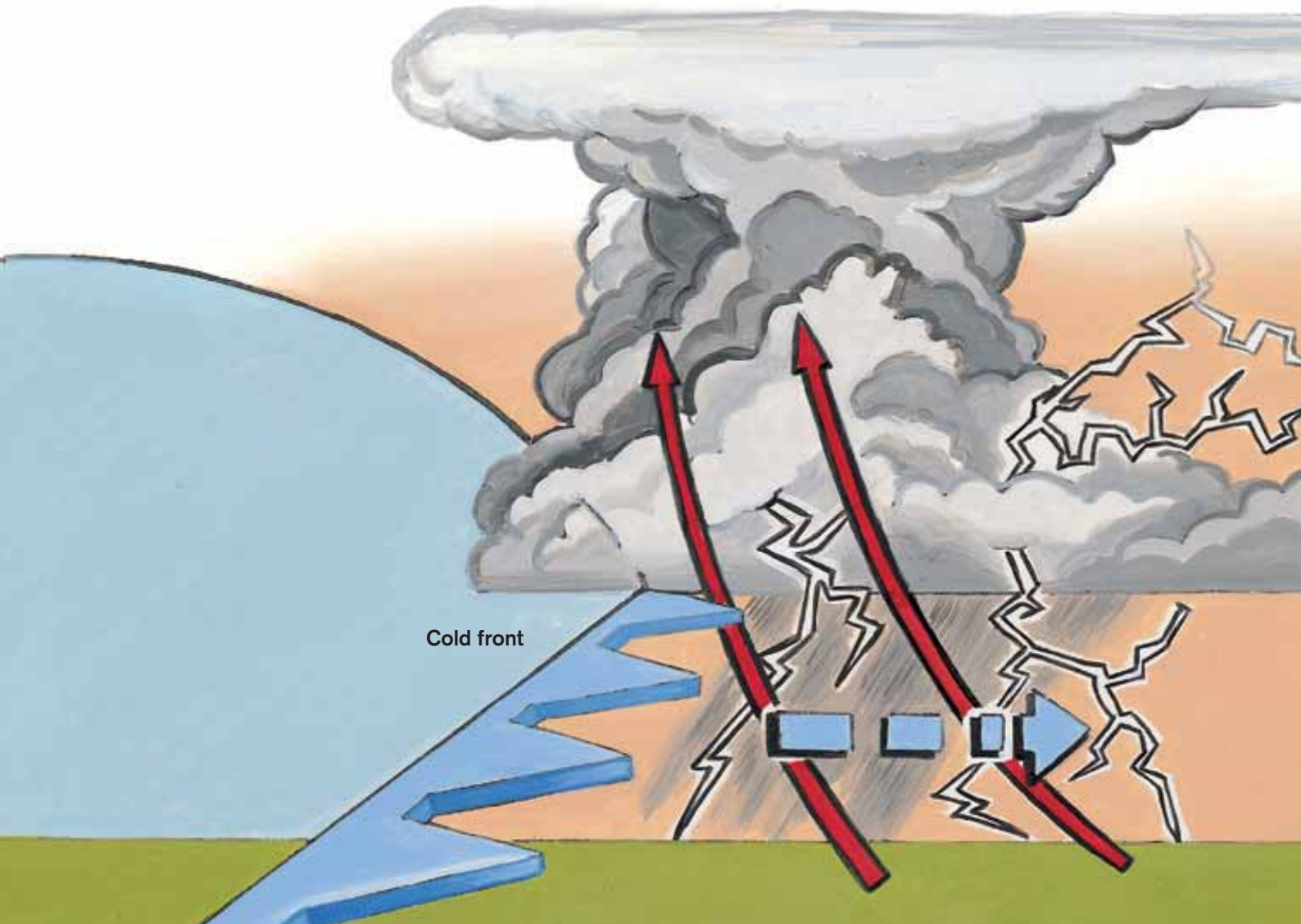
What happens when a warm air mass bumps into a cold air mass?

A warm front forms. The light warm air slowly slides on top of the heavier cold air. Clouds gather and rain or snow may fall. After a while, the warm front moves away. The sky clears and the weather gets warmer.



What happens when a cold air mass bumps into a warm air mass?

A cold front forms. The cold air slides in under the warm air. There are clouds, strong winds, thunderstorms, and perhaps heavy rain or snow. Soon the cold front passes. The rain or snow stops, and the sky clears. The weather usually gets colder. But watch out in winter! Icy winds can blow for days after the cold front has passed.



How do you measure temperature?

With a thermometer. The thermometer has a thin column of liquid—usually colored alcohol, sometimes mercury. The level of the liquid changes as the temperature changes.

In warm air, the liquid in the thermometer expands and rises. In cool air, the liquid shrinks and drops. A temperature scale alongside the column of alcohol or mercury shows the temperature in degrees ($^{\circ}$).

What is the hottest place on Earth?

The town of Al'Aziziyah, Libya. On September 13, 1922, the temperature in the shade reached a scorching 136 degrees Fahrenheit (58°C)!

The record in the United States is held by Death Valley, California. The temperature there has reached 134 degrees Fahrenheit (57°C). Every summer there is a race in Death Valley. But the ground is so hot that it sometimes melts the soles of the runners' sneakers.



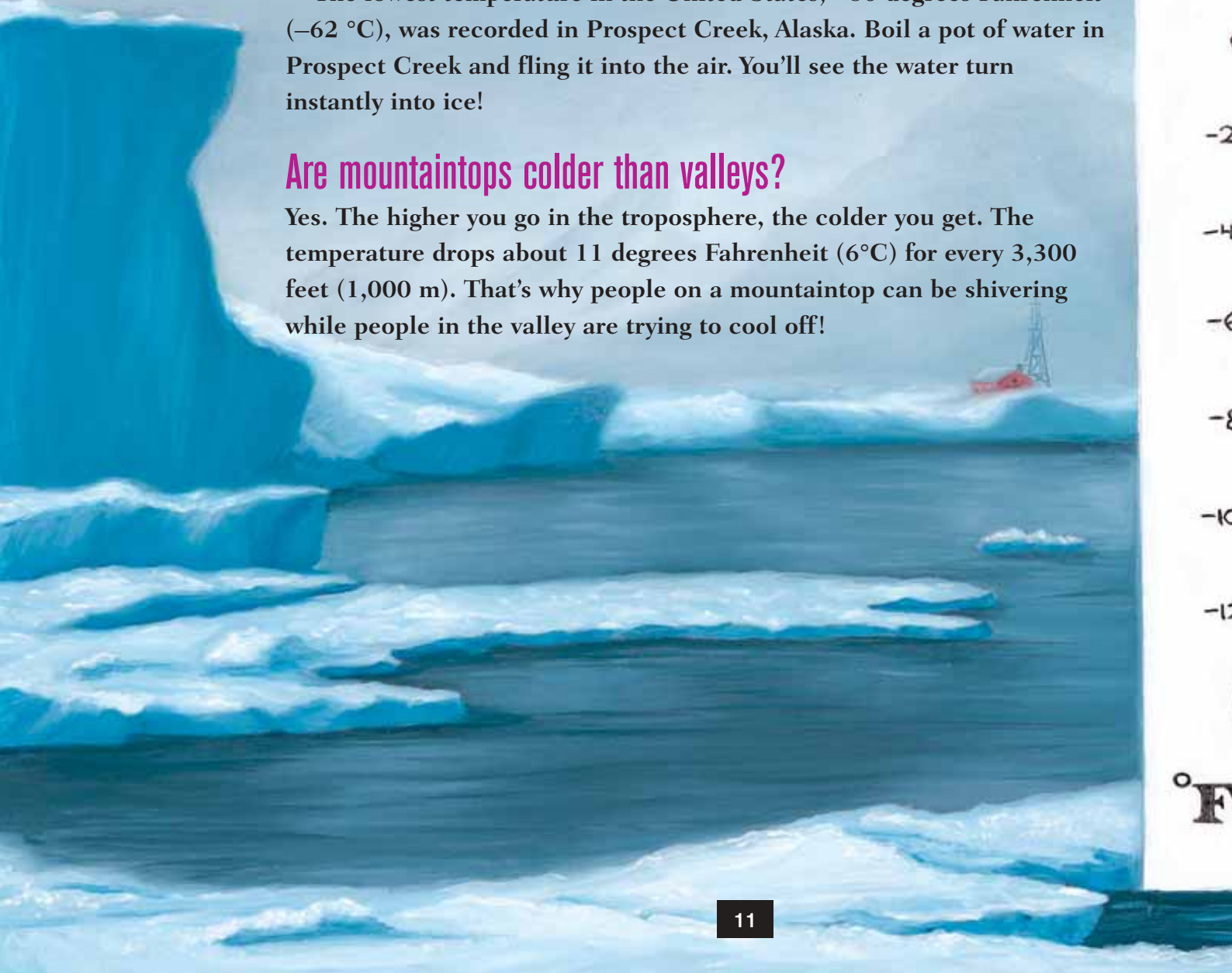
What is the coldest place on Earth?

Vostok in Antarctica. On July 21, 1983, the temperature hit a bone-chilling -128.6 degrees Fahrenheit (-89.2°C).

The lowest temperature in the United States, -80 degrees Fahrenheit (-62°C), was recorded in Prospect Creek, Alaska. Boil a pot of water in Prospect Creek and fling it into the air. You'll see the water turn instantly into ice!

Are mountaintops colder than valleys?

Yes. The higher you go in the troposphere, the colder you get. The temperature drops about 11 degrees Fahrenheit (6°C) for every 3,300 feet (1,000 m). That's why people on a mountaintop can be shivering while people in the valley are trying to cool off!



What is the difference between weather and climate?

Weather is the condition of the air and the atmosphere at one time and place. A summer hot spell and a sudden winter storm are examples of weather.

Climate is the usual weather in an area. Little rainfall on a desert and high temperatures around the equator describe climate.

Is Earth's climate changing?

Yes. It is always changing—but very slowly. Over the last 100 years the temperature has gone up about 1 degree Fahrenheit (0.6°C). Experts fear that the atmosphere may warm another few degrees in the twenty-first century. They call this global warming.

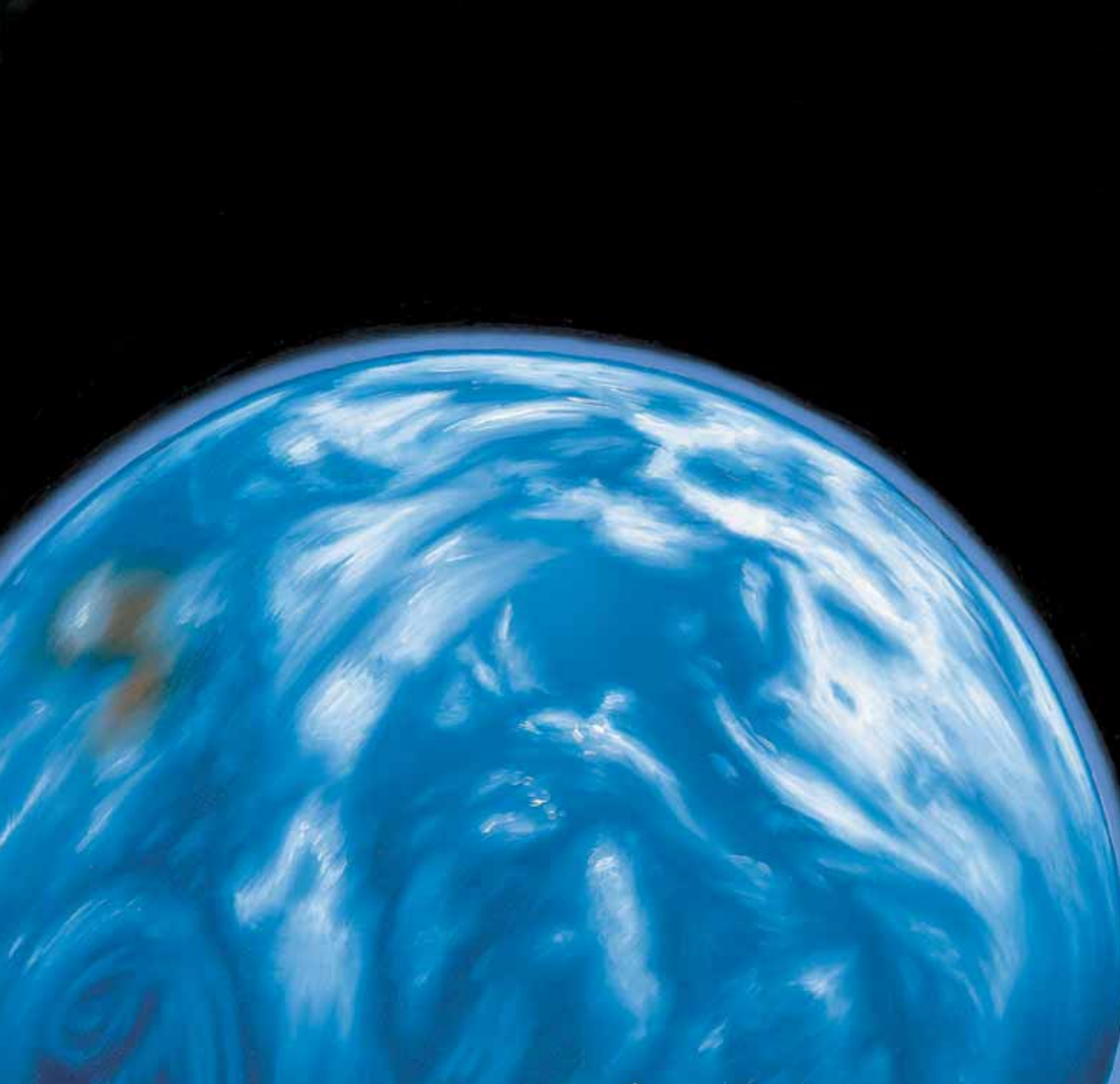
A few degrees may not seem like much of a change. But even a slight rise in temperature can increase rainfall, heat ocean waters, and melt polar ice. Over many years, global warming could force farmers throughout the world to grow different crops. And rising sea levels could flood the world's coasts.

What is the chief cause of global warming?

Widespread burning of such fuels as oil, coal, and wood. This adds vast amounts of carbon dioxide gas to the air. The carbon dioxide traps Earth's heat, which warms the surface and the atmosphere. Global warming is also called the greenhouse effect.

How can you slow down global warming?

Cut back on activities that require the burning of fuels. Walk or bike short distances instead of depending on car rides. Turn off lights when not in use to save electricity. And in the winter, dress warmly indoors so you can keep your house at a lower temperature and burn less fuel for heating.



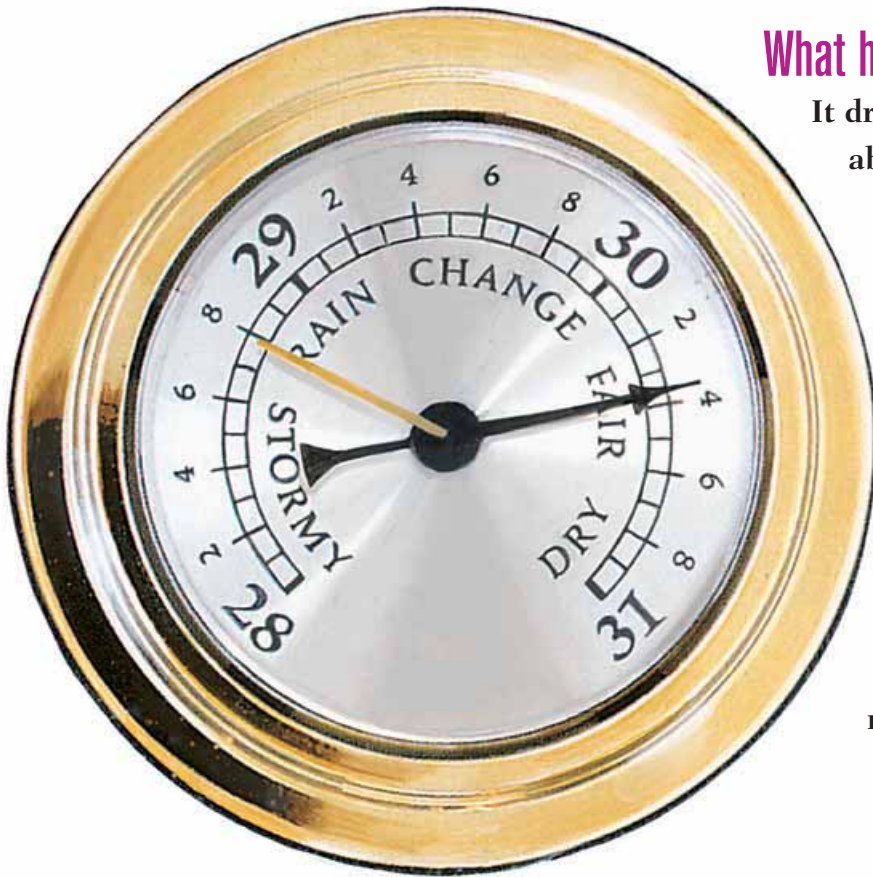
Does air have weight?

It sure does. Right now the weight of air on your shoulders is about 1 ton (1 t)!

At sea level, the air presses down with an average weight of 14.7 pounds (6.6 kg) on every square inch (6.5 cm²). This weight is called air pressure.

Why don't you feel air pressure?

Because air presses in all directions. The air inside your body presses out with the same force as the outside air presses in. Since the pressure inside is equal to the outside pressure—you don't feel a thing.



What happens to air pressure as you go higher?

It drops. The higher up you go, the less air there is above you. Less air pressing down means lower air pressure. For example, at the top of a 12,000-foot (3,658 m) mountain, the air weighs one-third less than at the base.

You can sometimes feel the pressure dropping as you go up in an elevator. Your ears pop as the air pressure inside your ears adjusts to the lower pressure.

Oddly enough, you don't feel a drop in air pressure inside an airplane that's taking off. That's because the pressure in the cabin is the same as the pressure on the ground. If not, your ears will pop!

Does air pressure affect the weather?

Yes. Low pressure and warm air masses usually bring cloudy weather and a chance of storms. High pressure and cold air masses usually signal clear, fair weather.

How do you measure air pressure?

With a barometer. The mercury barometer has a hollow glass tube set in a bowl of mercury. The air pressing down on the mercury pushes it up the tube about 30 inches (760 mm) or 1,000 millibars. In high pressure the mercury rises; in low pressure it falls.

The aneroid barometer is built around a metal box with most of the air removed. High pressure makes the box contract; low pressure allows it to expand. The change moves a needle over a dial. The dial shows you the shift in air pressure.

Which animals are “living barometers”?

Frogs. They can feel a drop in air pressure. As air pressure falls they croak more. A study in China shows that frogs are very accurate in sensing oncoming low pressure. So, if you hear frogs making more noise than usual, pack an umbrella!





What is wind?

Moving air. There is wind each time air flows from an area of high pressure to an area of low pressure. A big difference in pressure creates strong, gusty winds. A small difference brings winds that are light and breezy.

You can make a wind at home. Blow up a balloon. This puts the air in the balloon under high pressure. Now hold open the neck of the balloon. Feel the wind as the high-pressure air inside rushes into the low-pressure air outside.

Where are the windiest places in the world?

Commonwealth Bay, Antarctica, has winds that reach 200 miles (320 km) an hour. These winds blow for more than 100 days a year. Winds just one-third as fast would blow you off your feet!

The all-time record for wind over land was set on the top of Mount Washington, New Hampshire, on April 12, 1934. On that date the winds raced along at 237 miles (381.3 km) an hour. That's faster than the top speed of any car on the road today!

How do you measure the wind?

With an anemometer. The anemometer has three or four cups at the ends of rods that are attached to a central pole. The faster the wind blows, the faster the cups and pole spin. The speed of the spinning pole tells you the speed of the wind.

A weather vane shows wind direction. The simplest one is shaped like an arrow, pointed at one end and wide at the other. Set on a rod, the arrow turns freely with the wind. The wind blows equally on each side of the wide end. This turns the tip of the arrow to face into the wind. When the weather vane points north, you know a north wind is blowing. (A wind is always named after the direction from which it blows. A north wind blows from the north.)

Do winds always blow in the same direction?

No. Winds blow in all directions. But there are six bands of winds on Earth that generally blow the same way. They are called prevailing winds.

Prevailing easterlies blow from east to west around the North and South Poles.

Trade winds on both sides of the equator also blow from east to west.

Prevailing westerlies, which are between the prevailing easterlies and the trade winds blow from west to east.

Which winds affect us the most?

Prevailing westerlies. They sweep over much of North America, Europe, Asia, and large parts of the other continents. These powerful west-to-east winds carry weather systems with them. People in New York often have the weather that people in Chicago had the day before.

Prevailing westerlies also speed up airplanes. It takes a half hour less to fly from New York to London (with the wind pushing) than to fly back (against the wind)!

Which winds helped Columbus?

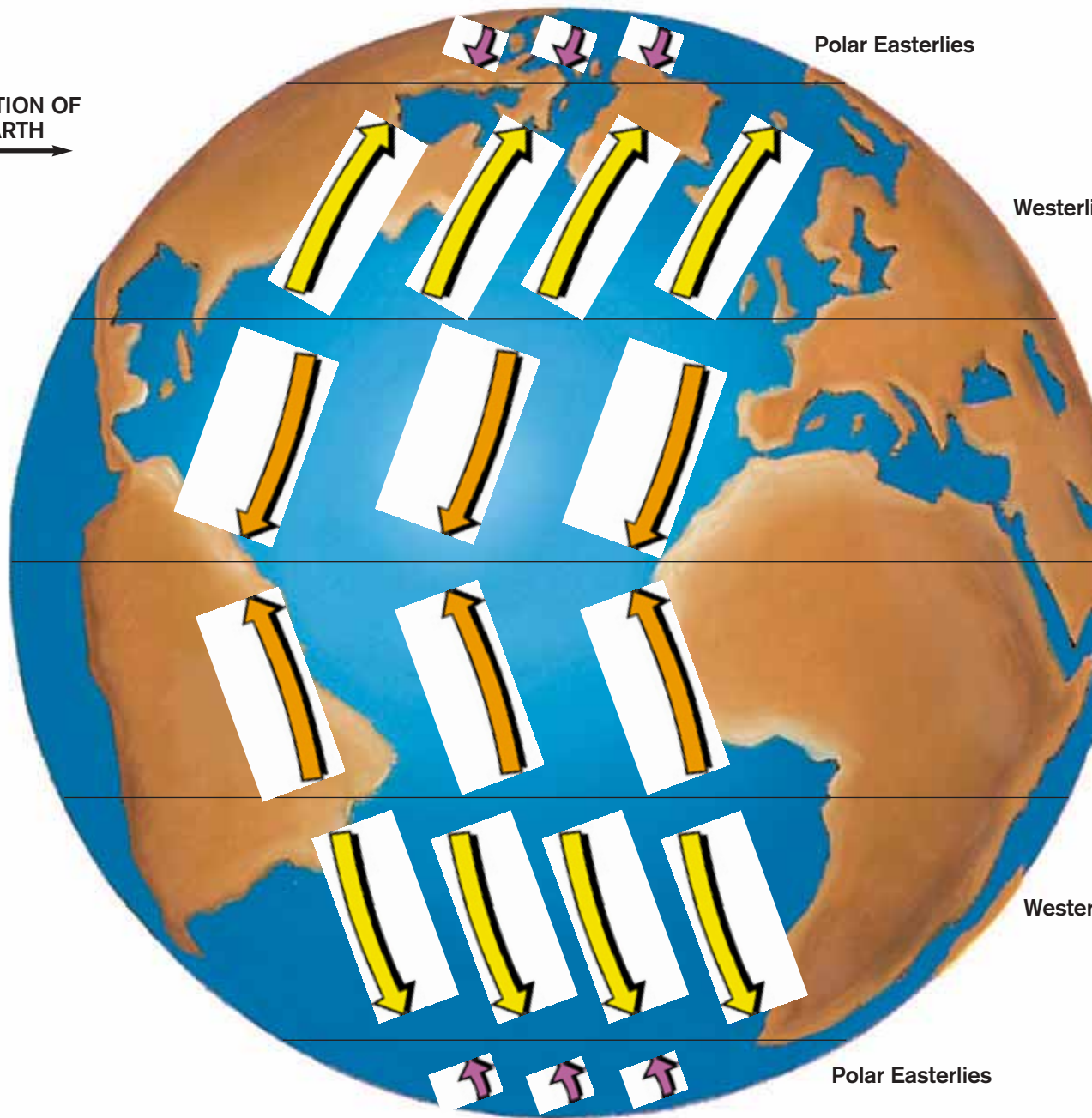
The trade winds. They helped Columbus get to America! Columbus sailed west in the southern region of the Atlantic Ocean, where the trade winds blow. The winds filled the sails of the *Niña*, the *Pinta*, and the *Santa María* and helped speed these—and all other sailing ships—on voyages from Europe to the Americas.

What is the jet stream?

A fast-moving river of air high in the atmosphere that takes a wavy path from west to east. These powerful winds can reach speeds of more than 200 miles (320 km) an hour. Large weather systems tend to follow the direction of the jet stream. Locating the jet stream helps weather scientists, called meteorologists, predict changes in the weather.

WIND MAP

ROTATION OF
EARTH
→





Do other winds have names?

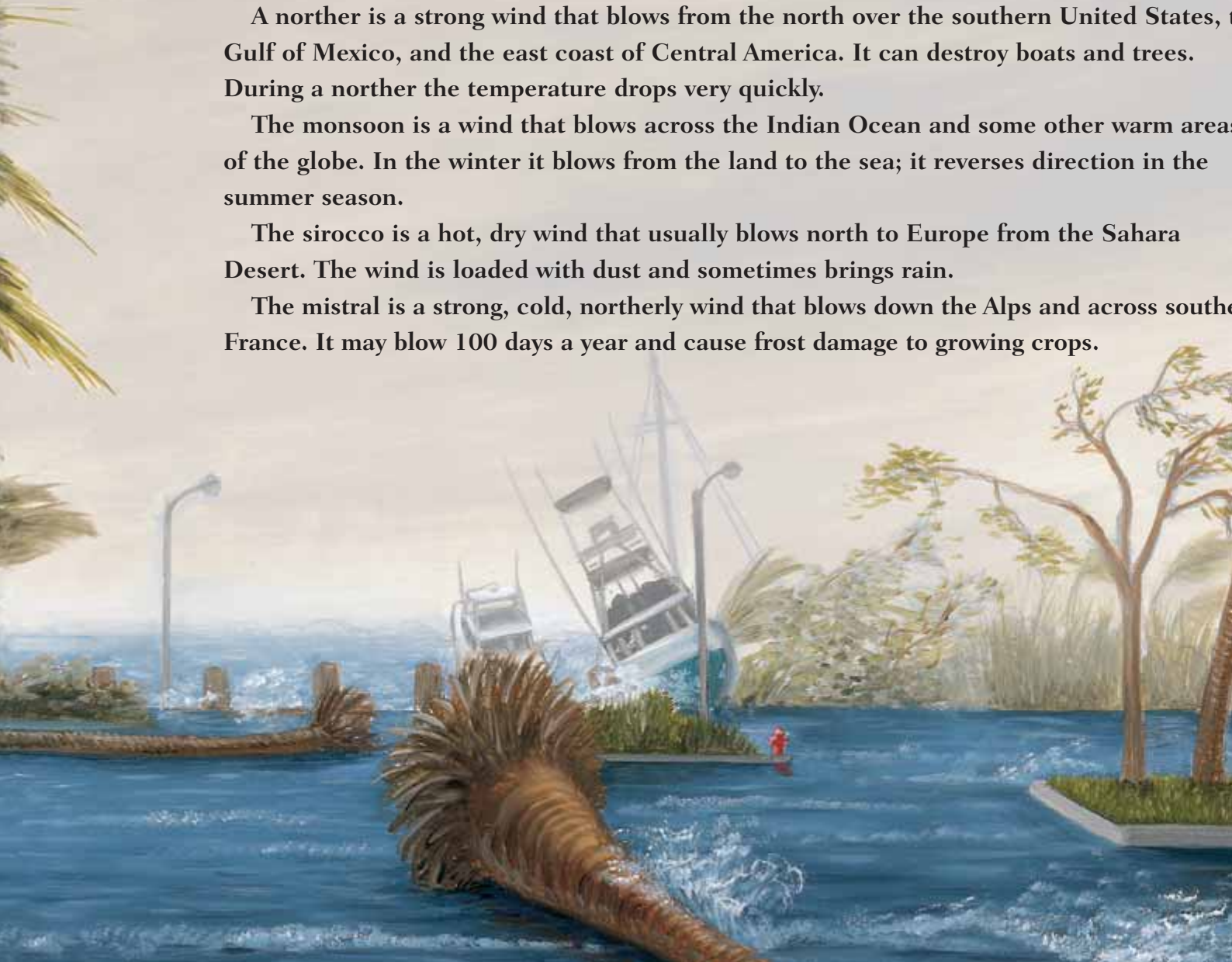
Yes. The chinook is a warm, dry wind that blows down the sides of the Rocky Mountains. It warms the plains east of the Rockies. The Santa Ana is similar to the chinook, but blows in the Sierra Nevada mountains of California.

A norther is a strong wind that blows from the north over the southern United States, the Gulf of Mexico, and the east coast of Central America. It can destroy boats and trees. During a norther the temperature drops very quickly.

The monsoon is a wind that blows across the Indian Ocean and some other warm areas of the globe. In the winter it blows from the land to the sea; it reverses direction in the summer season.

The sirocco is a hot, dry wind that usually blows north to Europe from the Sahara Desert. The wind is loaded with dust and sometimes brings rain.

The mistral is a strong, cold, northerly wind that blows down the Alps and across southern France. It may blow 100 days a year and cause frost damage to growing crops.



RAIN, SNOW, AND HAIL

What happens to puddles after it rains?

They dry up and disappear. Heat from the sun helps warm all the water on Earth's surface, which makes millions of gallons (liters) of water vanish from oceans, lakes, and rivers—and puddles. The liquid water becomes an invisible gas called water vapor. The change from liquid to gas is called evaporation.

Where does the water vapor go?

It mixes in with the air. You can't see it, you can't feel it, you can't smell it—but it's there.

The air with the water vapor rises as it is warmed by the sun. As the moist, warm air rises higher, it gets colder. In time, it gets so cold that the water vapor changes into tiny droplets called raindrops, of water. We call this condensation. If it's very cold, the water vapor forms little ice crystals instead of raindrops.

What is at the center of every raindrop?

A tiny bit of dust. The water vapor condenses around a speck of dust, which is at the center of the raindrop.

Are raindrops shaped like tears?

No. Raindrops are round. But as the drops fall, they may flatten out a bit—looking more like tiny hamburger buns.

In a heavy rain, the drops are about $\frac{1}{5}$ inch (0.5 cm) across. These big raindrops fall at a speed of about 20 feet (6 m) a second. Smaller drops, called drizzle, may take an hour to fall to Earth.

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