Core Knowledge® SCIENCE

# Properties of Matter

solid

gas

liquid

solid water

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Core Knowledge®

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## Table of Contents



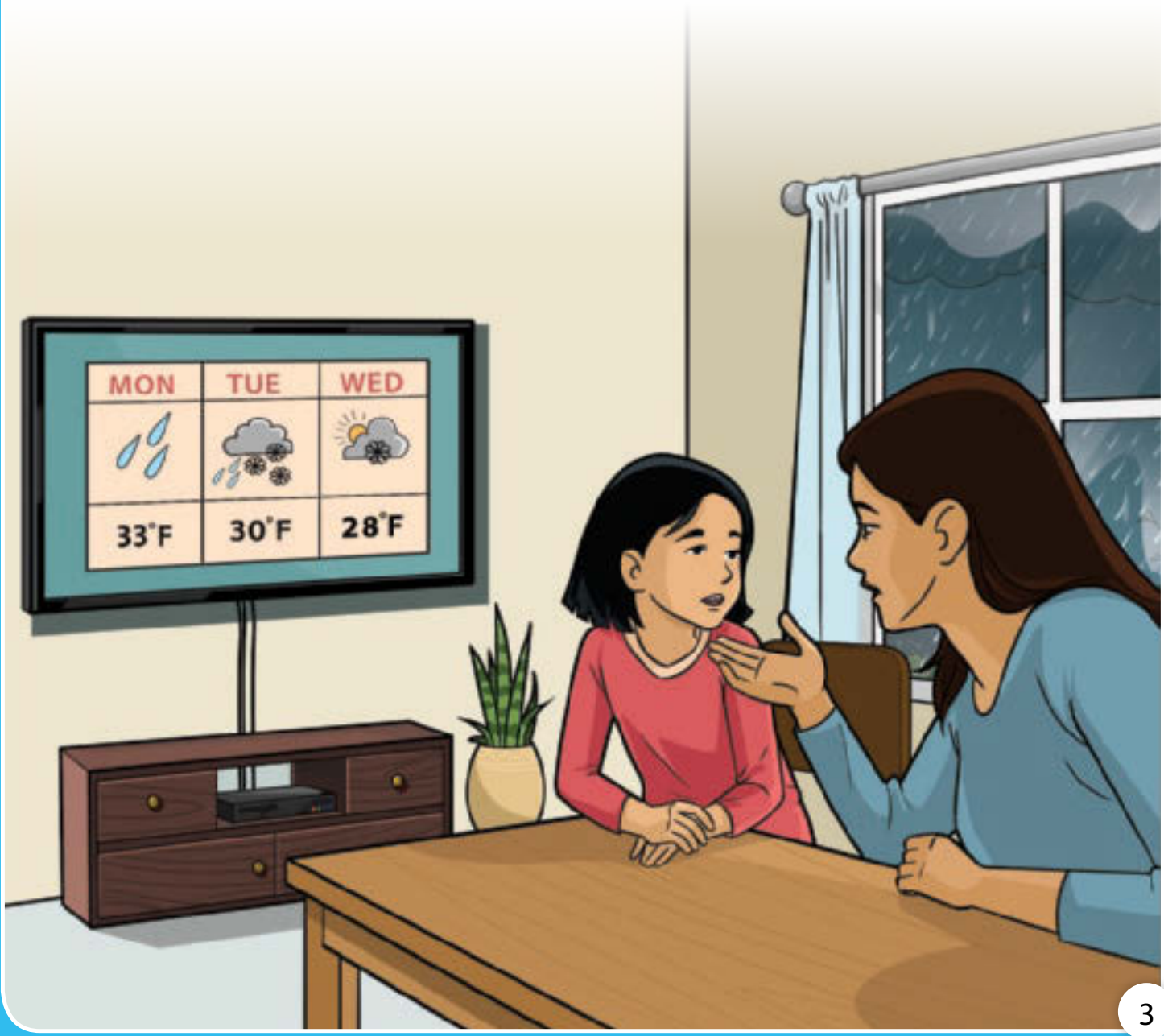
CHAPTER 1

# Where Did the Salt Go?

It was a gloomy and chilly Saturday. Maya looked out the window. Rain was falling hard. Water ran down the sidewalk. It filled potholes in the street. She wished the rain would stop. She wanted to go outside and play.

Maya's mom came into the room. "Maya, it is going to get cold later," she said. "The rain will turn to ice. The front walk will be slippery. Can you go to the shed and get some sidewalk salt? The salt will help keep the sidewalk from becoming icy and slippery."

Maya liked to help her parents. She put on her raincoat and boots. Then she headed outside into the rain.



Maya found a bucket of sidewalk salt in the shed. She tried to lift it, but it was too heavy.

Maya looked around. She found a paper bag with handles. It would be easier for her to carry. She used a small shovel to fill the bag with salt. Then she carried the bag to the front sidewalk. She would check the weather again in a few hours.

Later that afternoon, Maya looked outside again. She could tell it was getting colder. Snowflakes were mixing with the rain. It was time to spread the salt.

But when Maya got outside, she saw that the paper bag was very wet. It had turned to mush. The salt was almost gone, too. Maya wondered how this could have happened!

CHAPTER 2

# What Is Matter?

Look around your desk or table. What is on it? What is in it? You may have scissors, pencils, glue, and colored markers. All these objects look different. They feel different. They have different uses. But they all have one thing in common. They are made of something. They are made of stuff. Another word for stuff of any kind is matter.

Matter is the "stuff" that is all around you. It is anything that takes up space. Matter can be as small as a grain of sand. It can be as large as a tall tree. It can be as light as a feather or a cloud or even air. It can be as heavy as a boulder.

Sand is matter. People's hands are matter.

Tree leaves are matter. So are tree trunks and branches.

Feathers are matter. So is the air that you cannot see.

Rocks are matter. So are people and clothes.

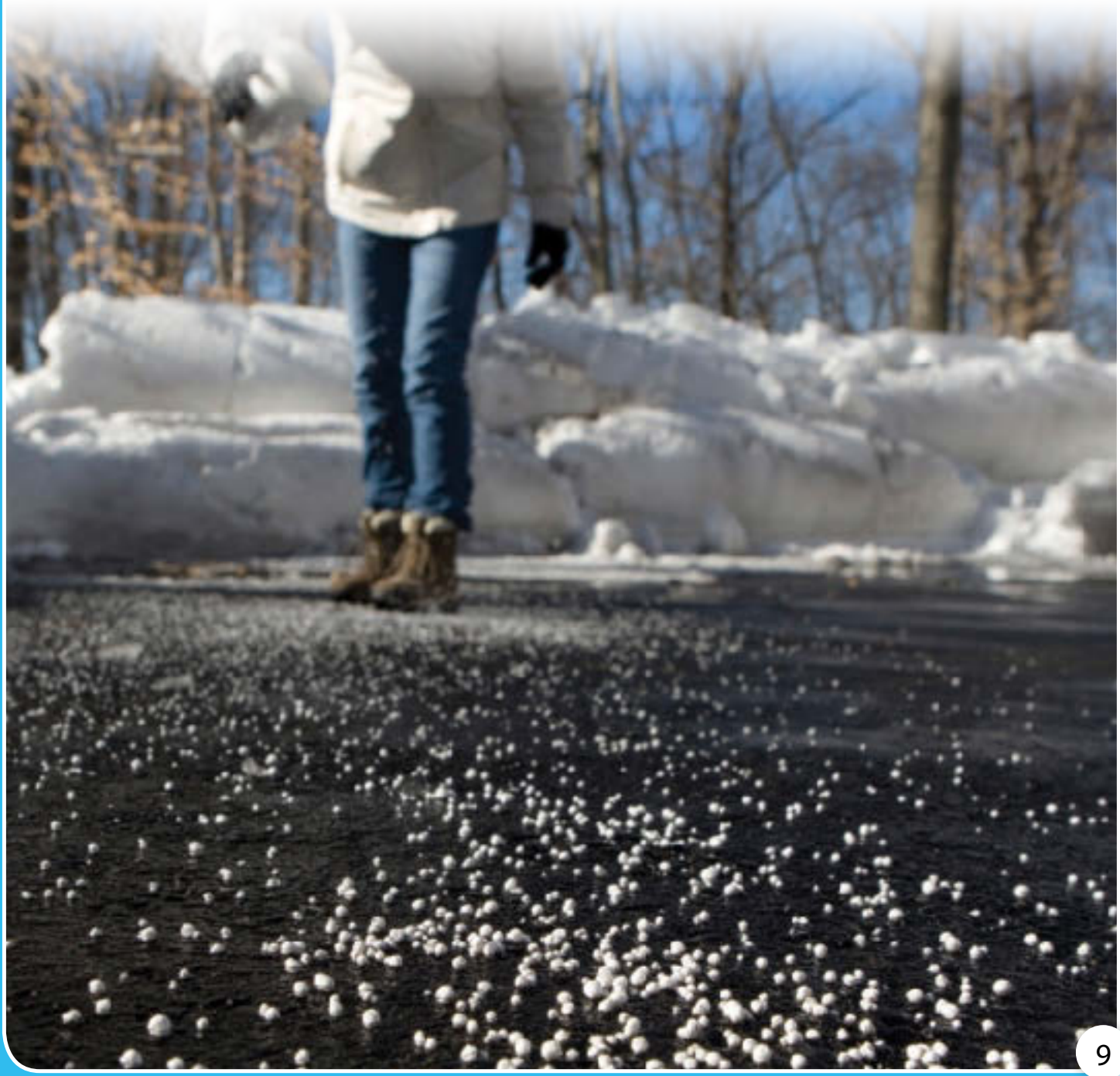
You can see and touch some kinds of matter. You can sometimes smell and taste it. You can measure matter. You can use different words to describe it.

Name three things in this photo that are matter. What are some words you can use to describe ice cream?

Can you think of some examples of matter from the story about Maya and her bag of salt?

Salt is matter. Rain, ice, and snow are matter. Sidewalks and houses are matter. Even Maya herself is matter!

All of these things take up space.



CHAPTER 3

# What Are the Different Kinds of Matter?

You know that rain is matter. You also know that rocks are matter. But they are different kinds of matter. It helps to group matter into different types. Scientists group matter by whether it is a solid, a liquid, or a gas. Solid, liquid, and gas are called states of matter.

There are three states of matter in this picture. Can you tell what they are? Read on to learn more about them.

## Solids

A solid is matter that has its own shape. If you put a solid in a container, such as a bucket or a bag, its shape will stay the same. It does not change shape to fill the container.

Wood is a solid. Logs stay the same shape whether they are in the container or not.

Wood blocks remain the same shape whether they are in a bucket or not.

An apple is a solid.

A book is a solid.

Solids can be rough or smooth. They can be shiny or dull. They can be soft or hard. They can be stiff, or they can be easy to bend. They can be long, short, light, or heavy. Solids can be all different colors. They can be see-through.

What are some ways you can describe these solid objects?

## Liquids

A liquid is a type of matter that does not have its own shape. It will fill the inside shape of any container it is in. A liquid also flows, or spreads from one place to another. Water and oil are some liquids.

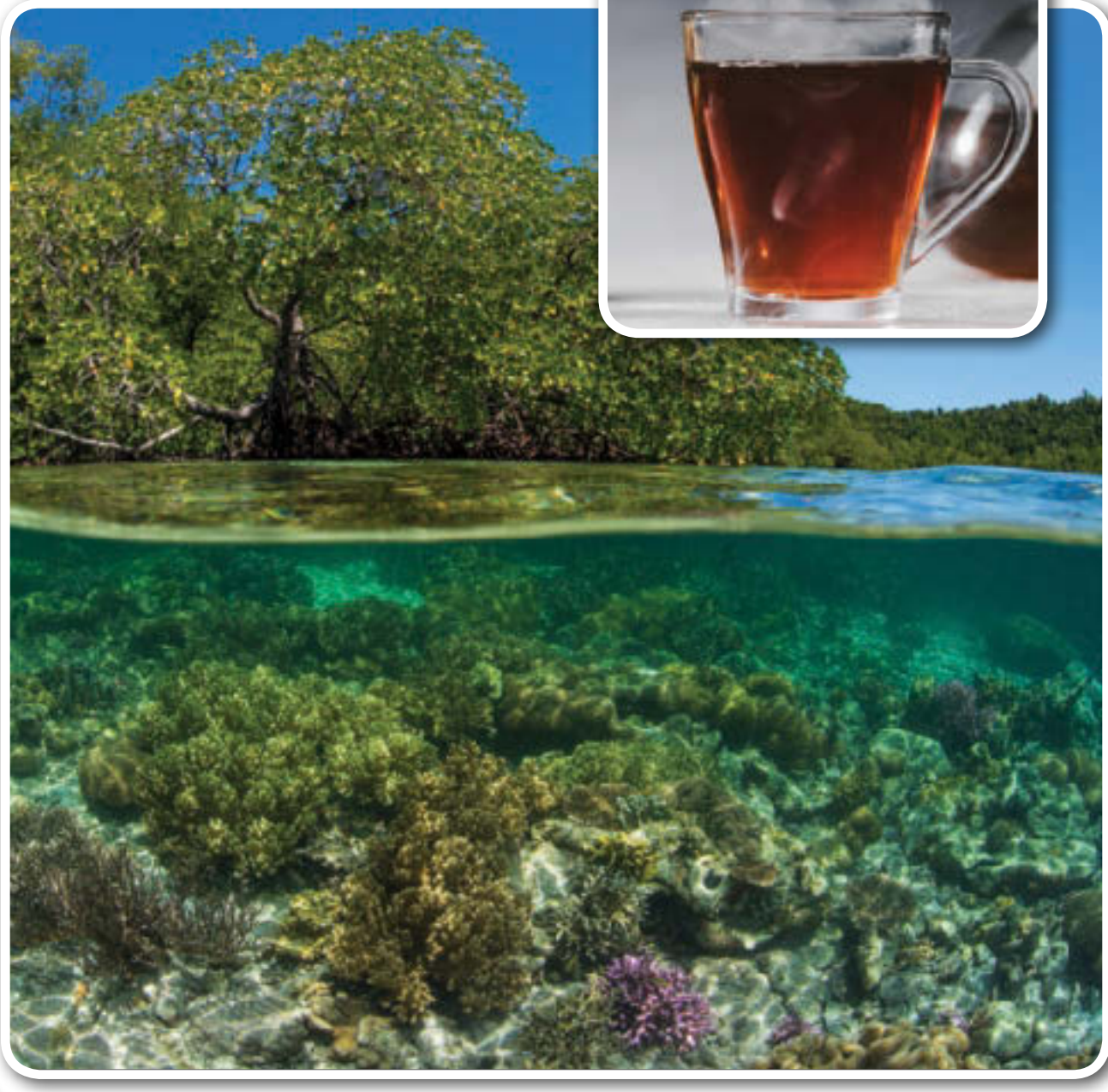
This honey takes the shape of the container it is poured into.

Honey poured onto pancakes flows into a different shape.

Olive oil is liquid. It flows and takes the shape of the bowl.

You can see through some liquids, like water. Other liquids, like dark oil, are hard to see through. Liquids can be thick or thin. They can be warm or cold. They can be any color. Some liquids have a smell. Others do not.

How would you describe the liquids that you see here?



## Gases

Like a liquid, a gas does not have a fixed shape. A gas takes the shape of its container. But unlike a liquid, a gas can spread out in every direction. It can fill an entire container. A gas can even escape a container that is not closed.

The air that you breathe is a gas. It fills the space around you. The matter inside balloons is a gas. It spreads out to fill the inside of the balloons, no matter how they are shaped.

Many gases are invisible, like air. Some gases have an odor. Others do not smell at all. The bubbles are filled with air. Air is gas.

The gases that come out of a volcano smell awful! They are poisonous and dangerous to breathe.

Now think again of the story about Maya and her bag of salt. What are some solids in the story? What are some liquids? What are some gases? Keep reading to help Maya solve the mystery of the disappearing salt!

CHAPTER 4

# You Can Measure Matter

You can observe matter to help you describe it. You can measure matter, too. You can find out how large or small it is. You can find out how light or heavy it is. You can find out how full or empty a container of matter is. Different tools measure different kinds of matter.

A ruler is too short to measure the length of this dog. What are the people using instead?

## Measuring Solids

There are many ways to measure solids. You can measure a solid's height to find out how tall it is. You can measure its weight to find out how heavy it is. You can measure a solid's width to find out how wide it is. Then you can use this information to help you describe it.

Rulers and measuring tapes are marked in inches and centimeters. They can tell you the height, length, and width of a solid object.


A scale shows pounds and ounces or grams. It measures weight. A scale tells you how light or heavy something is.

## Measuring Liquids

Liquids flow. They do not have a shape. You cannot measure a liquid's length or width. Instead, you measure how much space a liquid takes up. This is called volume. Words that describe volume include liter, cup, pint, quart, and gallon.

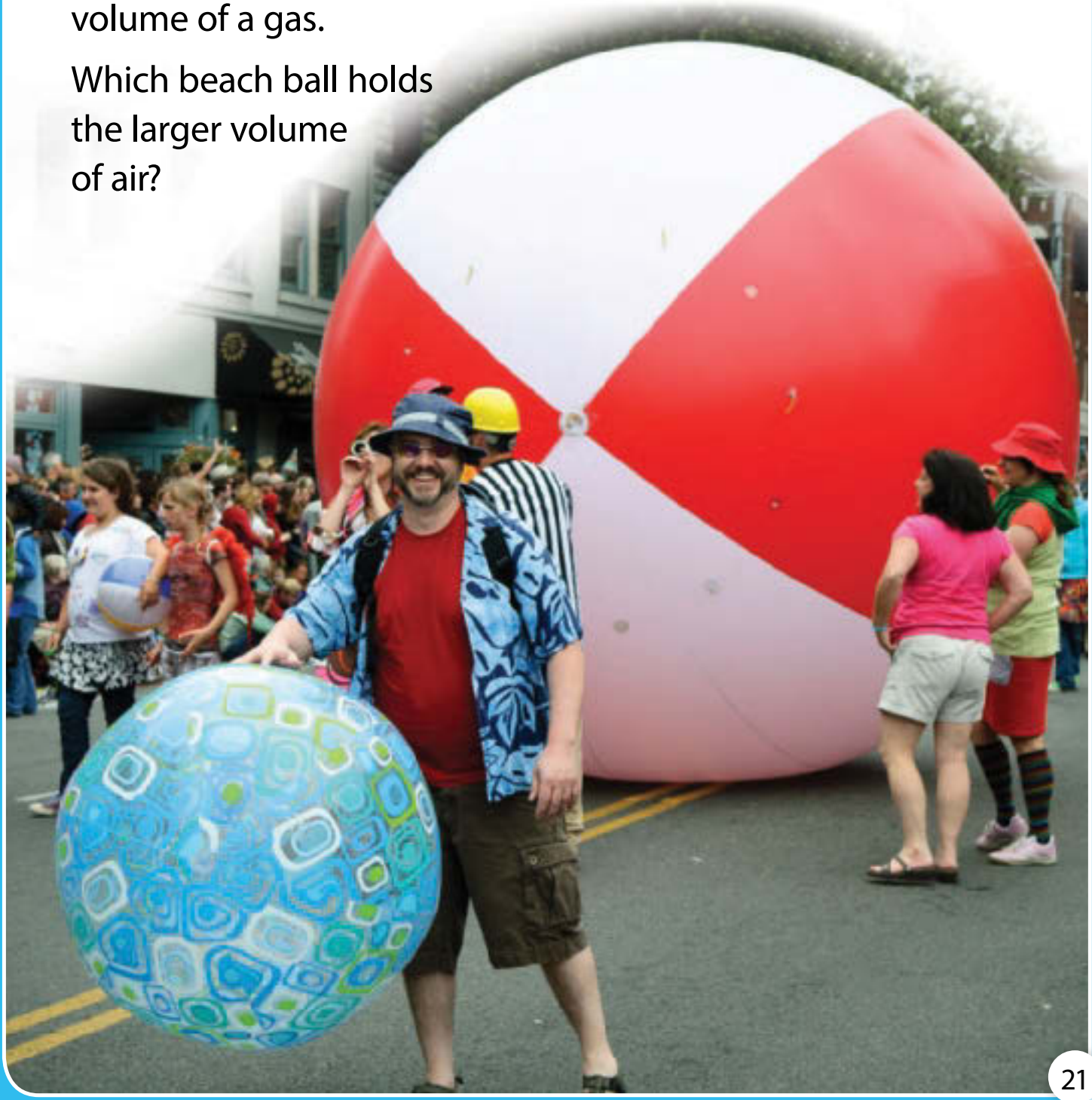

This container measures in milliliters. One milliliter is a very small amount of liquid.


You can buy milk in pints, quarts, half-gallons, and gallons.

## Measuring Gases

Most gases are invisible. You are probably wondering how you can measure something you can't see or hold. Gases are measured the same way liquids are. They are measured by the amount of space they take up. This measurement is the volume of a gas.

Which beach ball holds the larger volume of air?



CHAPTER 5

# Matter Has Properties

How can you describe the materials used to make this snowman?

The snow is white and cold. The carrot is long and pointy. The scarf is red, white, blue, and soft. The mouth and arms are thin and brown.

These are properties. Properties of matter are details that you can observe. You can measure many properties.

Weight is a property you can describe. Color is a property of matter. Size and shape are properties of matter. The way matter feels is a property, too.

You use your senses to observe matter. You can record data about matter. Then you can group matter by its properties.

What are some different ways you can group these objects?

Properties make matter useful for certain things.

Water is wet. It can put out fires.

Glue is sticky. It is used to hold things together.

Glass is see-through. It is perfect for making lenses in eyeglasses.

Bricks and wood are hard and strong. They are used to build homes.

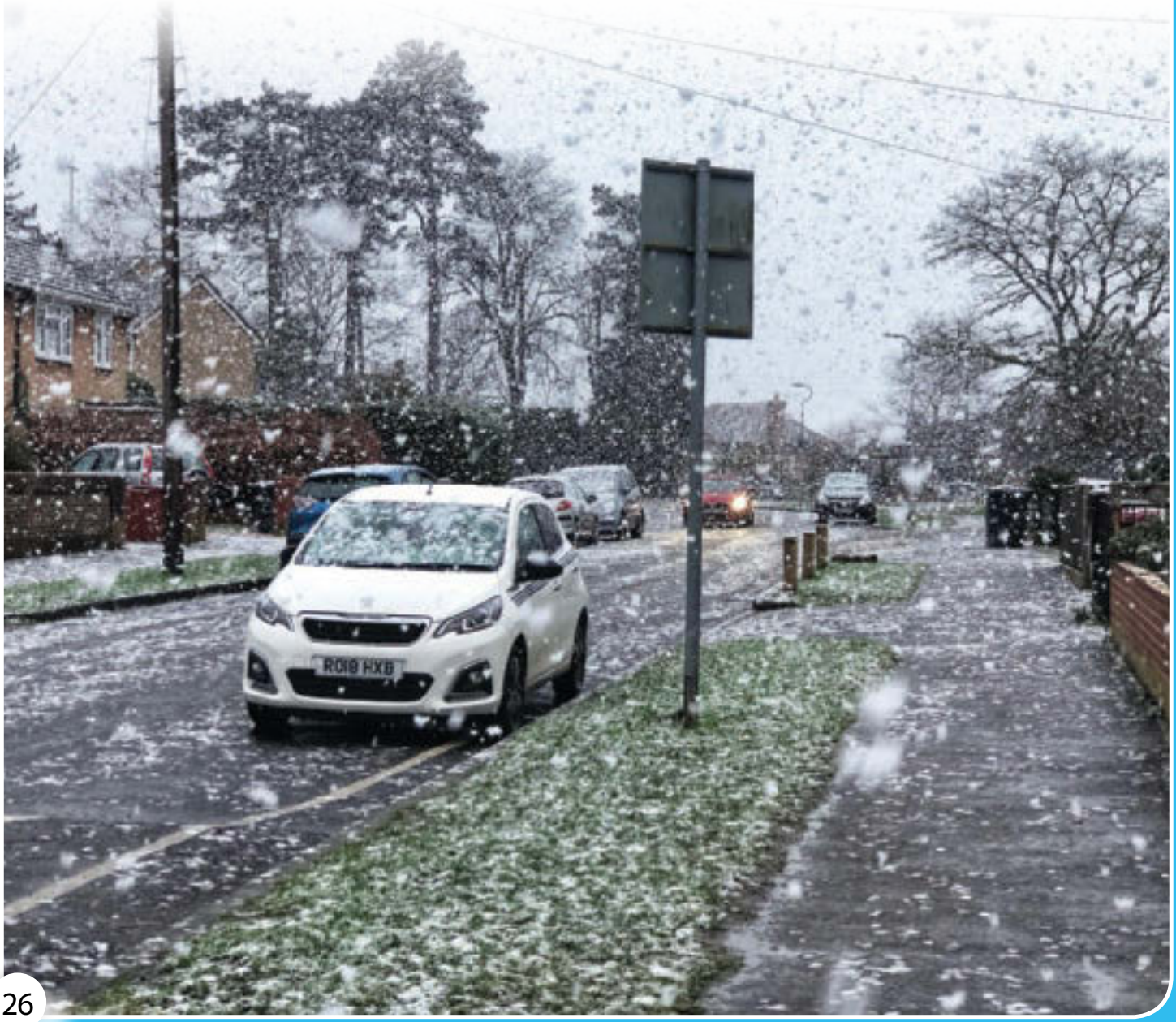
Do you remember what happened to Maya's paper bag in the story? The bag got wet. Then it turned to mush. That is because paper is thin and soft. Water can leak through it and make it softer. Paper is not a good material for storing things outdoors.

Look at the containers below. What materials are they made of? Which ones could have been better to hold Maya's salt? What properties make a material a better choice?

CHAPTER 6

# Heating and Cooling Matter

In the first part of the story, it was raining at Maya's house. Then it got colder. The rain started to turn to snow. A change in temperature caused this change. Temperature is a measure of how hot or cold something is. It snows when the temperature of the air is cold enough.



Temperature is measured in degrees. You can measure it with a tool called a thermometer. This thermometer has two scales. One scale is degrees Celsius (°C). The other scale is degrees Fahrenheit (°F). What is the temperature in °F? What is the temperature in °C?

Making matter warmer or cooler causes changes to its properties. Warming can change matter from a solid to a liquid. Cooling can change matter from a liquid to a solid. Warming can change matter from a liquid to a gas.

Heating a solid can change it to a liquid. You can see this change when you melt butter in a pan.

Heating some liquids can change them to solids. You can see this change when you fry an egg or when you bake cake batter.

Heating a liquid can also change it to a gas. Steam above boiling water is a sign of this change.

Changes happen when you cool matter, too. Cooling can change a liquid to a solid. You can see this change when you fill an ice cube tray with water. When you take it out of the freezer, the water is solid ice.

Icicles are solid water. They form when cold air changes the liquid water that drips from the roof.

Sometimes, changes are reversible. That means matter can go back and forth from one state to another. Heating can melt solid chocolate to a liquid. Cooling can change it back to solid chocolate again.

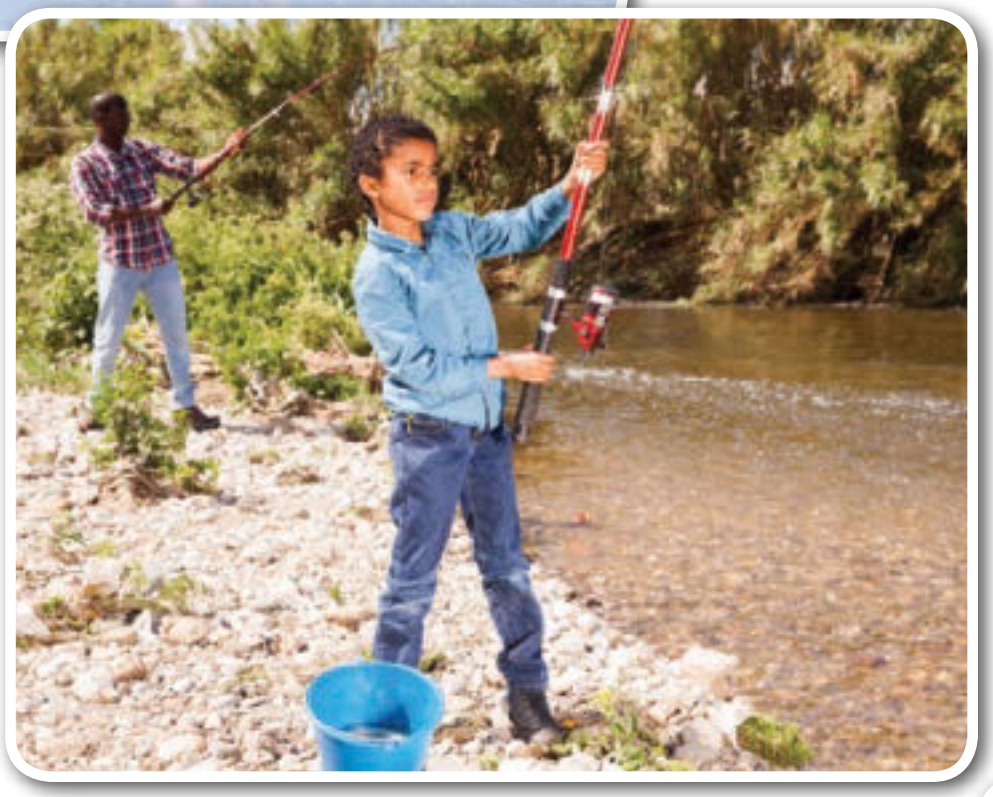
Sometimes changes cannot be reversed. A cooked pancake cannot be changed back to liquid batter.

## Water Can Be a Solid, a Liquid, or a Gas

Heating and cooling cause matter to change its state. Some matter changes states more easily than other matter. Water very easily changes among all three states. It changes and then can easily change back again.

When liquid water is heated, it changes to a gas called water vapor. When liquid water cools, it becomes a solid—ice. Ice changes back to liquid water when heat is added again.

This canal is ice now. In warmer temperatures, it will change to liquid water.



This river is liquid now. In colder temperatures it will change to solid ice.

CHAPTER 7

# What Can We Make from Matter?

We use matter to make the things we use every day. Look at the pictures. Can you name some different kinds of matter each object is made from?

The objects that we use every day have a purpose. Sometimes they help meet a need. Sometimes they help make a job easier. Sometimes they are just for fun. Engineers design things that people use. They choose matter that is best for each object's purpose.

Rubber makes this ball bounce. The ball works great for kickball!

Some objects that people build and use are made with just one kind of matter. This tank is a home for fish. It must be see-through so that people can see inside. It must be strong so that it can hold a lot of water. The container cannot get soft when it is wet. Glass is matter that is best suited for a fish tank.

Other objects that people build and use are made from different kinds of matter. Some objects are made of many parts. Each part is made from matter that is best suited for its purpose. The different parts work together. They help the object work the way it is supposed to.

When many small parts are put together, they can make something big. Sometimes these objects can be taken apart again. Sometimes they cannot. This house is big. It is made from many small bricks.

Here are more objects that are made from many small parts. Compare them. Think about how they are the same. Contrast them. Think about how they are different.

What kinds of matter are the objects made from? Which objects can be taken apart and put back together again?

## Science in Action

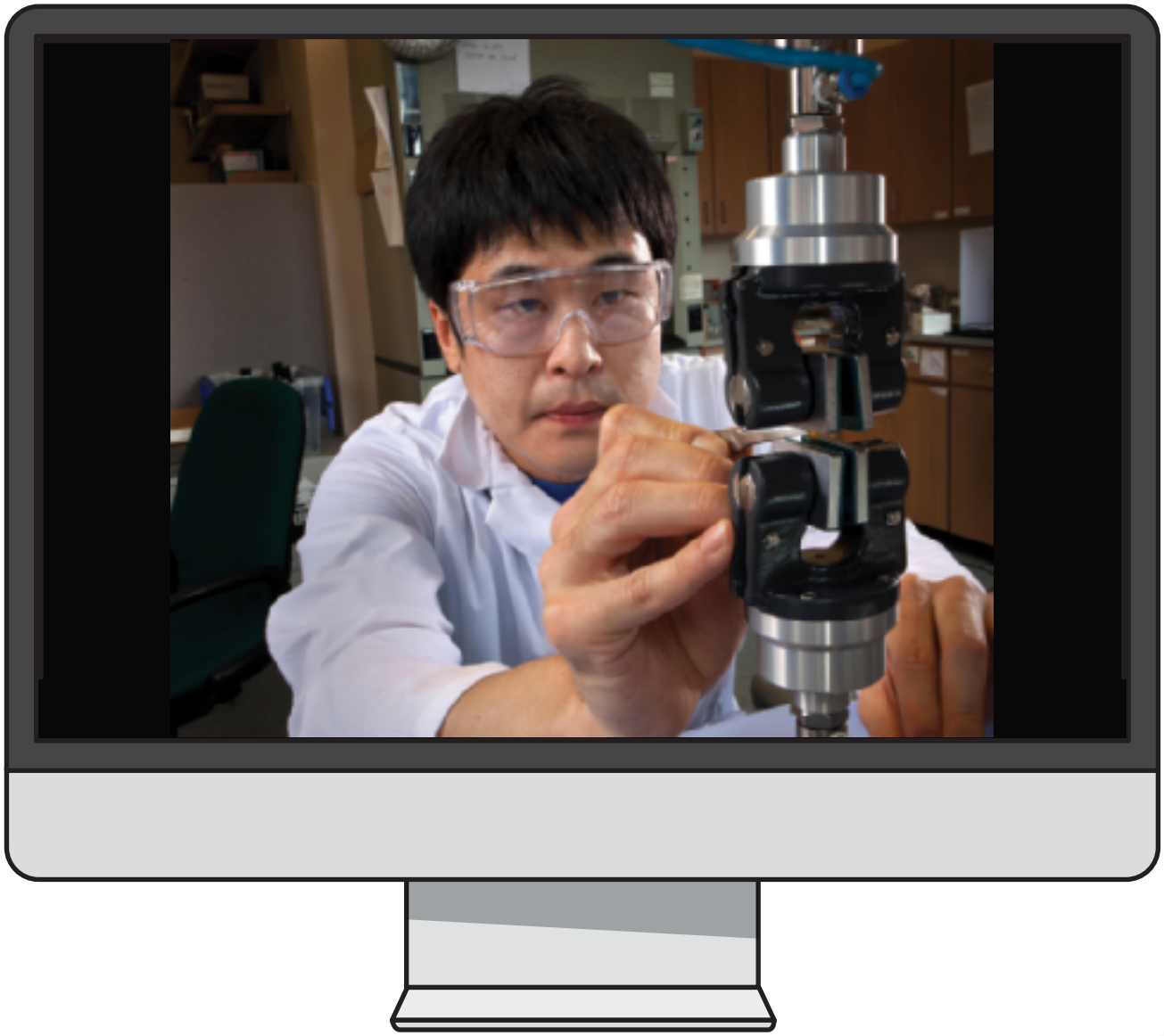
# Meeting a Materials Scientist

At school, Maya tells her teacher about the dissolving salt and the soggy paper bag. Mr. Prine asks the class, "Why did the paper turn to mush? Where did the salt go?"

Mr. Prine explains that salt and paper have properties that make water affect them in different ways. He says, "When paper gets wet, it turns to mush. Water breaks salt down into very small bits. How do people figure out what different materials will do in different situations?"

Mr. Prine asks his friend, Dr. Zhou, to talk with the class on a video call.

The class watches Dr. Zhou. He is a materials scientist. He explains, "Materials scientists study the properties of all types of matter. We investigate different materials to figure out how they can be useful. We also design new materials that work for special tasks. We design materials to solve problems and meet needs."



Dr. Zhou tells the class that he studies plastics to find ways to keep Earth safe. When people throw plastic away, it stays in landfills for a very long time. Dr. Zhou wants to design a plastic that can break down quickly. He wants to design a material that will not pollute Earth the way plastic does.

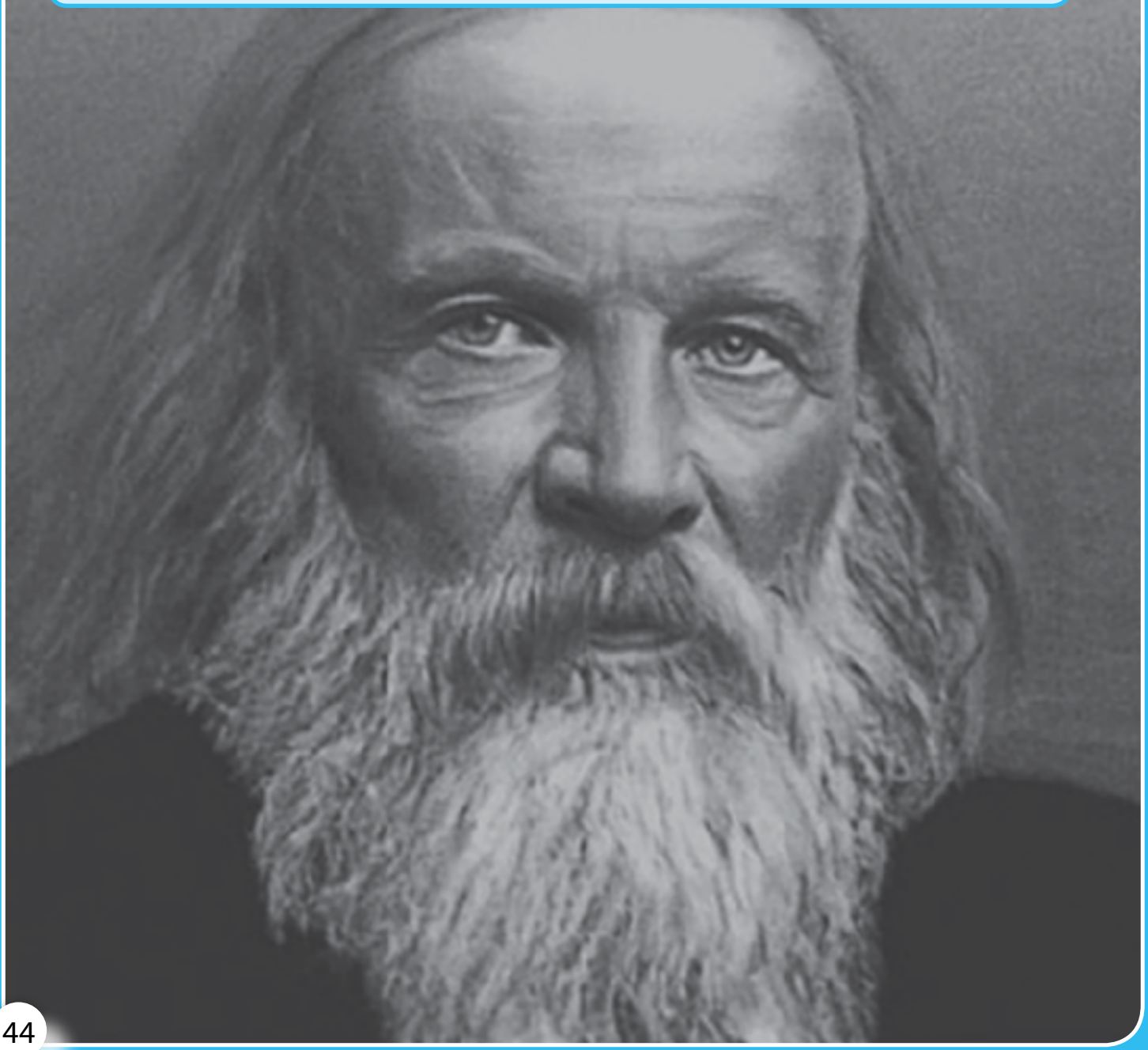
Dr. Zhou explains that the new material must feel and look like plastic. It must be able to be used like plastic. But it also has to be easily broken down by tiny living things in soil. Dr. Zhou tells the class that he will design and test his solutions until he finds one that works.

Dr. Zhou explains that many scientists before him have been studying types of matter for a very long time. He builds on what he has learned from their work. Scientists long ago started by learning about the different types of matter found in nature.

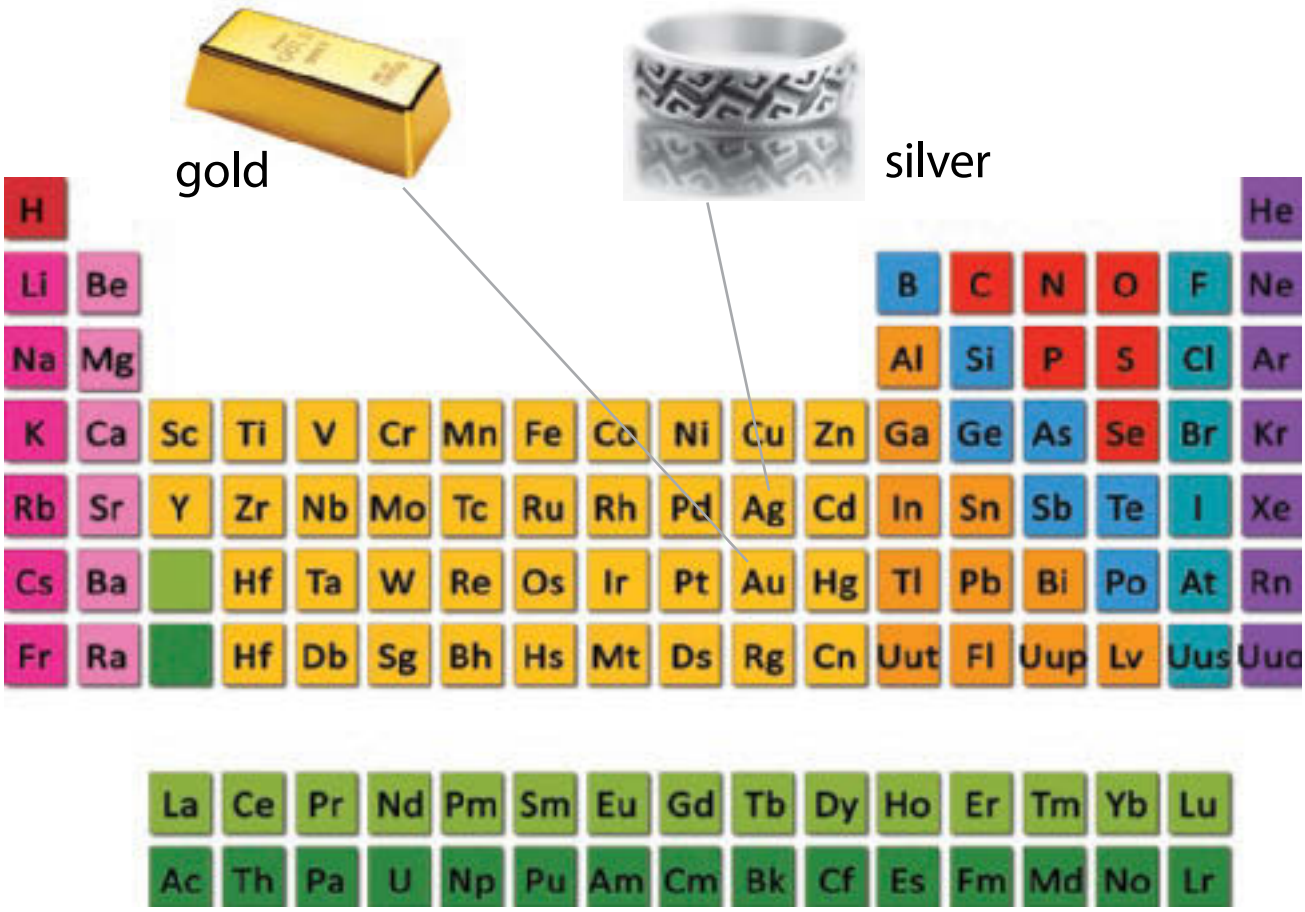
Dr. Zhou tells the students that his work depends on what he learned from the earlier work of a scientist named Dmitri Mendeleev /de*mee*tree/men*de*lae*ev/. Mendeleev was one of the first people to sort and group types of matter called elements in a way that made them easy to understand.

## Dmitri Mendeleev

Dmitri Mendeleev was a chemist in the 1800s. He studied elements. Elements are the most basic types of matter. Mendeleev listed the properties of each element. His list allowed him to group those elements together. Eventually, Mendeleev turned his list into the periodic table of elements.



The periodic table is a chart. It displays elements in rows and columns instead of as one long list. The arrangement groups elements by their similar properties. The types of matter in the same color on this table have something in common. For example, all the types of matter colored gold on the table are metal. Gold and silver are two types of matter in that bunch.




People around the world today still use the periodic table to understand types of matter. It now contains 118 elements. How many groups of different colors can you count?

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D. Hurst / Alamy Stock Photo: 20b
Danita Delimont / Alamy Stock Photo: 21
Danny Smythe / Alamy Stock Photo: 23d, 23f
Darling Archive / Alamy Stock Photo: 44
Derek Croucher / Alamy Stock Photo: 23h
devenorr / Alamy Stock Photo: 20a
Digifoto Neptune / Alamy Stock Photo: 23e
Dinodia Photos / Alamy Stock Photo: Cover A, 7d
Dmitriy Shironosov / Alamy Stock Photo: 19a
famveld / Alamy Stock Photo: Cover D, 33a
Ferenc Szelepcsenyi / Alamy Stock Photo: 12c
Gareth Dewar / Alamy Stock Photo: 39d
Gari Wyn Williams / Alamy Stock Photo: 42b
GraficallyMinded / Alamy Stock Photo: 30a
Harri Bragge / Alamy Stock Photo: 32
Iakov Filimonov / Alamy Stock Photo: 33b
Ian Shaw / Alamy Stock Photo: 27
Leila Cutler / Alamy Stock Photo: 8
Images By T.O.K. / Alamy Stock Photo: 41
IQpro / Alamy Stock Photo: 31b
Jeffrey Isaac Greenberg 3 / Alamy Stock Photo: 18
John Warburton-Lee Photography / Alamy Stock Photo: 7b
Kenishirotie / Alamy Stock Photo: 24c
kittichai boonpong / Alamy Stock Photo: 39a
Leithan Partnership t / a The Picture Pantry / Alamy Stock Photo: 13b
Leonid Nyshko / Alamy Stock Photo: 37
LightField Studios Inc. / Alamy Stock Photo: 13c, 14a
Maksim Lashcheuski / Alamy Stock Photo: 13a
Matthew Ashmore / Stockimo / Alamy Stock Photo: 26
Mirco Vacca / Alamy Stock Photo: 11b
Paul Maguire / Alamy Stock Photo: 24d
Peter Tsai Photography / Alamy Stock Photo: 34b
philipus / Alamy Stock Photo: Cover B, 15
Picture Partners / Alamy Stock Photo: 16a
Profimedia.CZ a.s. / Alamy Stock Photo: 23c
Radu Bighian / Alamy Stock Photo: 45b
Raul Mellado / Alamy Stock Photo: 28a
Richard Wong / Alamy Stock Photo: 39c
Robert Schneider / Alamy Stock Photo: 11a
Roman Sigaev / Alamy Stock Photo: Cover C, 28c
RTimages / Alamy Stock Photo: 45a
shapencolour / Alamy Stock Photo: 34a
Solarysys / Alamy Stock Photo: 36
StellaPhotography / Alamy Stock Photo: 7c
StockPhotosArt - Objects / Alamy Stock Photo: 34d
Stuart Burford / Alamy Stock Photo: 23g
Svetlana Lazarenka / Alamy Stock Photo: 11c
Tetra Images / Alamy Stock Photo: 11d
Tim Gainey / Alamy Stock Photo: 43
tim wege / Alamy Stock Photo: 28b
tom viggars / Alamy Stock Photo: 6
tuja66 / Alamy Stock Photo: 25b
Vaidas Bucys / Alamy Stock Photo: 23a
Valeria Aksakova / Alamy Stock Photo: 31a
victor cea / Alamy Stock Photo: 25a
Victoria Gnatiuk / Alamy Stock Photo: 22
XM Collection / Alamy Stock Photo: 24a
Yavuz Sariyildiz / Alamy Stock Photo: 16b
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