

Solids, Liquids, and Gases

A Science A-Z Physical Series

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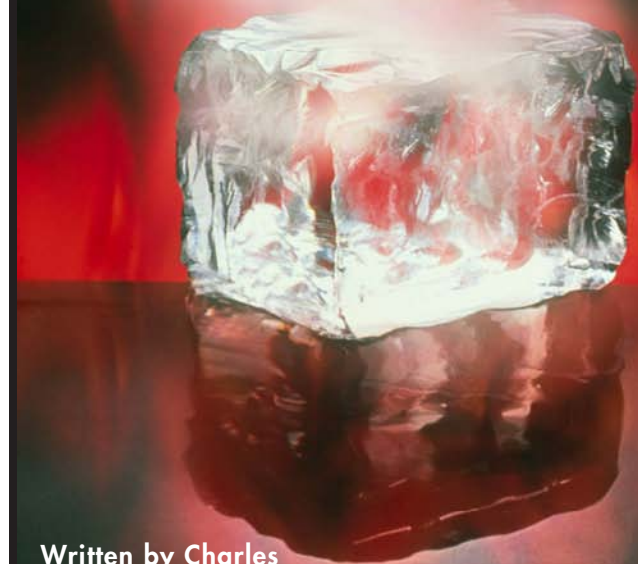
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Written by Charles
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KEY ELEMENTS USED IN THIS BOOK

The Big Idea: All things on Earth consist of matter. The most common states of matter are solids, liquids, and gases. Matter can change from one state to another. Matter in each state has identifiable properties. When matter combines, a mixture may form. The components of that mixture may retain their individual properties when combined, or the mixture may take on new properties. What allows us to have so many different things all around us is that matter can be found in various states, and it combines with other matter in many ways. It is useful to understand how materials may change when combined or when subjected to changes in temperature. This knowledge can keep us safe, and it has led to the development of medicines, fuels, recipes, and much, much more.

Key words: air, air pressure, condense, evaporate, freeze, frozen, gas, heat, liquid, matter, melt, mixture, properties, sand, shape, size, solid, solution, states of matter, substance, surface, temperature, water, water vapor

Key comprehension skills: Classify information

Other suitable comprehension skills: Compare and contrast; cause and effect; main idea and details; identify facts; elements of a genre

Key reading strategy: Summarize

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

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Table of Contents

Introduction	4
Matter.....	5
Types of Matter	6
Changing Matter	12
Combining Matter.....	15
Conclusion	18
Glossary	19
Index	20



Ice cream with whipped cream uses solid, frozen cream; liquid cream; and a gas in the can.

Introduction

Look around you. What do you see? Look at the book you are reading. Does it have a certain shape you can describe? What about the air you breathe? Can you feel it, smell it, or taste it? What about water from a drinking fountain? Can you see it and feel it? Does it have a certain size or shape?

Your world is made of many objects. Each has its own **properties**. These properties may include color, size, **temperature**, a certain shape, or a lack of shape. An object might feel rough or smooth, soft or hard, wet or dry. What are some other properties you can use to describe something? In this book, you will learn about the objects and **substances** all around you. You will also learn how these substances change.



Matter

The things around you that take up space are known as **matter**. Your desk, the milk you drink, and the air inside a basketball are matter. They all take up space. A grain of sand is a small bit of matter. It takes up a small amount of space. The water in a swimming pool takes up a lot of space.

Types of Matter

Matter comes in three main forms. Scientists call these forms the **states of matter**. Let's look at the picture of a fish tank. You can see gravel at the bottom of the tank. You can also see fish and decorations. Each of these things is a type of matter called a **solid**. They each have a specific shape. Their shape stays the same when moved from place to place. They also take up a specific amount of space.



Which states of matter do you see?



The water that the fish swim in does not keep the same shape when moved from one place to another.



A liquid takes the shape of its container but not the size.

If it were poured from the fish tank into a different-shaped container, it would take up the same amount of space. For example, if the water in the tank were moved into a large, round bowl, it would take the shape of the bowl. If the water in the tank were moved to a bowl smaller than the tank, the water would spill over the top of the bowl. The water in the tank cannot be squeezed into a smaller space.

If the bowl were bigger than the tank, the water from the tank would not expand to fill the bowl. Water is a type of matter called a **liquid**. Liquids do not keep the same shape when moved from one container to another. They also cannot be squeezed into a smaller space.

Do You Know?

Even though you can “pour” sand from one container to another, it is not a liquid. Why not? A pile of sand contains thousands of very small individual grains. Each small grain of sand is a solid. When you pour sand, it does take the shape of the container. But because each solid grain of sand keeps its shape, sand is a solid.



You can see air bubbles floating up through the



water in this fish tank. An air pump brings air from outside the tank into the water. You can see the bubbles made by the air in the water, even though you can't see the air in a classroom. Air itself is invisible, but you can feel it against your skin when the wind blows.

Air in the classroom and in the bubbles is in a state of matter called a **gas**. Gas takes up space, just as liquids and solids do. The air bubbles in the fish tank are taking up space. You have probably seen the evidence of air taking up space in balloons and bicycle tires. You can see a balloon get bigger as more air is blown into it. A bicycle tire gets fatter and harder as air is pumped into it.

Like liquids, gases don't have a specific shape. Gases take the shape of the container they are in. The air inside a balloon and a tire takes different shapes. But gases are also different from liquids. Unlike liquids, gases can be squeezed into a smaller space. When a tire is filled with more and more air, the air pushes harder against the inside of the tire, making the tire harder. If you add too much air to a balloon, the balloon stretches until it pops.



As you blow into a balloon, the gas squeezes so more air fits inside.

Things like tires and basketballs work best when they have the right amount of air. If a tire does not have enough air, it will be flat. If a basketball has too little air, it will not bounce. If it has too much air, it will explode. Look on the edge of a tire or near the place where you put air into a basketball. You will see a number that tells you the amount of air to put into the tire or ball.



PSI is a measure of pounds per square inch, or air pressure.



Changing Matter

Matter can change from one state to another. Have you ever made your own Popsicles by freezing a fruit drink in an ice cube tray? If you have, you changed a liquid into a solid by lowering the temperature. When you eat a Popsicle on a hot day, the Popsicle melts and drips down your fingers. Just by taking heat away, you can change a liquid into a solid. By adding heat, you can change a solid back into a liquid.





Adding or taking away heat to matter can make it change states. This water will evaporate faster if it is warmed.

Have you ever spilled a drink of water and forgotten to clean it up? When you look at where you spilled the water the next day, you can't see it. It changed into an invisible gas called **water vapor**. When liquid water changes to a gas, it **evaporates**. The change of a liquid to a gas is called *evaporation*. You don't need warm temperatures to make a liquid evaporate. But by increasing the temperature, you can make it evaporate faster.

Have you ever seen water form on the outside of a glass of ice water? Where did this water come from? The water on the outside formed when water vapor in the air touched the cold glass. The water vapor in the air cooled when it touched the cold glass, changing it into a liquid. When a gas changes to liquid, it **condenses**. The change is called *condensation*.



Do You Know?

Earth's water is found in all three states. About two-thirds of Earth's surface is covered by water in the liquid state or solid state. The oceans, rivers, and lakes make up the liquid water. The ice caps of the North and South Poles make up most of the water in the solid state. Some of Earth's water is water vapor, a gas. Most of this water vapor is found in the atmosphere above Earth's surface.





What states of matter are mixed together in this lunch?

Combining Matter

It may seem easy to identify different states of matter. In many cases, this is true. But sometimes it is not so easy. Let's think about lunch. Let's pretend that you are going to have chicken soup, crackers, a cheese sandwich, and a glass of lemonade.

You probably identified the crackers and cheese sandwich as solids. But what about the other food items? How would you describe the soup? The soup contains liquid. But it also has some solid pieces of chicken, vegetables, and noodles. Because the soup has two states of matter, it is called a **mixture**.

Lemonade is another kind of mixture. It is made of lemon juice (liquid), water (liquid), and sugar (solid). This type of mixture is called a **solution**. Solutions are often a combination of liquids and solids.



Think About It

How could you separate sand and sugar that have been mixed together?

Hint: One option is by using a magnifying glass and a toothpick.



Gases can also be mixed with liquids. Soda pop is a mixture of gases and liquids. The bubbles in a glass of soda pop are gases. Even liquids can be mixed with other liquids. If you mix liquid dish soap with water, you are making a mixture of two liquids.

Do You Know?

You can separate the salt from a solution of salt water by letting the water evaporate. When all the water has evaporated into the surrounding air, the salt is left behind.



Conclusion

Everything that takes up space is made of matter. Common states of matter are solids, liquids, and gases. A lot of the substances we use every day—such as soda pop, candy, and ice cream with chocolate chips—are combinations of solids, liquids, or gases.

By changing the temperature, matter can change from one state to another. Water is matter that we see change state almost every day. Where might you find all three states of water on the same day?



How many states of matter do you see?



Glossary

condenses	changes states from a gas to a liquid, mainly due to the temperature getting cooler (p. 14)
evaporates	changes states from a liquid to a gas, mainly due to the temperature getting warmer (p. 13)
gas	matter that can freely change shape and size; often it can't be seen (p. 9)
liquid	matter that keeps its size but takes the shape of its container (p. 8)
matter	anything that takes up space and has weight (p. 5)
mixture	a combination of substances in which a chemical reaction does not occur (p. 16)
properties	features or qualities that can be used to describe something (p. 4)
solid	matter that keeps its shape and size (p. 6)

solution	a mixture in which one substance is spread evenly through another substance, such as a solid dissolving in a liquid and becoming invisible (p. 16)
states of matter	the solid, liquid, or gaseous condition of a substance (p. 6)
substances	particular kinds of materials (p. 4)
temperature	the measure of how hot or cold something is (p. 4)
water vapor	the state of water in which it is an invisible gas (p. 13)

Index

air pressure, 11
gases, 3, 9, 10, 13, 14, 17, 18
liquids, 3, 7–10, 12–14, 16–18
mixture, 16, 17
properties, 4
sand, 5, 8, 17
solids, 3, 6, 8, 9, 12, 14, 16, 18
water, 4, 5, 7–9, 13, 14, 16–18