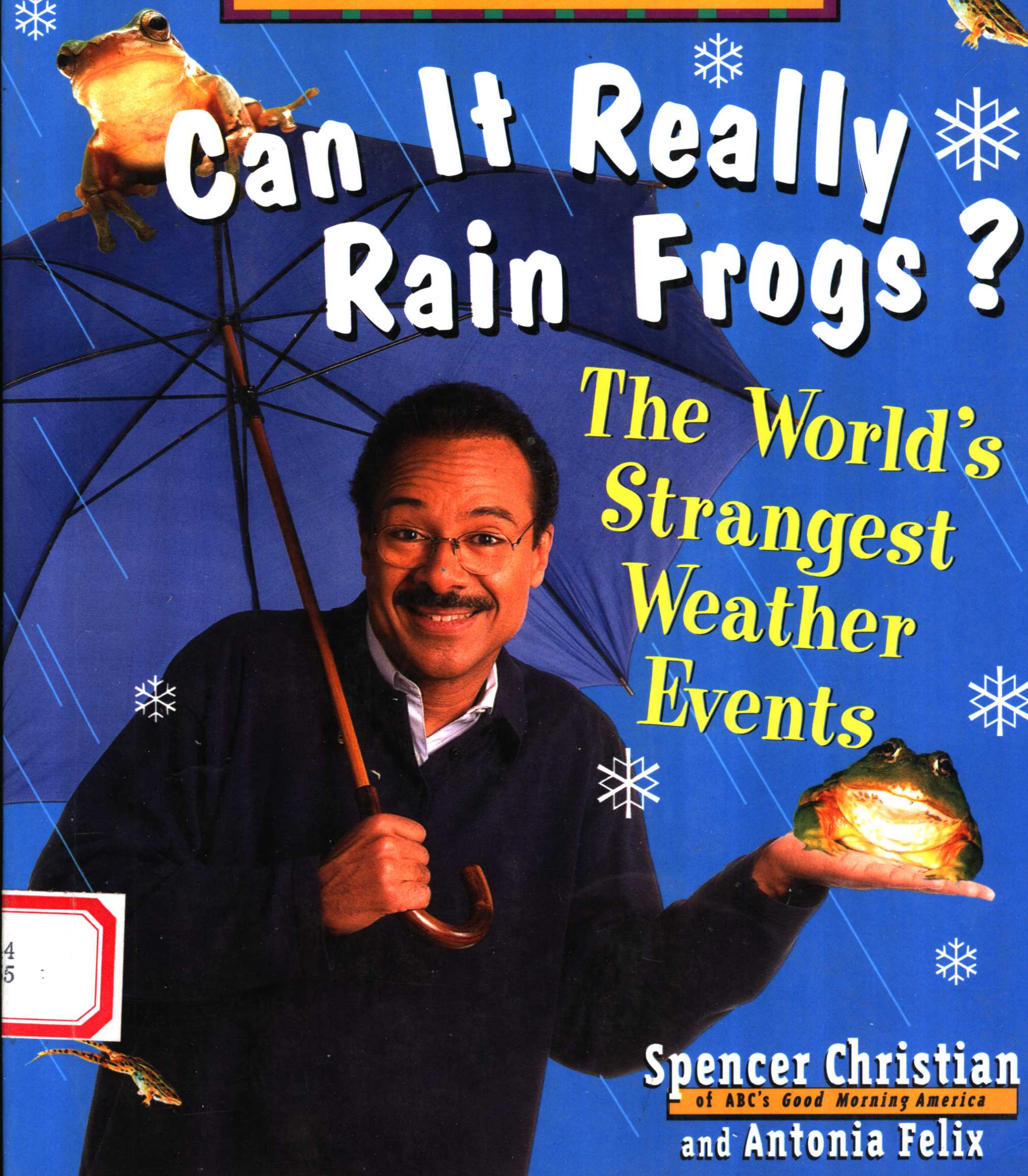
SPENCER CHRISTIAN'S

World of Wonders

Can It Really Rain Frogs?

The World's Strangest Weather Events



Spencer Christian
of ABC's *Good Morning America*
and Antonia Felix

SPENCER CHRISTIAN'S
World Of Wonders

Can It Really Rain Frogs?

The World's Strangest Weather Events

Spencer Christian
and Antonia Felix

JOHN WILEY & SONS, INC.
New York • Chichester • Weinheim • Brisbane • Singapore • Toronto

This text is printed on acid-free paper.

Published by John Wiley & Sons, Inc.

Design by Pronto Design & Production Inc.

Illustrations: Abe Blashko for the illustrations of Spencer Christian and the illustrations on pages 37, 41, 55, 81, 90, and 91 and Jessica Wolk-Stanley for the other illustrations.

The publisher and the author have made every reasonable effort to insure that the experiments and activities in the book are safe when conducted as instructed but assume no responsibility for any damage caused or sustained while performing the experiments or activities in the book. Parents, guardians, and/or teachers should supervise young readers who undertake the experiments and activities in this book.

Library of Congress Cataloging-in-Publication Data

Christian, Spencer.

Can it really rain frogs?: the world's strangest weather events / Spencer Christian and Antonia Felix.

p. cm — (Spencer Christian's world of wonders)

Includes index.

Summary: Describes strange weather events such as raining frogs, singing caves, colored rain, and auroras, and discusses weather lore and weather forecasting.

ISBN 0-471-15290-0 (pbk. : alk. paper)

1. Weather—Juvenile literature. 2. Meteorology—Juvenile literature. [1. Weather. 2. Meteorology.] I. Felix, Antonia. II. Title III. Series: Christian, Spencer. Spencer Christian's world of wonders.

QC981.3.C5 1997
551.5–dc21 96-47735

Printed in the United States of America

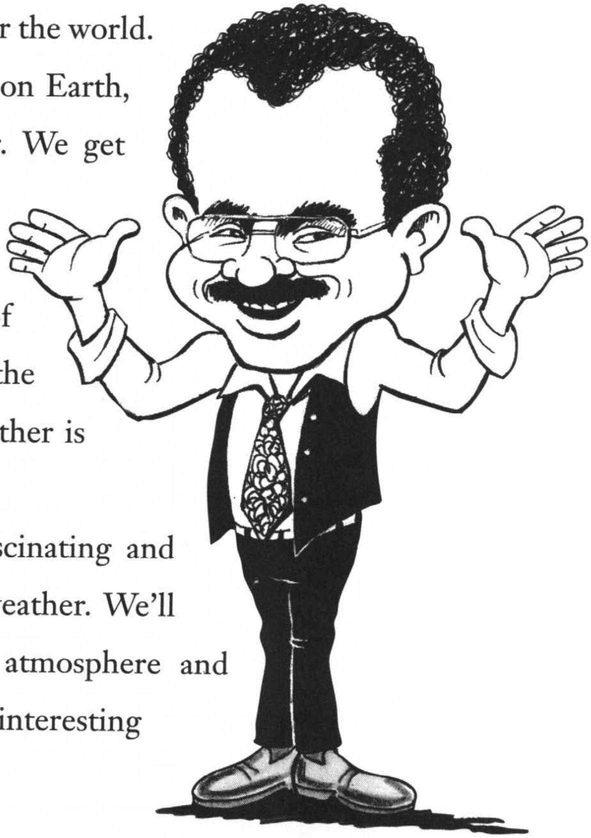
10 9 8 7 6 5 4 3 2 1

Introduction

Welcome to the Wonders of Weather

Weather is the number one topic all over the world.

As long as human beings have been on Earth, we have been affected by the weather. We get frustrated by storms that interrupt our travel or picnic plans, and we take great pleasure in the warm, early days of spring and the gentle rains that make the flowers bloom. All over the world, weather is one thing that everyone is interested in.



In this book, we'll look at many fascinating and even **bizarre** facts about the weather. We'll explore the big picture, such as the atmosphere and Earth's water system, and we'll uncover interesting details like the dazzling variety of snowflakes and the makeup of a lightning bolt. We'll discover the awesome power of wild winds in hurricanes and tornadoes. Can a groundhog really predict how many more months of winter are in store? We'll look at this popular tradition and much more weather folklore. And we'll learn that throughout history, there have been strange and downright wacky weather reports of showers that have poured down everything from clams and spiders to a *human* hailstone and—yes—frogs!

Although I haven't been lucky enough to report a frog shower in my career as a weather forecaster (not yet, anyway), my life has been filled with many exciting and even frightening experiences with weather. I'll share these stories with you as together we discover the wild and wonderful world of weather.

Contents

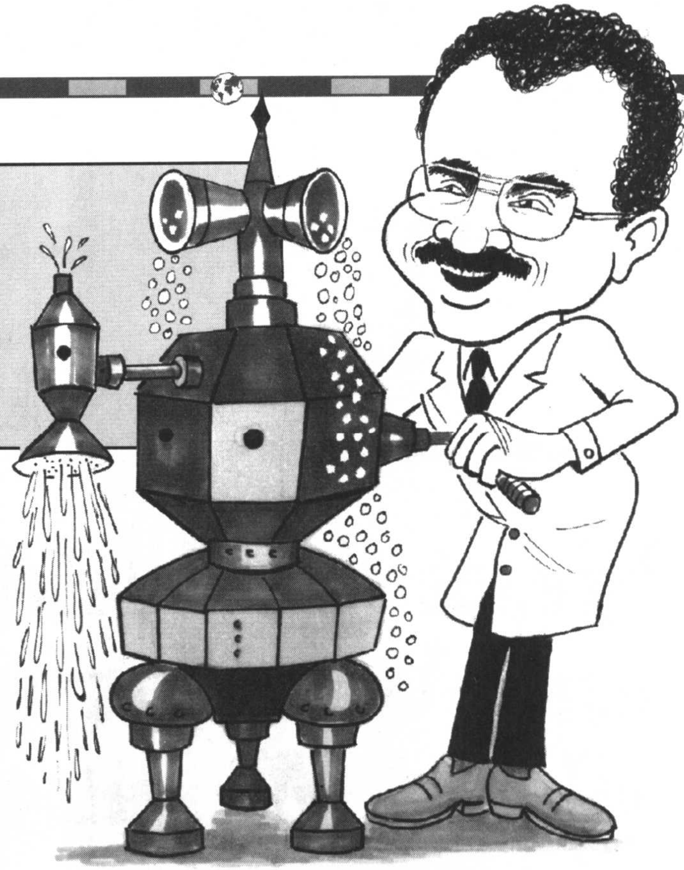
1

Meet the Wild and Wonderful World Weather Machine

Weather is the sum of the outdoor conditions we face every day, such as rain, snow, wind, and clouds. Without wind and clouds, the sun would bake the area near the equator to temperatures close to the boiling point of water, while much of the rest of our planet would be bitterly cold. Without rain, all land areas would be dust and rock incapable of supporting plants, animals, or people.

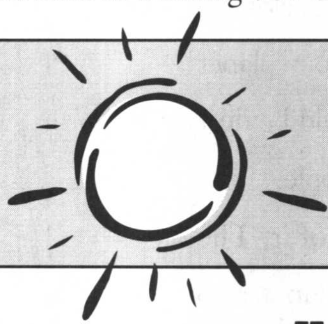
So, our planet is lucky to have weather—and lots of it. The awesome processes that created our planet also created a system that I like to call the great world weather machine. Before we go on to the details of weather, we'll explore the fascinating workings of this wonderful machine.

Weather is what happens outside our windows every day, while **climate** is the pattern of weather that occurs over long periods of time.



The Sun

All of Earth's energy comes from our sun, which, like every other star in the universe, is really a gigantic nuclear reactor. At the center of this giant ball of gases, 600 million metric tons of hydrogen are burned every second, creating temperatures up to 36 million° Fahrenheit (2.2 million° Celsius). At its surface, the sun's temperature is a toasty 11,000° Fahrenheit (6,093° Celsius), and a patch the size of a postage stamp gives off enough energy to light five hundred 60-watt light bulbs. Although only a small amount of the sun's energy hits Earth, it provides as much heat as burning 700 billion tons of coal per day.



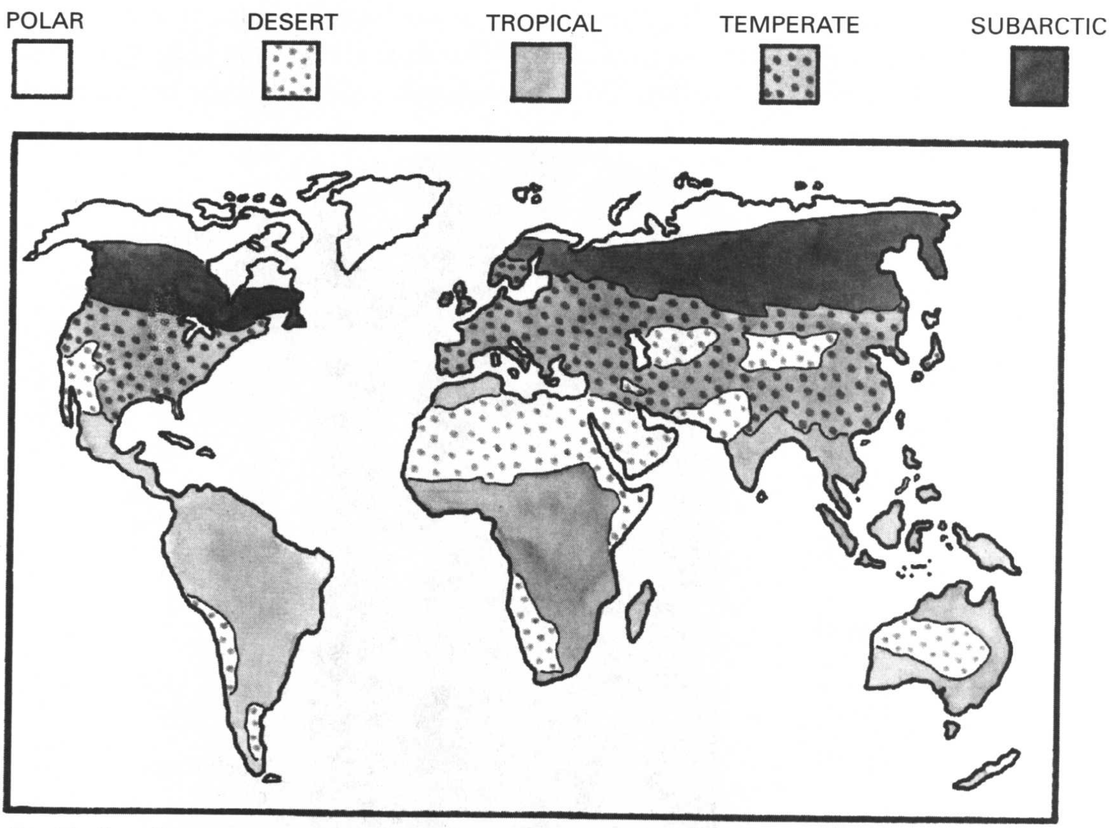
The sun has a surface area about 12,000 times greater than that of Earth.

How Earth Takes the Heat

Like the energy from a fireplace, the heat from the sun doesn't warm all parts of our planet evenly. A much larger portion of the sun's energy is absorbed by the area north and south of the equator that we call the **tropics**. The **equator** is the imaginary circle around the earth that divides the Northern Hemisphere, the top half, from the Southern Hemisphere, the bottom half. If there were no way to distribute the sun's heat more evenly, temperatures near the equator would average 130° to 140° Fahrenheit (54°–60° Celsius)!

On the other hand, most of the rest of the world would have an **arctic** climate, and the harbors of cities like New York and Sydney, Australia, would be clogged with ice every day of the year.

Instead, including the tropics, there are five climate zones on Earth. **Temperate** climates are regions that have warm summers, cold winters, and rain and snow. **Desert** climates have hot and dry weather throughout the year. **Arctic** climates, also called polar climates, are the coldest on Earth, and occur near the North and South Poles. Areas with subarctic climates have long, cold winters, light snow, and cool summers.



Earth's five climate zones

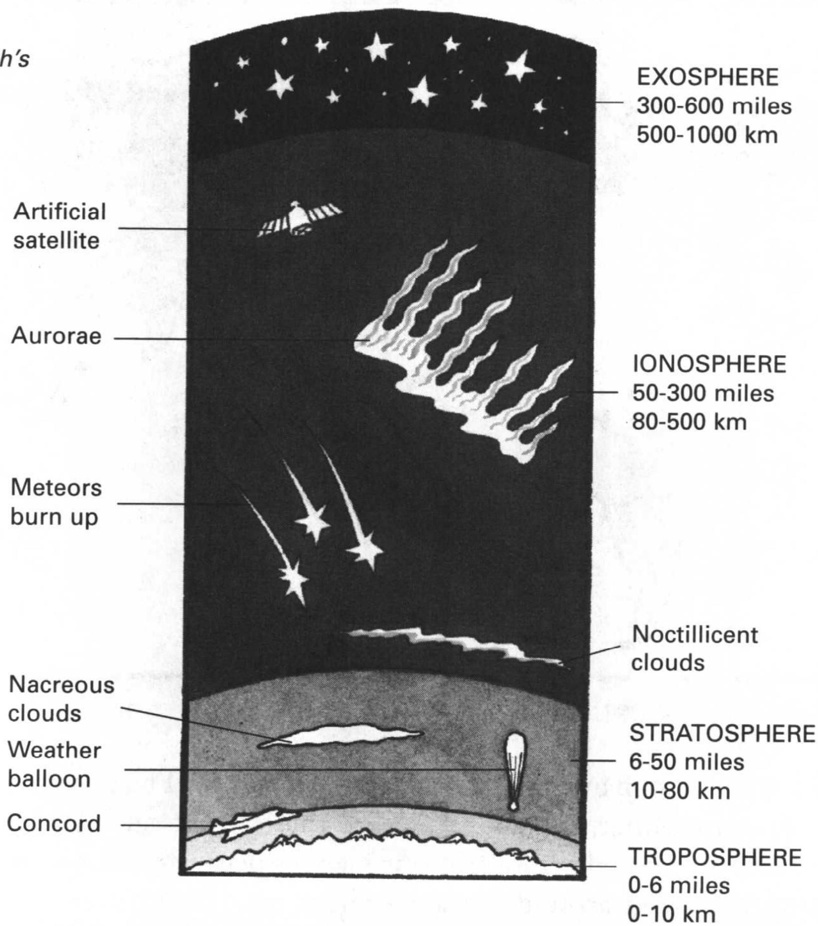
Why are there so many different climates on Earth? The answer has to do with air, water, and weather. Air and water are the basis of our planet's heating and cooling system. Let's take a look at our planet's oceans of air and water, and discover how they move around to transfer heat.

The Atmosphere

Picture Earth as you've seen it in photographs taken from space—a blue ball covered with swirls of white clouds. The beautiful blue color is caused by sunlight reflecting off Earth's **atmosphere**. Now imagine this ball the size of a schoolroom globe. How big would our model Earth be if it also showed the atmosphere, the life-giving layer of gases that surrounds the planet? The change would be almost impossible to notice, because the atmosphere would appear as a layer about as thick as a coat of clear varnish. This layer appears very thin from space, but it contains our entire life-support system—all our weather and protection from the sun's radiation.

Although small traces of our atmosphere can be found hundreds of miles from Earth, almost all of it is pressed into a layer that extends 6 miles (10 kilometers) up from the surface. This layer of atmosphere is called the **troposphere**,

Layers of Earth's atmosphere



and it is here that weather occurs. The next level, the **stratosphere**, extends to 50 miles (80 kilometers) above the planet. The **ionosphere** is the next level, 50 to 300 miles (80 to 500 kilometers) above Earth.

When you see a falling star, a meteor burning up in the atmosphere, you're looking into the ionosphere. Beyond that is the **exosphere** and, you guessed it, space—the final frontier.

The atmosphere is made up of gases that are constantly on the move. Most of these gases were created within Earth itself over millions of years. When our planet was very young, volcanoes exploded huge amounts of poisonous gases into the air. When plants developed in the sea and on land, they began releasing oxygen into the atmosphere. The air you are breathing right now is the product of plants that lived millions of years ago!

Air is a mixture of invisible molecules of nitrogen, oxygen, carbon dioxide, water vapor, and a few other substances. These molecules are kept from flying off into space by **gravity**, the force that attracts objects to Earth.

Air is a very mysterious substance. If you open and close your hand, it feels like nothing is there. But when you breath, something substantial fills your lungs. While air seems weightless when you hold a balloon, under pressure it fills tires that can support the weight of huge trucks. Although it seems harmless on a calm day, in violent storms moving air can topple trees, demolish buildings, and even pick up railroad cars and carry them hundreds of yards.

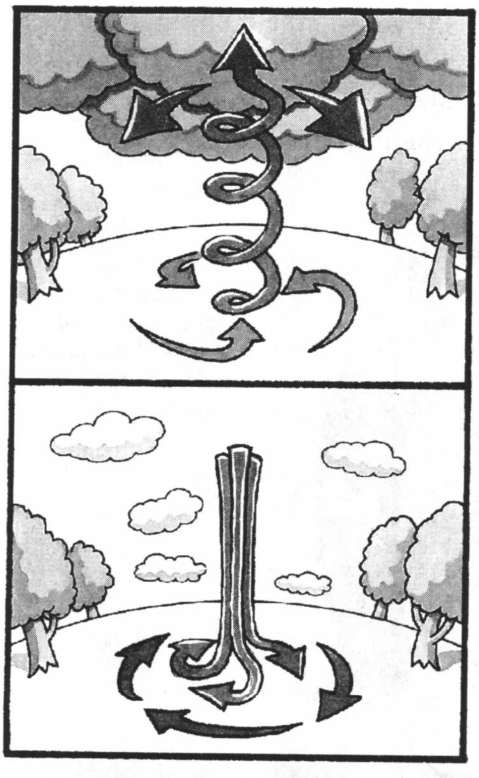
Your body is not affected by air pressure in the atmosphere because the pressure inside your body balances the pressure outside.

What Is Air Pressure?

Although air is about 800 times less dense than water, the total weight of the air surrounding Earth comes to 5.75 quadrillion tons. That translates into a weight of about 14.7 pounds (6.6 kilograms) on every square inch, or about 1 ton (.91 metric tons) of weight on your entire body.

Why don't you feel it? Put your palms together in front of your chest and push. Your hands don't move because the force pushing from both directions is equal. You don't feel **air pressure** because there is pressure inside your body as well as outside, so the forces are equal. However, when you go up in an airplane or elevator, air trapped inside your ears has a higher pressure than the air outside your body. The pressure of the air pushing out makes your ears "pop," equalizing the pressure.

There are lots of other examples of how air reacts under pressure. When you blow up a balloon, you force air inside, increasing the pressure. If you push on the surface of the balloon, you can feel the high-pressure air inside pushing back. Puncture the balloon, and the air rushes out with a force you can feel. The more tightly air is packed, the stronger the force.



In a low-pressure system, air rises and cools to form clouds and sometimes precipitation. Air under high pressure sinks, creating clear skies.

EXPERIMENT

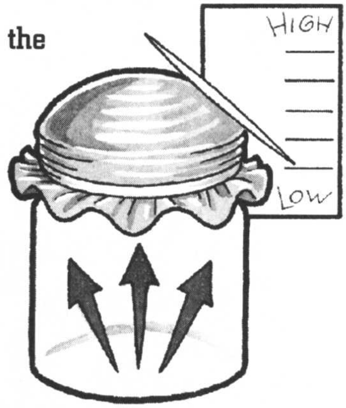
DO-IT-YOURSELF WEATHER-WATCHING: THE BAROMETER

The weather instrument used to measure air pressure is called a **barometer**. You can observe changes in air pressure yourself with your own homemade barometer.

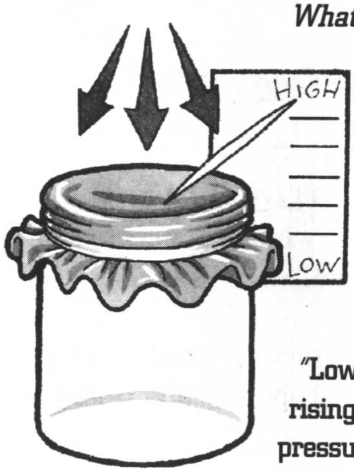
What You Need:

- Balloon
- Scissors
- Wide-mouthed glass jar
- Rubber band
- Toothpick
- Glue
- Tape
- Pencil
- 3" x 5" index card, or piece of paper cut to that size

What to Do:



1. Cut off the neck of the balloon, and stretch the rest of the balloon over the mouth of the clean, dry jar.
2. Secure the balloon in place with the rubber band.
3. Glue the toothpick onto the top of the balloon, with half of it sticking over the edge of the jar.
4. Position the card on the jar so the toothpick points to the center, and attach with tape. Draw a short line at this center point, and two lines above and two lines below it. Write the word "High" above the toothpick, and "Low" below the toothpick.
5. Place the barometer indoors, away from windows, where it will not be affected by moisture or heat. Observe the barometer daily, and note the changes on a sheet of paper. What kind of weather occurs one or two days after the toothpick moves to the "Low" area?



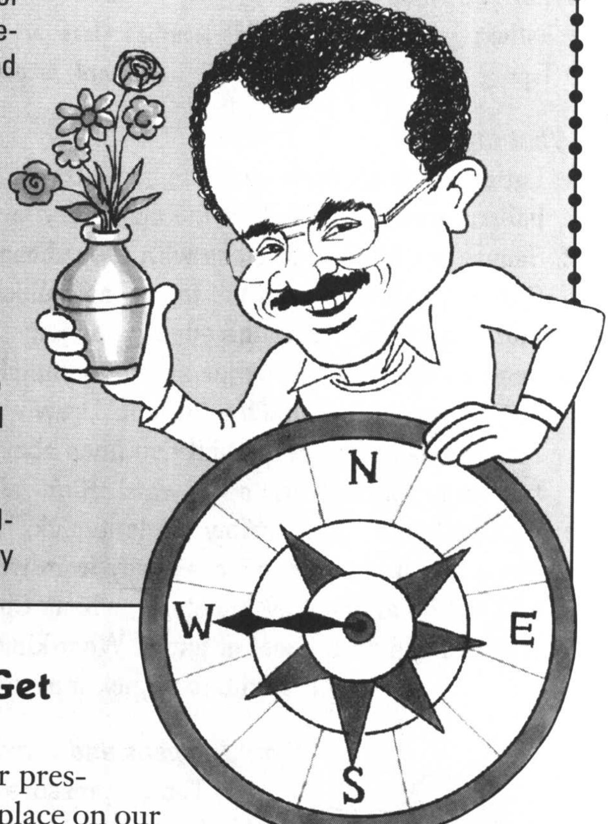
What Happens and Why:

The air pressure inside your jar stays the same, but the air outside changes. When the air pressure outside increases, it pushes down on the balloon surface. This causes the toothpick to point upward, into the "High" area. When the air pressure outside decreases, the pressure inside is stronger. The higher air pressure inside the jar pushes out against the balloon surface. This makes the toothpick point downward, toward "Low." A low air-pressure reading tells you that warm air is rising and cooling, forming clouds that can bring rain. A high-pressure reading predicts fair, dry weather.

Naming the Wind

In 50 B.C., the great Roman general Julius Caesar commissioned a Greek architect to construct a magnificent eight-sided, 46-foot-high white tower in the center of Athens. Why eight sides? This building was called the Tower of the Winds, because each side represented a direction from which the wind blew: north, northeast, east, southeast, and so on. On each side was carved a sculpture that showed the nature of the wind that came from that direction. For example, North was represented by a man dressed in warm clothes, to show that the wind from the north was cold, and West was a man carrying a flowerpot, to show that the west wind carried warmth.

Today, we still label the winds according to the direction from which they come. For example, when the weather forecaster announces that there is a 10-mile-per-hour northwest wind, it means the wind is blowing *from* the northwest.



How Does Air Pressure Get Things Moving?

Many weather events are related to air pressure. Air pressure varies from place to place on our planet. Cold, heavy air sinks closer to Earth and causes an increase in air pressure. But warm, light air tends to rise, reducing air pressure. When cold air sinks down, it SQUEEZES the warm air beneath it away. That is why, at ground level, the winds blow from cold places to warm places. When air moves straight up and down, we call it a **current**. When it moves **horizontally**, we call it wind.

Measuring changes in air pressure is a good way of predicting weather. High air pressure is a sign of fair weather, but if air pressure drops sharply, there's a good chance of rain or a storm.

Where the Winds Blow

The winds move air all around the planet, bringing warmer air to cooler areas and cooler air to warmer areas. Because the temperature in different levels of the atmosphere is not always the same, winds high above the ground can blow in a direction that is different from the directions of winds at the surface. Some winds blow in the same general direction all year long, while others blow in certain seasons, at certain times of the day, or only when storms arise.

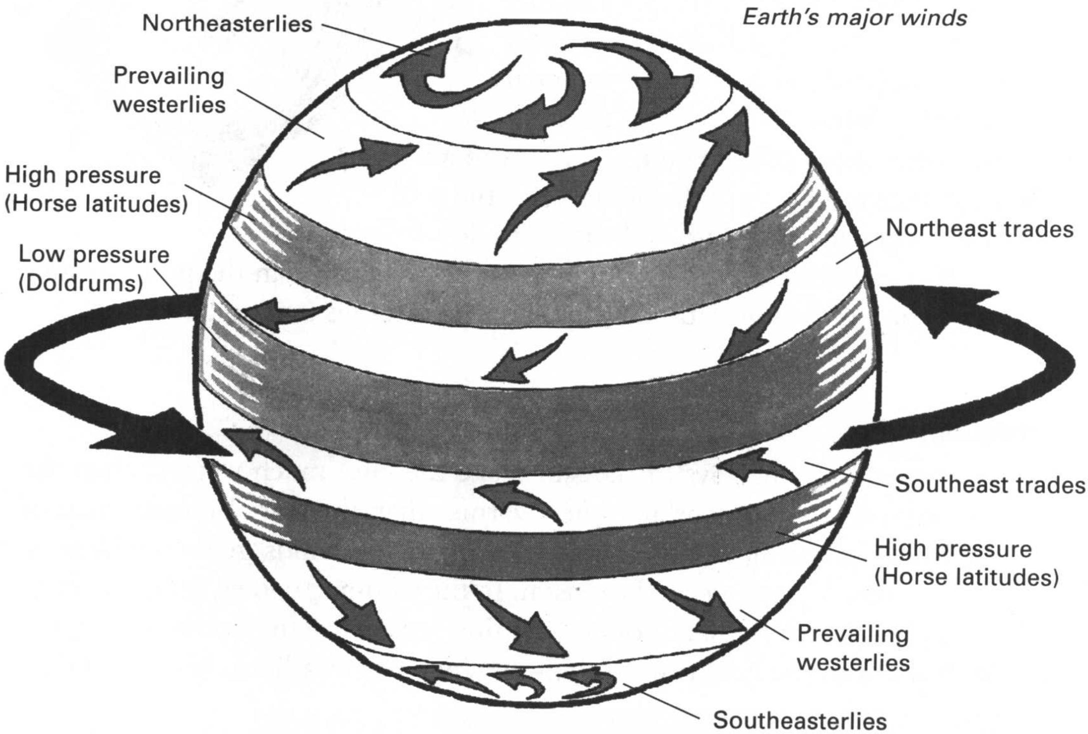
There are four basic types of winds: prevailing winds, seasonal winds, local winds, and storm winds.

Prevailing winds

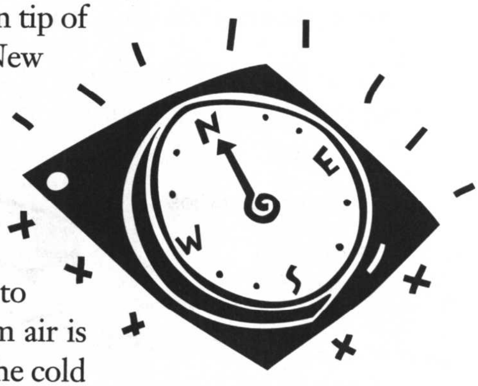
Although the weather changes from day to day, the equator is always hot and the poles are always cold. As a result of this fundamental temperature difference, Earth is ringed by bands of winds that generally blow in the same direction. These **prevailing winds** are the most important part of the system that moderates the temperatures on our planet.

- The equatorial **doldrums**: The area near the equator receives so much sunshine that the hot air rises almost straight upwards in strong currents, so there is very little wind.

Earth's major winds



- The northeast trade winds: When the warm air around the equator rises, cooler air moves towards the equator to replace it. Because Earth spins faster near the equator, the movement of air flows northeast from the coast of Africa towards the Caribbean Sea. These winds are called the **trade winds** because in the early years of ocean travel, ships used their power to reach distant places where goods could be traded.
- The horse latitudes: At about 30 degrees north and south latitudes, the air that was warmed near the equator cools and sinks straight downward, producing a narrow band of high pressure in which little wind blows. Many early sailing ships, caught in this band for weeks at a time, were forced to dump extra cargo, including horses, to make the vessel lighter. That's why this band is called the **horse latitudes**.
- The prevailing westerlies: The warm air that sinks in the horse latitudes is drawn toward the colder North and South Poles. This air, set in motion by the spinning of Earth, produces a broad band of winds blowing from west to east that covers almost all of the United States and Europe in the Northern Hemisphere, and the southern tip of South America, southern Australia, and New Zealand in the Southern Hemisphere.



- The polar easterlies—northeasterlies and southeasterlies: As warm air flows northward toward the North Pole, the cold polar air is drawn southward and is curved by Earth's rotation to flow from northeast to southwest. At the opposite end, where warm air is flowing southward toward the South Pole, the cold polar air is drawn northward and curved to flow from southeast to northwest. Because temperature differences are smaller in the polar regions than they are in the mid-latitudes, these polar easterlies tend to be weaker.

Seasonal winds

In the summer, the strong rays of the sun make the land much warmer than the oceans; in the winter, the oceans are much warmer than the land. In many areas of the world, these temperature differences mean that the winds generally blow in opposite directions depending on the season. In the summer, cooler, moist air from the water is blown over the land, often bringing seasonal rain. In the winter, the cooler air flows from the land toward the water, and the weather is much drier.

Local winds—land and sea breezes

The breezes that blow across the coast in tropical areas are called local winds. You can always count on them—the same wind pattern is repeated every day and every night. During the day, the wind blows from sea to land, and is called a sea breeze. As the sunshine heats up the land, the warm air over the land rises. Then the cool air from the sea is drawn in to replace it. The night brings a land breeze, when air moves from land to sea. After sundown, the sea stays warmer than the land, and as the air rises above it, cooler air from the land is drawn toward the sea.

Wind: The Incredible Mover and Shaper

We have never invented a machine as powerful as the wind, which helps to completely change Earth's surface every few million years. Here are some ways that wind alters the planet's shape:

- Desert winds pound boulders into sand and dust.
- Sand dunes are built up by desert winds that blow from one direction over a long period of time. Some dunes, reaching several stories high, slowly move across the desert landscape. In Iran and Algeria, some become as tall as skyscrapers!

- Seeds carried by the wind take root and grow into plants and trees, which change the landscape wherever they grow.
- In the Sahara Desert in northern Africa, very strong winds have lifted up and carried away rock to leave a huge, deep hole called the Qattara Depression.
- A desert wind can act like a sculptor, creating interesting shapes as it blasts away at rock. In a process called **abrasion**, the wind carries away soft rock and leaves only the hard rock behind. A large area of hard, flat rock that has been worn down by abrasion is called a **plateau**. A mini-plateau, such as those found in Monument Valley, Arizona, is called a **mesa**.