Reading Essentials in Science

DOWN TO EARTH!

Air and Wind

TRACI STECKEL PEDERSEN

PERFECTION LEARNING®

For the Teacher

DOWN TO EARTH!

Air and Wind

Genre

Expository

Text Features

Contents	Chapter Headings	Index	Sidebars	Chapter Titles
Glossary	Experiments	Diagrams	Photographs	Charts
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Organizational Patterns

Concept/Definition	Description	Cause and Effect

Vocabulary

aerovane	anemometer	atmosphere	atom	barometer
dense	exosphere	global	gravity	local
mesosphere	molecule	ozone layer	satellite	stratosphere
thermosphere	troposphere	water vapor	weather vane	

Overview

Air is an invisible, tasteless, odorless mixture of gases that all living things depend on. Its special properties determine its behavior and importance. Like all gases, the molecules in air are spread far apart and move around freely. When heated, the molecules spread out even farther, making the air less dense. This is why warm air rises and cool air sinks. Air exerts pressure on everything around it. Air pressure varies with density.

The atmosphere is a blanket of air that surrounds the Earth. It is divided into five layers—the troposphere, stratosphere, mesosphere, thermosphere, and exosphere.

Air always moves from areas of high pressure to areas of lower pressure. This creates wind. When warm air above the Earth's surface rises, it leaves an area of low pressure below. Cooler air then rushes in to take its place. This movement of air forms local and global winds.

Winds can vary greatly in speed. They can range from calm to breezy to windy. Hurricane and tornado winds can reach speeds of more than 200 mph.

Wind is a powerful force. Weather vanes, anemometers, and aerovanes are instruments used to measure wind speed and/or direction. Several scales, including the Beaufort Wind Scale, classify winds according to their speed and effects. Wind energy can be harnessed and used to generate electrical power. It is a clean, safe way to make the most of our amazing air.

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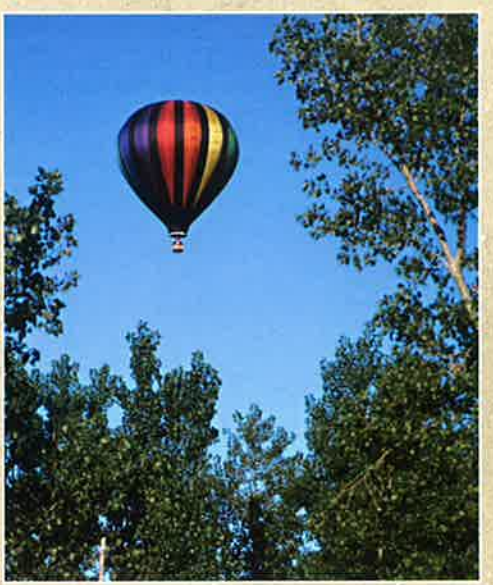
It's in the Air

What do hot-air balloons, sailboats, and kites have in common? They all rely on air to work. Without air, a hot-air balloon would never leave the ground. Without moving air, a sailboat wouldn't sail very far and a kite couldn't take flight.

Air affects your life in other ways too. Every breath you take fuels your body. The movement of air produces weather. Moving air might even be a source of power for your sound system or video games.

People living in ancient times were curious about air. They had many questions about the mysterious substance that seemed to surround them. Some believed that air was nothing at all. After all, you can walk right through it. You can't see it, taste it, or smell it. It took thousands of years and plenty of experiments to find out what we know about air today.

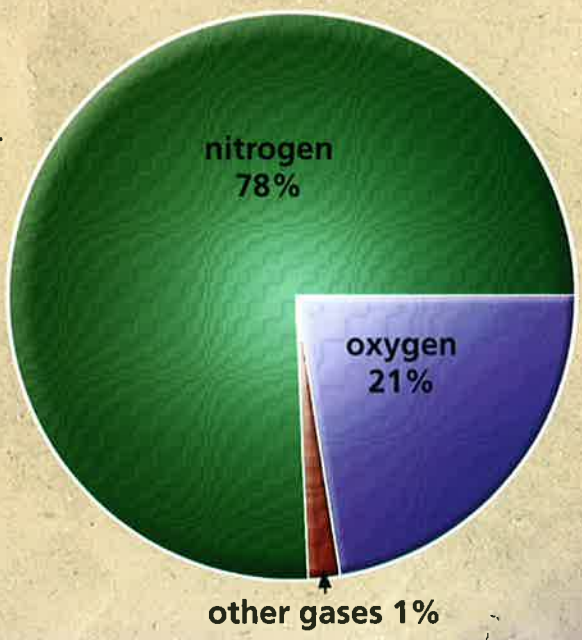


A Closer Look at Air

So what *do* we know about air today? Scientists now understand the unique properties of air that determine its behavior and importance.

Air Is a Gas

Take a deep breath. You've just inhaled a variety of gases. Air is about 78 percent nitrogen and 21 percent oxygen. The last 1 percent is a mixture of other gases such as carbon dioxide, argon, hydrogen, and helium. **Water vapor** is also present in the air, but it is not considered part of the actual air.



Air Takes Up Space

Even though you can't see it, air takes up space. Air is made of tiny particles, or **atoms**, of gas. Most of these atoms are stuck to other atoms to form **molecules**. These molecules may be invisible, but they take up space just like the molecules in a visible solid or liquid.

Inquire and Investigate: Does Air Take Up Space?

Question: If I push an empty cup into water, will the water enter the cup? Why or why not?

Answer the question: I think the water (will/will not) enter the cup because _____.

Form a hypothesis: Water (will/will not) enter the cup because the cup is full of air.

Test the hypothesis:

Materials

- cup
- sink or tub full of water

Procedure

- Quickly push the cup (open end down) straight down into the water until it hits the bottom of the sink. Lift the cup out of the water quickly. Check the inside of the cup. Is it wet?

Observations: The cup is dry. Water didn't enter the cup. (A few drops may splash into the cup from the movement in and out of the water.)

Conclusions: This happens because the cup is full of air. Even though you can't see it, the air takes up space in the cup. It pushes against the water, preventing it from entering the cup.

Scientist of Significance

About 50 A.D., a Greek engineer named Hero was the first known person to try the cup experiment. Hero turned over an "empty" container and pushed it down into water. The water didn't enter the container because it was filled with air.

Hero took the experiment a little further. He punched a hole in the closed end of the container and tried again. Now the water entered the container because the air could escape out the top.

Hero did many other experiments with air and water. He eventually invented the aeolipile (ee OH lee peyel), which was an early version of the steam engine.

Air Is Airy

The molecules in a gas are spaced far apart. This means that air is "airy," or not very **dense**. The molecules in a gas are able to move around freely. This is why you can walk through air. The air molecules simply part and move around you.

Hot Air Rises

When molecules are heated, they move faster. As they pick up speed, they spread farther apart. The farther apart the molecules are, the less dense the air is. This "lighter" air rises. The opposite is true as well. When molecules are cooled, they slow down and move closer together. This makes the gas more dense, so it sinks.

Hot-air balloons use this movement of hot and cold air. When heated, the air inside a balloon becomes less dense than the air outside the balloon. This causes the balloon to rise. To land the balloon, a vent is opened so some of the hot air can escape. The cooler air now sinks, bringing the balloon down with it.

Air Has Weight

Because everything is made of atoms and/or molecules, everything has weight. Air, however, has fewer molecules in a given space, so it is extremely light compared to liquids and solids. This is why air "floats" above the Earth's surface.

A Heavy Subject

The actual weight of air is .07 pounds per cubic foot. Try this activity to find out how much the air in your classroom weighs. Measure the length, width, and height of the room in feet. Multiply the three measurements together to get the volume of the room. Then multiply the volume by .07. This will tell you how much the air in your classroom weighs. For example, the weight of the air in a 30' x 30' room with a ceiling height of 10' is 630 pounds [(30 x 30 x 10) x .07].