UNIT E

PHYSICAL SCIENCE

Investigating Matter

Unit Project

Soap Tests

Analyze advertisements for soap and record the manufacturer's claims. Choose at least three kinds of soap and plan ways to test them to see if the claims are true. Organize your findings on graphs, tables, or charts. Compare the results of your tests to the advertisements.

Chapter 1

Properties of Matter

Vocabulary Preview

matter
physical property
solid
liquid
gas
atom
evaporation
volume
mass

Every day we look at, listen to, feel, smell, and taste different kinds of matter. We even breathe it! Because matter comes in so many shapes and sizes, people have come up with many ways to measure it.

FAST FACT

People use lasers and satellites to measure really big objects. Mt. Everest in the Himalayas is the tallest mountain in the world. At 8848 meters (29,028 ft), it is as tall as a building with 2,950 stories!

FAST FACT

Our senses help us observe and describe matter. Dogs are famous for their sense of smell. Bloodhounds can use their sense of smell to follow a trail more than 100 miles long and 100 hours old.

Type of Animal	Best Smeller
Insects	Silkworm moths
Fish	Sharks
Mammals	Elephants
Amphibians	Newts
Birds	Petrels and albatrosses
Reptiles	Snakes and lizards

LESSON 1

What Are Physical Properties of Matter?

In this lesson, you can . . .

- **INVESTIGATE** kinds of matter.
- **LEARN ABOUT** the properties of different objects.
- **LINK** to math, writing, art, and technology.

This picnic basket is made of straw. The basket can hold many other things that are made of matter.

INVESTIGATE

Physical Properties

Activity Purpose Can you pour paper? Can you fold milk? Why not? Different objects have different properties. In this investigation you will **observe** different properties of matter.

Materials

- penny
- nickel
- marble
- key
- cotton balls
- piece of peppermint candy
- index card
- book
- uncooked macaroni
- twist tie
- peppercorns

Activity Procedure

1. Copy the charts shown.
2. Look at the objects you have been given. Notice whether they look shiny or dull. Notice how many colors each one has. **Record** your **observations.**

How It Looks				How It Feels			
Object	Shiny	Dull	Color	Hard	Soft	Rough	Smooth

How It Smells				How It Sounds			
Object	Sweet	Sharp	No Smell	Loud	Soft	Makes a Ping	No Sound

3. Touch the objects. Feel whether the objects are hard or soft. Feel whether they are rough or smooth. **Record** your **observations.** (Picture A)

4. Next, tap each object lightly with your fingernail. What kind of sound does it make? **Record** your **observations.**

5. Smell each object. **Record** your **observations.**

Picture A

Draw Conclusions

1. Which objects are hard and rough? Which objects are hard and smooth? Which objects are soft and rough? Which objects are soft and smooth?

2. **Compare** your chart with the chart of another group. Are any objects in different columns? Why?

3. **Scientists at Work** Scientists learn about the world by **observing** with their five senses. Which of the five senses did you *not* use in the investigation?

Process Skill Tip

Scientists study the world closely and **record** what they sense. This is called **observing.** Observing is one way scientists answer questions about matter.

LEARN ABOUT

Physical Properties of Matter

FIND OUT

- how to observe matter
- about three states of matter

VOCABULARY

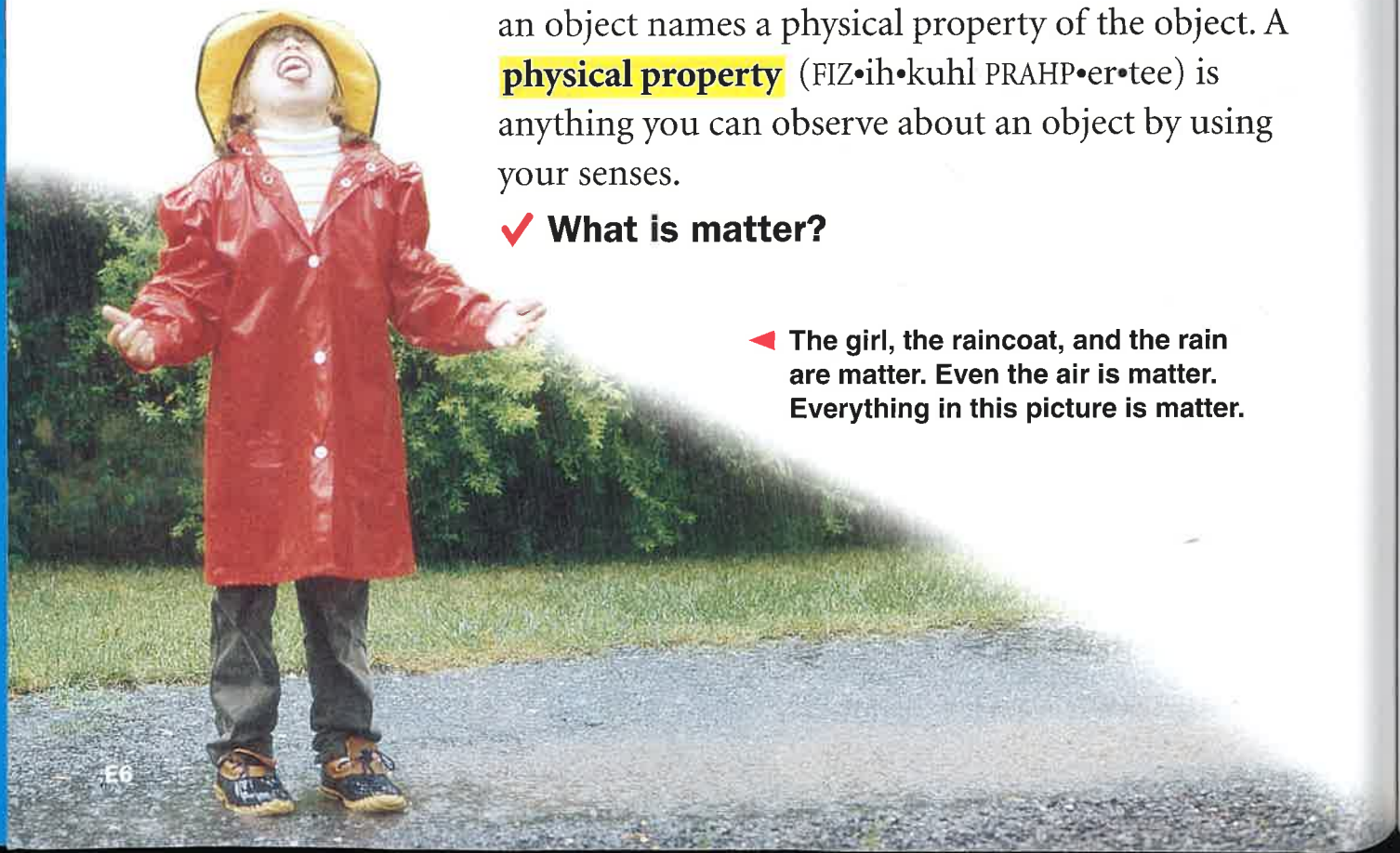
matter
physical property
solid
liquid
gas

Matter

Look around your classroom. You may see desks, books, other students, and the teacher. What else do you see? Everything you see takes up space. Your classroom must have enough space to hold you and all the other things that are in it. Everything in the classroom is matter. **Matter** is anything that takes up space.

Look at your desk. Can you pick it up with one arm? It is probably too heavy. Can you bend it? It is probably too stiff. You can use many different words to describe your desk. Each word you use to describe an object names a physical property of the object. A **physical property** (FIZ•ih•kuhl PRAHP•er•tee) is anything you can observe about an object by using your senses.

✓ **What is matter?**



The girl, the raincoat, and the rain are matter. Even the air is matter. Everything in this picture is matter.

What Matter Looks Like

You can observe some physical properties of matter with your sense of sight. In the investigation you observed some things that are dull and some things that are shiny. You also looked at the colors of the objects.

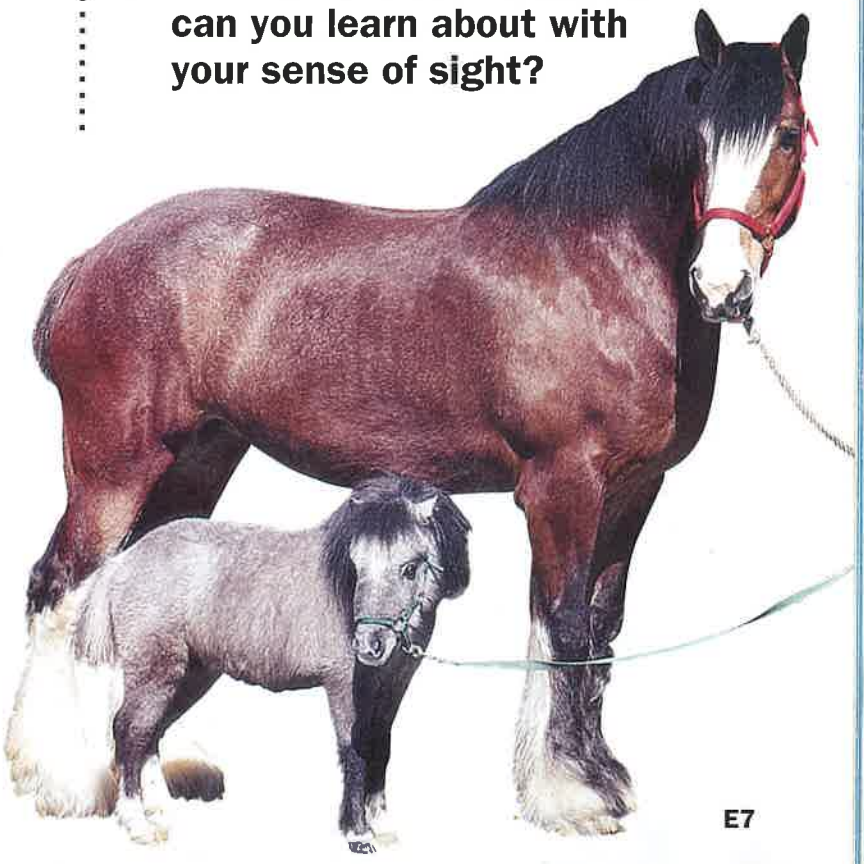
There are some things, such as most glass windows, that you can see through. Some of these things don't have any color. Then you can see the colors of the things on the other side. But some things you can see through, such as tinted windows, do have color. Then you can't tell the colors of things on the other side.

Another physical property you can see is size. Have you ever seen a group of basketball players? They don't seem tall by themselves. But when a player is standing next to you, you can see that the player is tall. Size is easiest to see when you can compare one object to another.

A property you cannot see is temperature. But you can see the effects of temperature. You can infer that something is hot if you see steam coming from it. You can guess that something is cold if you see it with ice or snow.

▲ **The glass has no color, so when you look through it, you can see that the liquid in it is pink. You can tell the drink is cold because it has ice in it. The steam rising from the cup of tea lets you infer that it is hot.**

✓ **What properties of matter can you learn about with your sense of sight?**



One of these horses is much larger than the other one. Size is a physical property of matter. ►

What Matter Feels Like

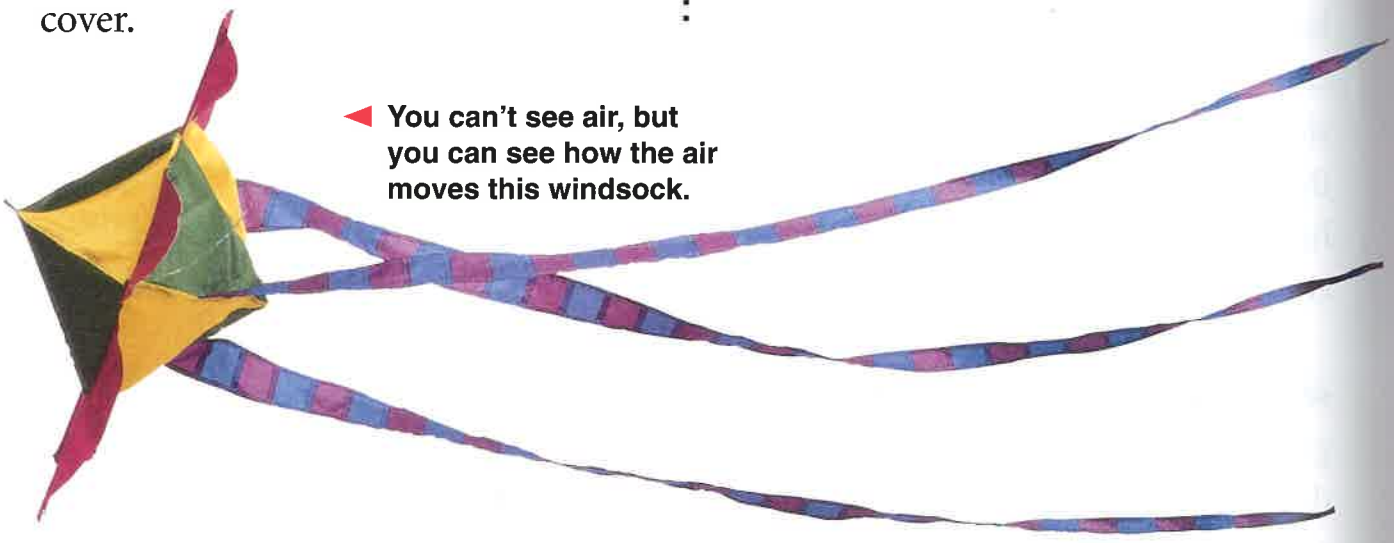
Many people wear shirts under wool sweaters because wool sweaters feel scratchy. You can learn about some physical properties of matter by using your sense of touch.

Sandpaper feels rough, but sand feels smooth. The bark on a tree and gravel against bare feet both feel rough. *Smooth* can describe objects as different as a mirror and a book cover.

You can feel some things that you can't see. You can feel the push of the wind. You can also feel whether something is hot or cold.

Different parts of the same object may feel different. A wool jacket feels rough, but the buttons may feel smooth. A cat's fur is soft, but its claws are sharp.

✓ **What are some words you can use to describe how matter feels?**



◀ **You can't see air, but you can see how the air moves this windsock.**

◀ **Snow feels cold and wet. Temperature and wetness are both physical properties of matter.**

Different parts of these slippers feel different. The fur is soft, but the soles feel hard and smooth. ▼

What Matter Tastes and Smells Like

People have to be careful about tasting things. Some things can make you ill, even if you taste just a small piece of them. But if you are careful, you can learn by tasting things. Your tongue can taste things that are sweet, sour, salty, and bitter.

You enjoy your favorite foods partly because of their smell. You may begin to feel hungry when good smells come from the kitchen.

Not all smells are pleasant. But people can get used to smells so they don't notice them anymore. Barnyards have strong smells. A visitor from the city might notice them right away. A farmer who works every day in a barn may not notice the strong smells at all. But smell comes from matter, and it is a physical property of matter.

✓ **What can we learn from our senses of taste and smell?**

▲ The unpleasant odor of a skunk is a warning to stay away.

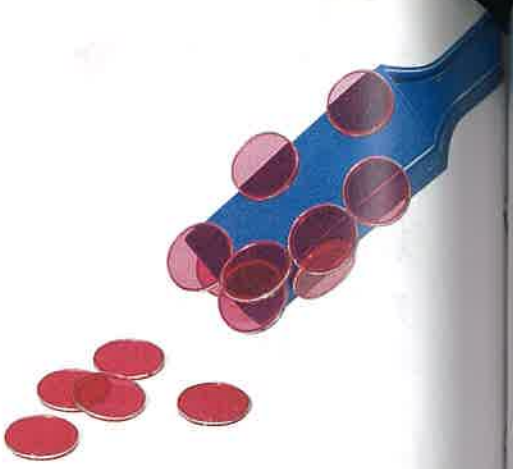
◄ Roses usually smell nice.

Humans can taste many foods but don't always like what they eat. ►

Other Properties of Matter

Matter has many other properties that you can see, hear, and feel. Many objects break if you drop them. Others bounce. Rubber bands stretch. Kite string doesn't stretch at all. A paper clip can bend, but a twig will snap in two if you try to bend it. Magnets attract objects that contain iron. You can feel the force it takes to pull the object away from the magnet.

✓ **What are some of the other properties of matter?**



▲ **Magnets attract objects that contain iron.**

Putty, clay, and this gel are things that can bend. ▼

▲ **Many objects break easily if you drop them.**

Three States of Matter

Matter has different forms, called states. The three states of matter we can observe are solids, liquids, and gases.

Solids A **solid** takes up a specific amount of space and has a definite shape. A solid does not lose its shape. For example, a book keeps its shape when it is on a shelf or in your hands. A solid also has a volume that stays the same. That means a solid object takes up the same amount of space all the time.

▲ **This sculpture of a fish is made of ice. Ice is a solid. As long as the sculpture stays frozen, it will keep its shape. If the ice warms up, it will melt and become a liquid. Then the sculpture will lose its shape.**

▲ **Solid**

▲ **Gas**

Liquid

Liquids A **liquid** has a volume that stays the same, but it can change its shape. A liquid takes the shape of any container it is put into. But one cup of water always takes up one cup of space, in any container.

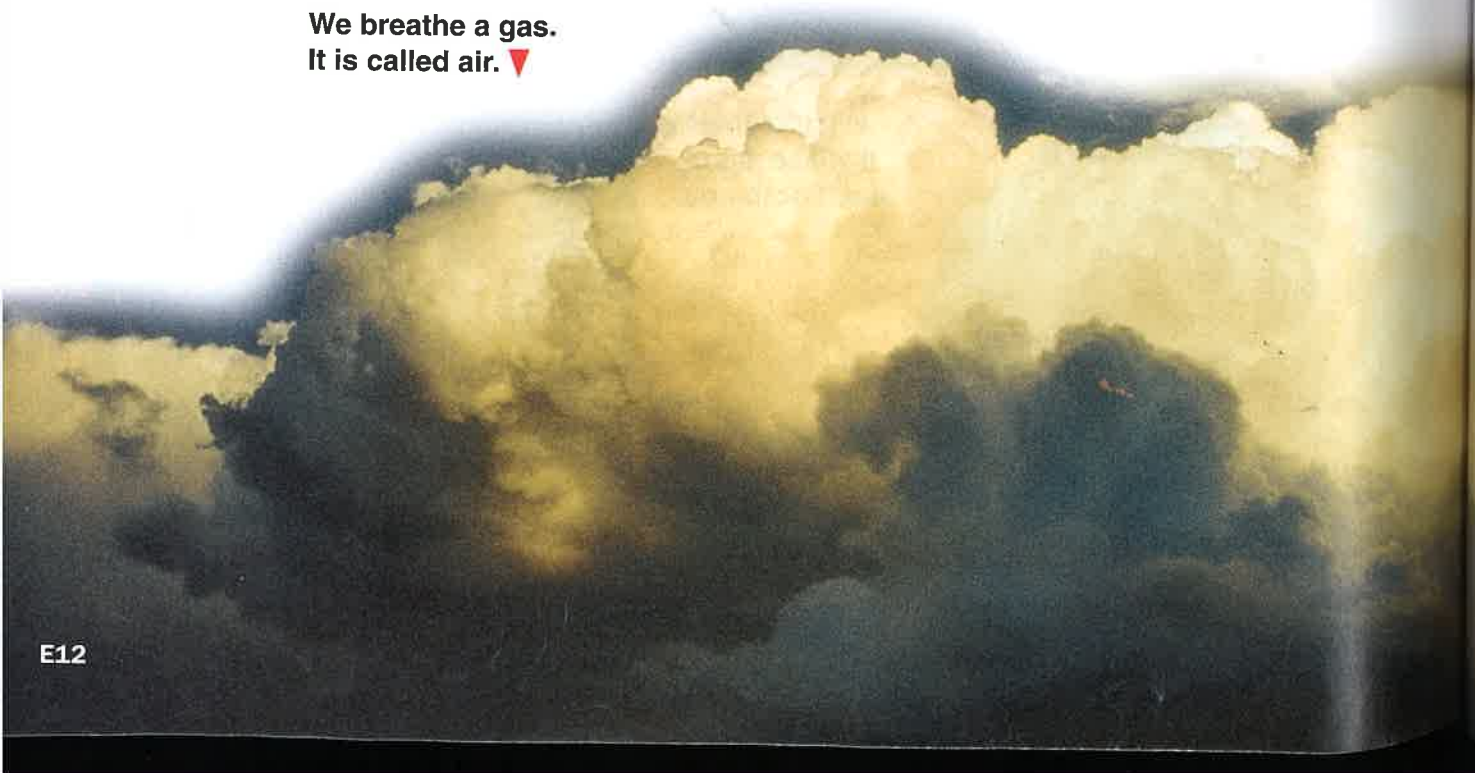
One cup of water might not look like very much in a short, wide glass. But in a tall, skinny glass, one cup of water can look like a lot. No matter what it looks like, it is the same volume of water in both glasses.

Gases You may know that a gas takes the shape of the container it is in. A **gas** does not have a definite shape or a definite volume. It takes up all the space in its container. The air in your classroom is a gas. It takes the shape of your classroom. It also takes up all the space inside the classroom. If you put the same amount of air into a larger classroom, the air would spread out to take up all the space in that room.

✓ **What are the three states of matter we can observe?**

▲ **The shape of the water changes as it falls. When it hits the stream, the banks help it hold a shape.**

We breathe a gas. It is called air. ▼



Summary

Matter is anything that takes up space. Matter has many physical properties that you can observe using your five senses. You can feel matter, taste matter, see matter, hear matter, and smell matter. Matter has different states. The three states we can observe are solids, liquids, and gases.

Review

1. What is matter?
2. What is a physical property?
3. How can we learn about matter?
4. **Critical Thinking** Think of last night's dinner. What properties of matter did you observe?
5. **Test Prep** Which set of words all name physical properties of matter?
   - **A** solids, liquids, diamonds
   - **B** ice, water, steam
   - **C** hard, soft, sticky
   - **D** rocks, rubies, emeralds

LINKS

MATH LINK

Cups Per? How many cups of matter does it take to fill a liter container? A gallon container?

WRITING LINK

Narrative Writing—Story Helium is a gas that is lighter than air. When you fill a balloon with helium, the balloon rises. Write a story for your classmates about the travels of a helium balloon that floats away.

ART LINK

Statues in Stone Sculptors choose their stone carefully. Different kinds of stone have different physical properties that can make it easier or harder to work with. Investigate the stone statues in your city or state. Find out what kind of stone they are made from.

TECHNOLOGY LINK

To learn more about properties of matter, watch *Fun With Matter* on the **Harcourt Science Newsroom Video.**

LESSON 2

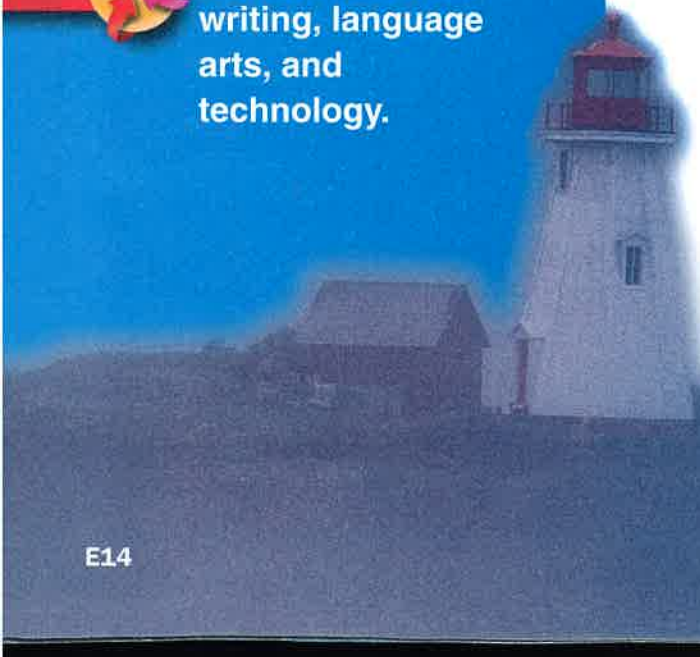
What Are Solids, Liquids, and Gases?

In this lesson, you can . . .

INVESTIGATE three states of matter.

LEARN ABOUT the differences between the three states of matter.

LINK to math, writing, language arts, and technology.



INVESTIGATE

One Way Matter Can Change

Activity Purpose Matter can change from one state to another. Think about what happens when you make ice cubes. You put water in a freezer, and it turns into ice. What might happen to an ice cube that is left out in a warm room? Investigate to see if your idea is correct.

Materials

- clear plastic cup
- paper towel
- 2 ice cubes
- marker

Activity Procedure

1. Place the plastic cup on the paper towel. Put the ice cubes in the cup. (Picture A)

Three states of matter surround us everywhere. Liquid water is in the ocean and in fog. The lighthouse is a solid. We breathe air, which is a gas.

2. **Predict** what the ice cubes will look like after 45 minutes. Use your past observations of ice cubes to predict what will happen this time. **Record** your prediction.

3. **Observe** what's in the cup after 45 minutes. **Record** what you see. Was your prediction correct?

4. Mark the outside of the cup to show how high the water is. **Predict** what you will see inside the cup in the morning if you leave it out all night. Then leave the cup sitting out.

5. **Observe** the cup the next morning. **Record** what you see.

Picture A

Draw Conclusions

1. What do you think caused the ice to change?
2. What do you think happened to the water when you left it out all night?
3. **Scientists at Work** Scientists make **predictions** based on things they have **observed** before. What had you observed before that helped you make your predictions?

Investigate Further Fill half an ice cube tray with water. Fill the other half with orange juice. **Predict** which will freeze first, the water or the orange juice. **Communicate** what you **observe.**

Process Skill Tip

Scientists **observe** things that happen. They use their observations to **predict** what will happen the next time a similar thing happens.

LEARN ABOUT

Solids, Liquids, and Gases

FIND OUT

- what matter is made of
- how matter changes

VOCABULARY

atom

evaporation

Atoms

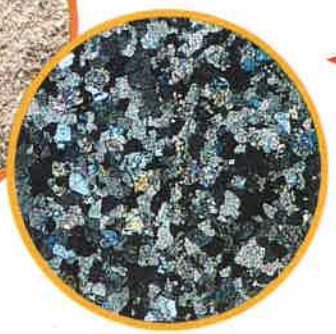
A puzzle has many pieces that fit together to form a picture. If you look closely, you can see each piece. If you look even more closely, you can see the tiny dots of color on each piece. All matter is like the puzzle. The more closely you look, the smaller the pieces you can see.

Some pieces of matter are so small that you can see them only by using special tools. Some pieces are so small that you cannot see them at all. But scientists can observe the effects of what these pieces of matter do. These pieces are called atoms. **Atoms** are the basic building blocks of matter.

✓ **What are atoms?**

From far away, you can see the carved figure of a woman sitting down.

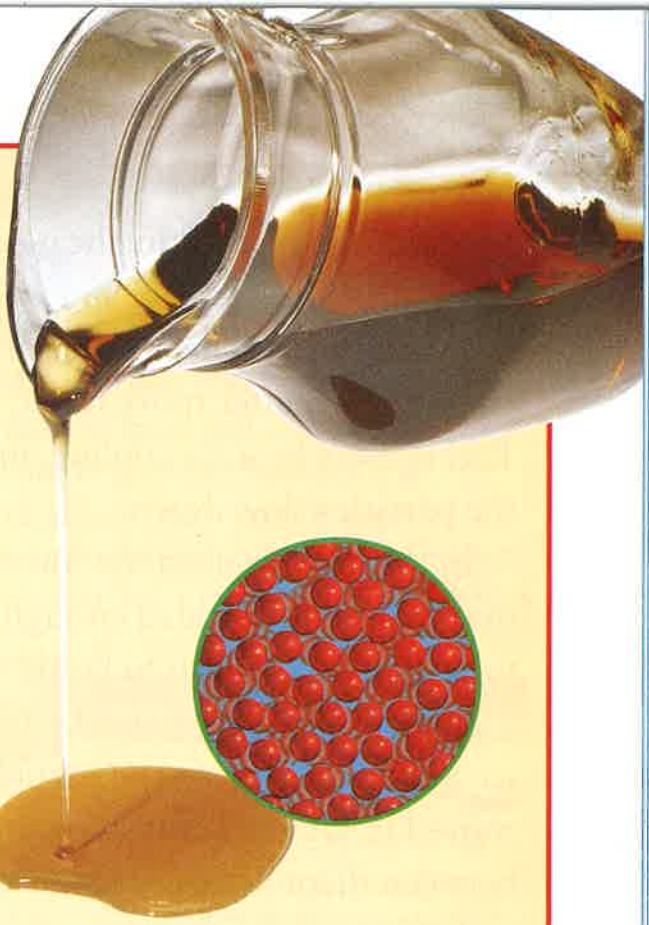
When you move closer, you can see the colors and roughness of the stone.

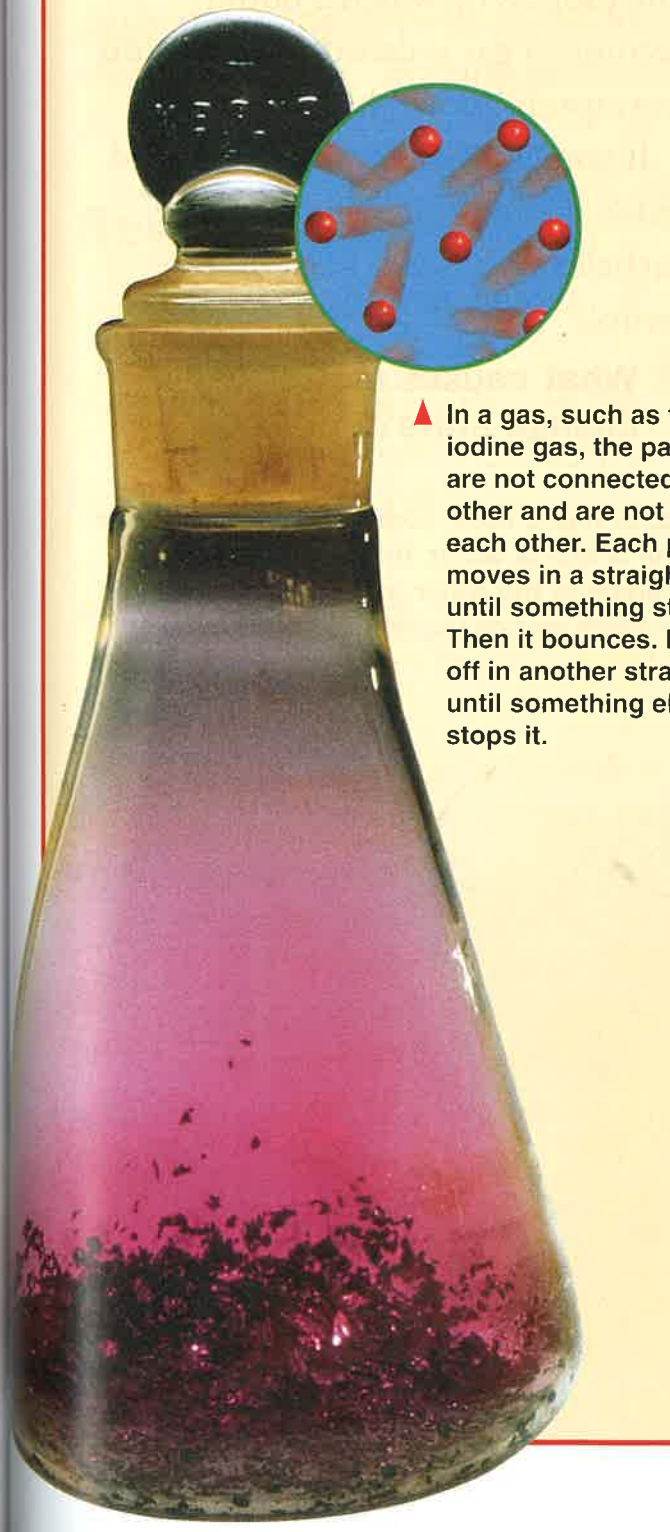


If you use a microscope, you can see some of the tiny pieces that make up the stone.

How Particles Are Connected

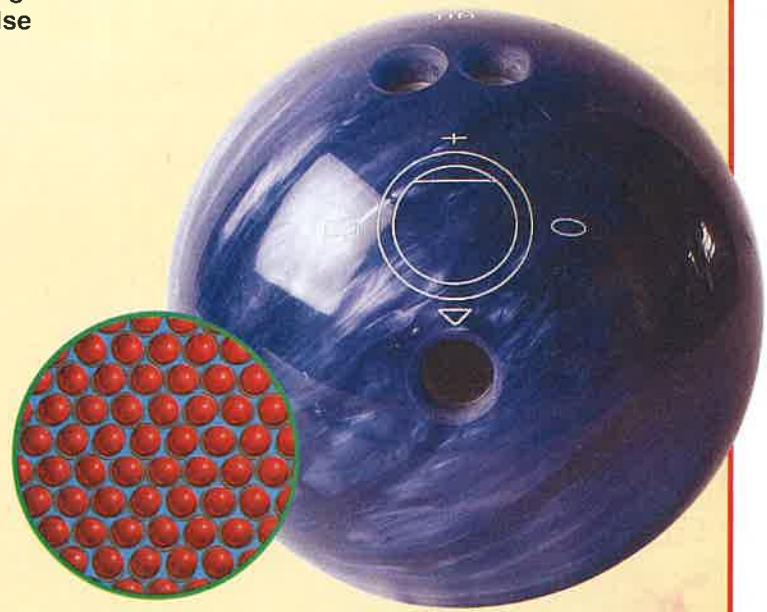
The particles in matter are arranged differently in each state of matter. But in all the ways they are arranged, the particles move.





In a gas, such as this iodine gas, the particles are not connected to each other and are not close to each other. Each particle moves in a straight line until something stops it. Then it bounces. It moves off in another straight line until something else stops it.

In a liquid the particles are more loosely arranged than in a solid. This allows the particles to slide past each other.



A solid is hard because its particles do not move very much.

How Matter Changes States

Adding heat or taking heat away causes matter to change states. This is because adding heat makes the particles in matter move faster. Taking away heat, or cooling, makes the particles slow down.

In the investigation the warm air in the classroom added enough heat to the ice to change it to liquid water. The heat caused the particles in the ice to move faster. As the particles moved faster, the connections between them became looser. In time, the connections got so loose that the particles could slide past each other. At that point, the solid ice became liquid water.

With still more heat, the particles broke apart from each other completely. The liquid became a gas. The process by which a liquid becomes a gas is called **evaporation** (ee•vap•uh•RAY•shuhn).

If you take heat away from liquid water, the opposite happens. The particles slow down and solid ice forms.

✓ **What causes matter to change state?**

Hot lava, or liquid rock, comes from this volcano. When the lava hits water, the heat in the lava causes some of the water to turn to steam. Then the lava cools and changes into solid rock. ▼

Summary

Atoms are small particles that make up matter. In solids atoms fit tightly together and do not move very much. In liquids, they slide past each other. The atoms in gases are far apart and are not connected. They keep moving until something stops them. Adding or taking away heat can cause matter to change states.

Review

1. What are the building blocks of matter?
2. In which state of matter are the particles most tightly connected?
3. Why does gas **NOT** have a definite shape?
4. **Critical Thinking** When you boil water, what makes the liquid water turn into a gas?
5. **Test Prep** Which set of words names three states of matter?
   - **A** solid, gas, water
   - **B** solid, liquid, gas
   - **C** hard, soft, smooth
   - **D** salty, sweet, sour

LINKS

MATH LINK

Measuring Heat People often need to know the temperature of what they cook. Find out the names of two kinds of kitchen thermometers and what each kind is used for.

WRITING LINK

Informative Writing—Description Write a description of a lake or pond for a younger child. Tell what it is like in each season. Be sure to describe what happens to the water in each season.

LANGUAGE ARTS LINK

Parts of Speech Find out what parts of speech the words *solid, liquid,* and *gas* are. Use each word in a sentence.

TECHNOLOGY LINK

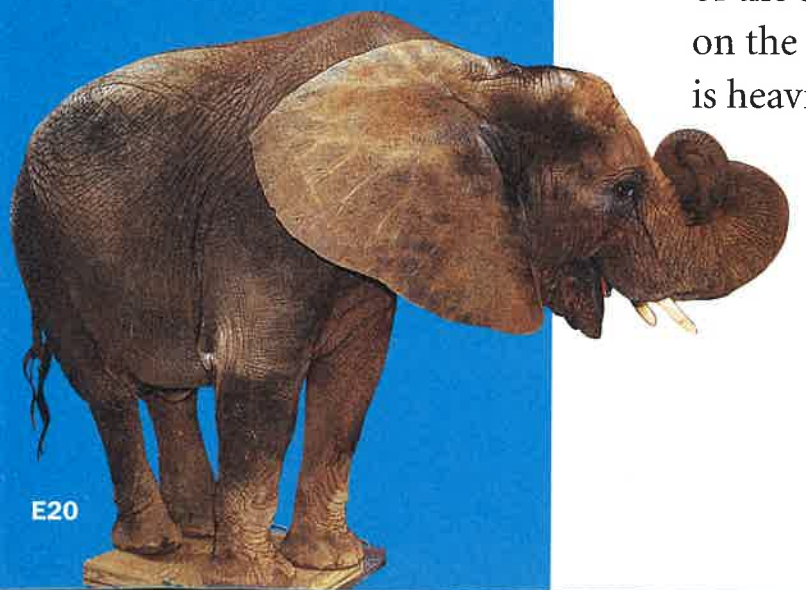
Learn more about how matter changes state by investigating *Solids, Liquids, and Gases* on **Harcourt Science Explorations CD-ROM.**

LESSON 3

How Can Matter Be Measured?

In this lesson, you can . . .

- **INVESTIGATE** the mass and volume of objects.
- **LEARN ABOUT** ways to measure mass and volume.
- **LINK** to math, writing, language arts, and technology.



◄ **Tools have been invented for measuring all sorts of things. Here an elephant is being weighed.**

INVESTIGATE

Measuring Mass and Volume

Activity Purpose If you pick up a C-cell battery and a D-cell battery, which feels heavier? In this investigation you will find out the difference in mass between the two batteries. You will also **measure** the amount of space a liquid takes up.

Materials

- balance
- 3 C-cell batteries
- 3 D-cell batteries
- clear plastic cup
- marker
- water
- masking tape
- 3 clear containers of different sizes

Activity Procedure

Part A

1. Put a C-cell in the pan on the left side of the balance. Put a D-cell in the pan on the right side. **Record** which battery is heavier. (Picture A)

2. Add C-cells to the left side and D-cells to the right side until the pans are balanced. You may need to use some of the small masses from the balance to make the cells balance perfectly. **Record** the number of C-cells and D-cells you use.

Part B

3. Fill the cup half-full with water. Use a piece of tape to mark how high the water is in the cup. **Predict** how high the water will be in each container if you pour the water into it. Mark each prediction with a piece of tape. Write *P* (for *Prediction*) on the tape.

4. Pour the water into the next container. (Picture B) Mark the height of the water with a piece of tape. Write *A* (for *Actual*) on the tape.

5. Repeat Step 4 for each of the other containers.

Picture A

Picture B

Draw Conclusions

1. **Compare** the numbers of C-cells and D-cells it took to balance the pans. **Draw a conclusion** from these numbers about the masses of the batteries.
2. Describe the height of the water in each container. Why did the same amount of water look different in the different containers?
3. **Scientists at Work** Scientists **measure** matter by using tools that are marked with standard amounts. What was the standard amount you used in this activity to measure the water?

Process Skill Tip

Using tools to **measure** allows scientists to study and **compare** different pieces of matter.

LEARN ABOUT

Measuring Matter

FIND OUT

- how to measure matter
- how to use tools to measure matter

VOCABULARY

volume

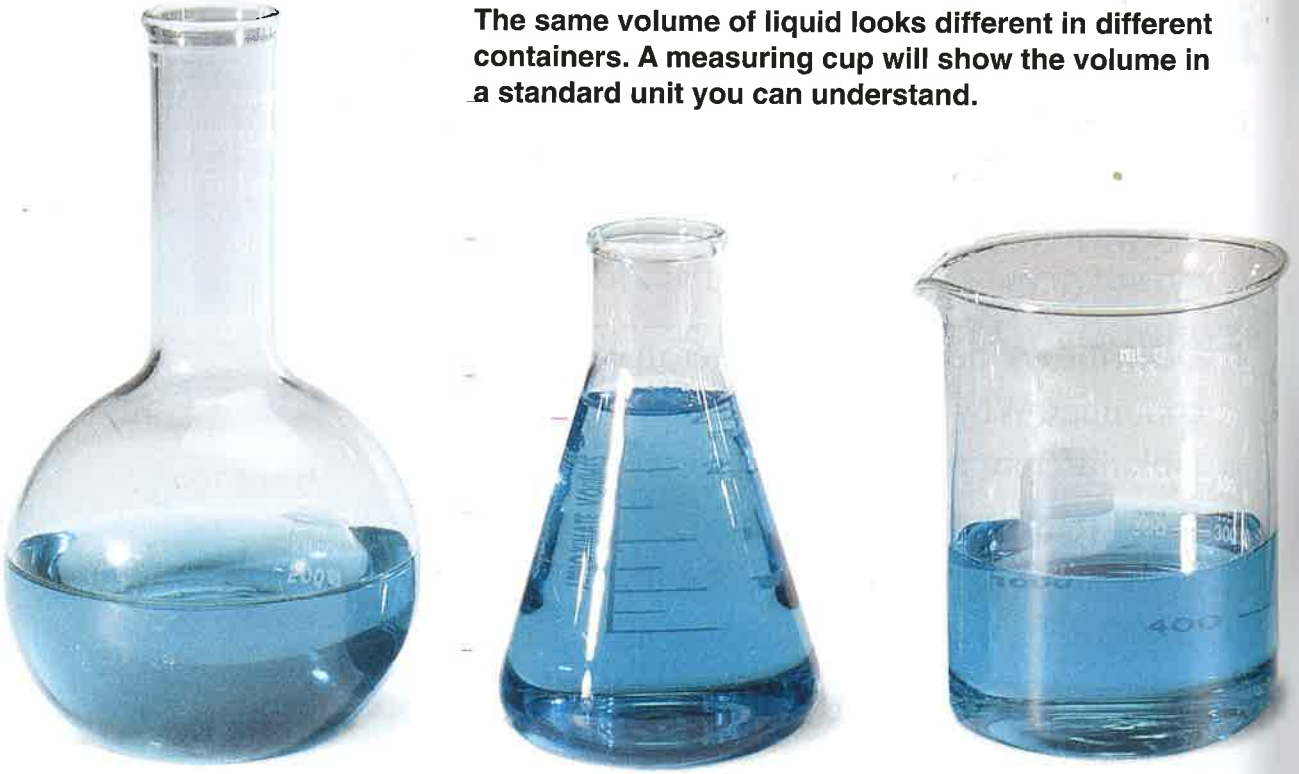
mass

Measuring Volume

Suppose you fill a glass all the way to the top with orange juice. Then you try to put ice cubes into it. The orange juice will spill out over the top of the glass. The orange juice takes up space, and the ice cubes take up space. If you want to add ice cubes to the drink, you have to leave enough space for them.

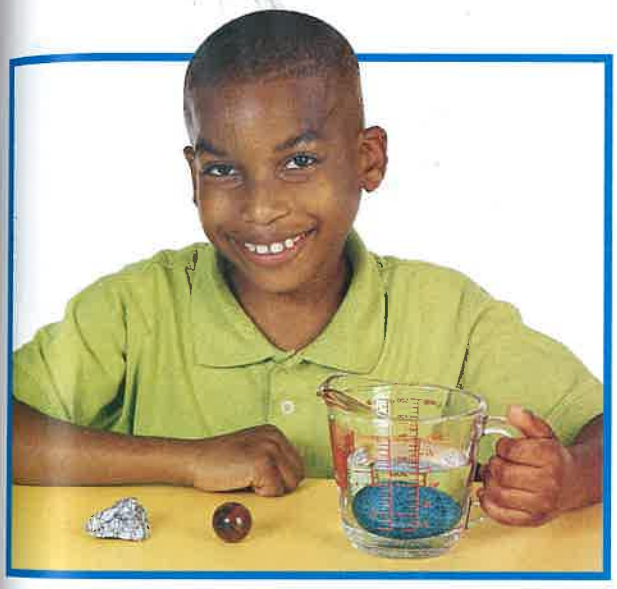
All matter takes up space. The amount of space matter takes up is called its **volume** (VAHL•yoom). Scientists measure volume by using tools. The volume of a liquid can be measured by using a measuring cup.

✓ **What is volume?**



The same volume of liquid looks different in different containers. A measuring cup will show the volume in a standard unit you can understand.

Like liquids, solids have volume. Since a solid holds its shape, you cannot measure its volume easily in a measuring cup. A rock or a marble will not take the shape of the cup.



You can measure the volume of a small rock. Pour some water into a measuring device. Record the level of the water. Gently place the rock in the water. Record the new water level. The difference in the water levels equals the volume of the rock.

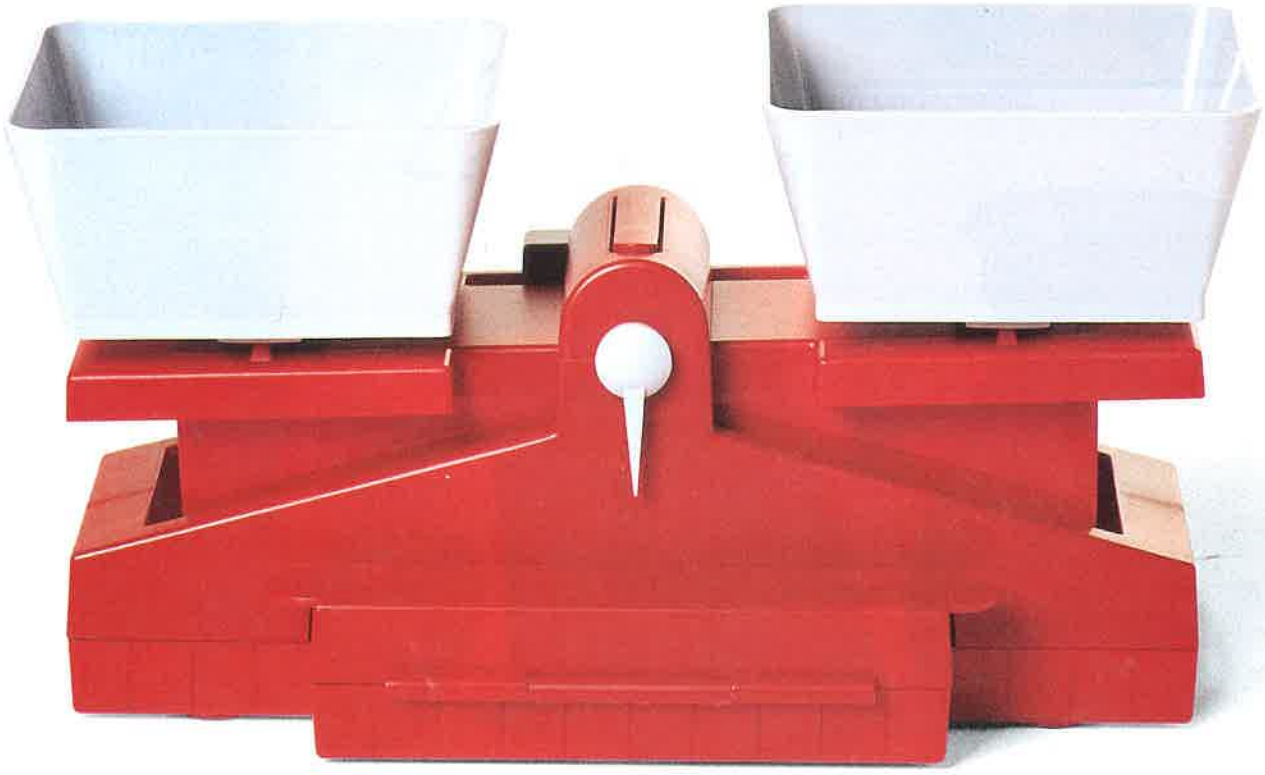
Measuring Mass

All matter has mass. **Mass** is the amount of matter in an object. You can't tell how much mass an object has if you just look at it. A golf ball and a Ping Pong ball are about the same size. But a golf ball has much more mass than a Ping Pong ball. You have to measure to find out how much mass an object has.

In the investigation you used a pan balance to measure mass. You may have used another kind of balance in the grocery store to measure the

The balloon filled with air has more mass than the empty balloon. This shows that air has mass. ►

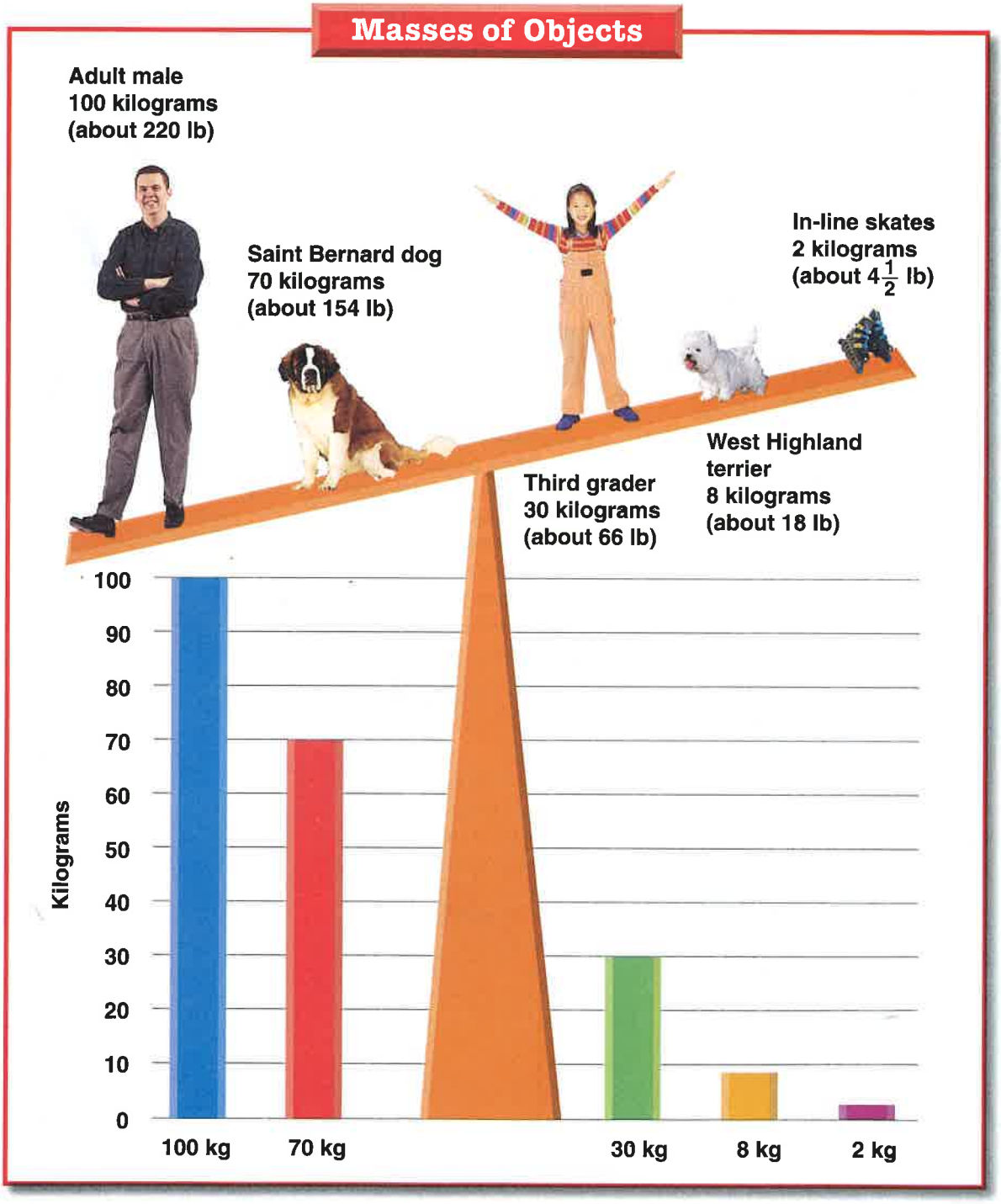
An empty pan balance has the same amount of mass on both sides. ▼



masses of fruits and vegetables. You may use a scale at home to measure your own mass.

You can't see air. In fact, you can't see most gases. But like all matter, gases have mass. Look at the balloons on the previous page. You can see that when you put air into a balloon you add to its mass. If you put too much air into a balloon, the balloon will pop. Then you can feel the mass of air rushing out of the balloon.

✓ **What is mass?**

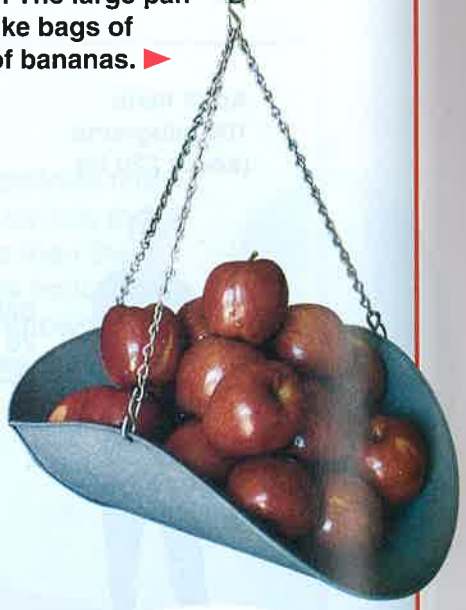


Tools for Measuring Mass and Volume

Suppose you need 1 teaspoon of salt. You would use a measuring spoon, not a scale. Measuring tools are made for certain tasks. Using the right tool makes measuring easy.

When you need medicine, it is important to take the right amount. This spoon measures the correct volume of medicine.

This scale makes measuring fruits and vegetables easy. The large pan can hold big items like bags of apples or bunches of bananas.



A postage scale is made to measure the masses of letters and packages. A letter has a small mass. To measure its mass, you need a scale that can measure small masses.

Restaurants make food in large volumes. This measuring tool can hold large amounts of liquid.

To find a person's mass, you need a scale a person can stand on. When the boy stands on this scale, he can read his mass.

Scientists often measure liquids. This container, called a *graduate,* is marked along the side. By using it, a scientist can see exactly what the volume of a liquid is.

Adding Masses

Suppose you draw a picture on a large sheet of paper. Then you cut the paper into pieces to make it into a puzzle. When you put the puzzle back together, it's the same size as the whole sheet of paper. And it still has the same mass.

Suppose you measure the mass of an apple. Then you cut the apple in half and measure the mass of each piece. If you add the masses of the two pieces, you will find that the total is the same as the mass of the whole apple.

When you cut the apple in half, you still have the same amount of apple to eat. In any way matter is arranged, its mass stays the same.

✓ **What happens to the mass of an object when you cut the object into pieces?**

The balance is holding two identical boxes of crayons. Taking the crayons out of the box does not change their mass. The mass is the same when the crayons are in the box and when they are out of the box. ▼

Comparing Mass and Volume

Different kinds of matter can take up the same amount of space but have different masses. A Ping Pong ball takes up about the same amount of space as a golf ball. But the Ping Pong ball has much less mass. A lime has about the same volume as an egg. But the lime has more mass.

✓ **Which do you think has more mass, a cup of water or a cup of air?**

Mass and Volume

All the jars are filled. They all have the same volume of matter in them. But look closely at the matter in each jar. Each kind of matter has a different mass. The jelly beans have more mass than the pasta. The sand has more mass than the marbles.

Summary

Volume is the amount of space an object takes up. Mass is how much matter is in an object. The mass of an object stays the same in any way its matter is arranged. Different objects can have the same volume but different masses.

Review

1. Name one kind of tool for measuring the volume of a liquid.
2. Do objects that are the same size always have the same mass? Explain.
3. Name some tools you could use to measure mass.
4. **Critical Thinking** Name two kinds of fruit. Which do you think has more mass? Explain.
5. **Test Prep** Choose the best definition of *volume*.
   - **A** the amount of air an object holds
   - **B** how much something weighs
   - **C** the amount of matter in an object
   - **D** the amount of space something takes up

LINKS

MATH LINK

Measuring Water Fill a film canister to the top with water, and put the lid on it. Measure the height of the canister. Then freeze it. In two hours, measure the height of the canister again. What happened to the water?

WRITING LINK

Informative Writing—Explanation Think about going shopping for milk. Tell what it would be like if there were no standard volumes of milk sold. Write a story for your teacher that explains what you would have to do.

LANGUAGE ARTS LINK

Many Word Meanings Look up the words volume and mass in a dictionary. Write two sentences for each word. But use meanings that are not from science.

TECHNOLOGY LINK

Learn more about measuring matter by visiting this Internet Site.

SCILINKS™

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Classifying Matter

Many centuries ago, Greek thinkers tried to understand what matter was made of. They thought that everything—gold, silver, sulfur, trees, dogs, and horses—was made of different combinations of four different materials. These materials, called elements, were earth, air, fire, and water. Some other Greek thinkers thought matter was made up of small particles. They called these particles atoms. But the element theory was more popular. Nobody thought or wrote about atoms again until the early 1800s.

The Atomic Theory

In 1803 John Dalton published his studies of what he called ultimate particles. He had carried out many experiments with water. Using electricity, he split water into its two elements—hydrogen and oxygen. He found that the two elements had different weights. He found that he could predict the amount of oxygen formed if he knew how much hydrogen was formed. Dalton had read about the old Greek idea of atoms. He thought it explained many of the things he had observed. From

The History of Matter

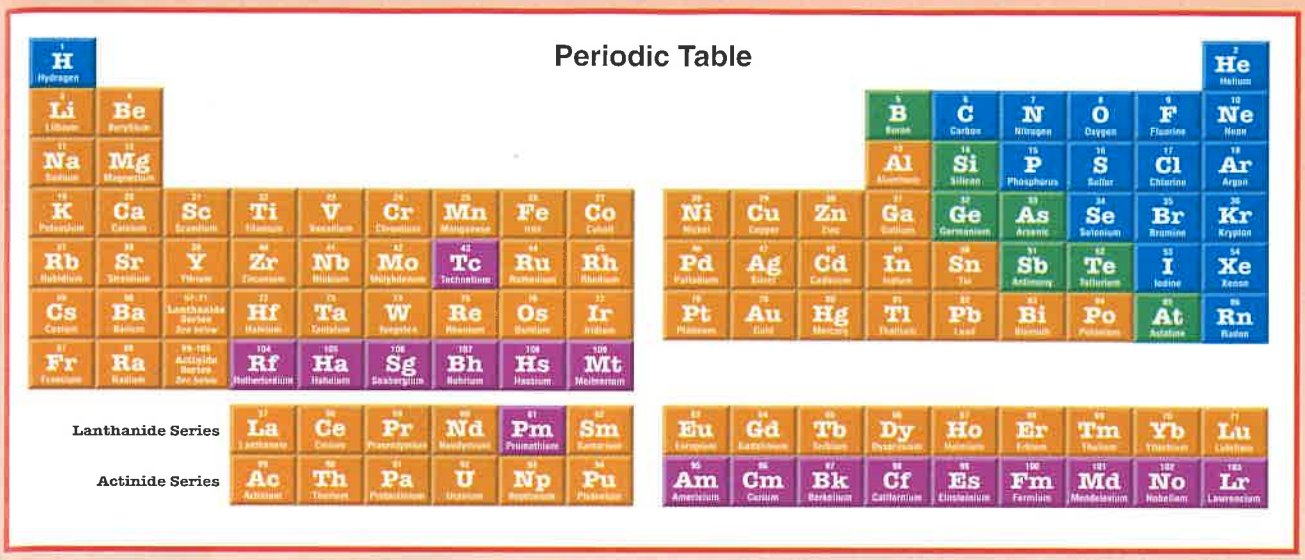
400s B.C.
Democritus proposes that matter is made of atoms. Aristotle and others think matter is made of four elements.

1803
John Dalton publishes his studies of ultimate particles.

1869
Dmitri Mendeleev devises the periodic table of the elements.

1937
Emilio Segre finds technetium, the first artificial element.

1996
Element 112 is produced in a German laboratory.



his experiments, he inferred three things about atoms:

- Atoms of different elements have different weights.
- Two atoms of the same element are identical.
- An atom of one element can't be changed into an atom of a different element.

Making Sense of Elements

In the 1700s and 1800s, many scientists searched for new elements. As more and more elements were discovered, people began to look for an order. Could they predict the elements that hadn't been discovered yet?

In 1869 a Russian scientist named Dmitri Mendeleev studied each of the 63 known elements. He grouped the elements by their properties. He grouped all the metals together and all the nonmetals together. Then he ordered the elements in each group by how much their atoms weighed. He organized his ordered groups in a table, called the periodic table. The table is arranged in rows and columns. Mendeleev left gaps in his table where none of the known elements fit. He predicted that these gaps would be filled as new elements were discovered. Today, more than 100 elements are listed on the periodic table.

Think About It

- Why did Mendeleev's periodic table let him predict new elements that hadn't been discovered yet?

PEOPLE IN SCIENCE

Dorothy Crowfoot Hodgkin

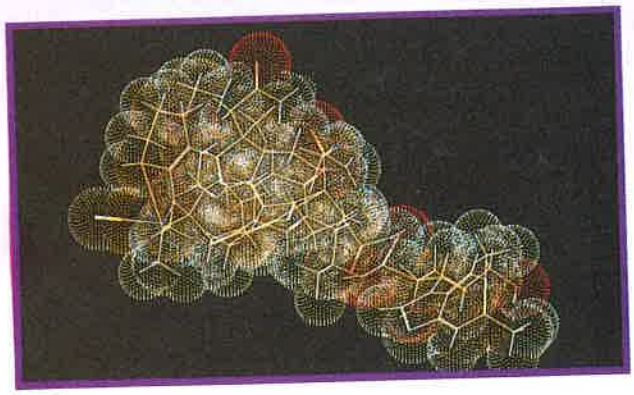
CHEMIST

"You're finding what's there and then trying to make sense of what you find."

Dorothy Crowfoot Hodgkin won the Nobel Prize in chemistry in 1964. She was only the third woman ever to win it. By the time she won the award, she had spent more than 30 years studying insulin. Insulin is a chemical made in the body that allows us to use sugar for energy. The results of her studies helped fight diseases and save lives.

Hodgkin did most of her research at Oxford University in England. While there, she attended meetings of the research club. At these meetings she was able to communicate her ideas and research findings with other students and scientists.

Hodgkin loved studying how things were put together. She became



Insulin

interested in crystals. She used X rays to find the shapes of the crystals. She did much of her work before computers had been invented, so her research took a very long time. She used the first IBM computers to help do her calculations. Later, she sent her data to a professor in Los Angeles who had a faster computer. They used mail and telegrams to send information back and forth.

Hodgkin traveled around the world to meet and talk with other chemists. She continued to do research, teach, and travel throughout her life.

Think About It

1. How did not having a computer slow down Hodgkin's research?
2. How can communicating with others help solve a problem?

Properties of Metals

Which metals have magnetic properties?

Materials

- magnet
- penny
- piece of aluminum foil
- straight pin
- scissors
- dime
- paper clip

Magnetic	Objects
Non-Magnetic	Objects

Procedure

1. Copy the chart onto a sheet of paper.
2. Place the magnet close to the penny. Does the penny stick to the magnet? Write down the results on your chart.
3. Repeat Step 2 for each of the other objects. Write down the results for each one on the chart.

Draw Conclusions

Study your completed chart. Are all metals attracted by a magnet? Which kinds are?

Mass of Liquids

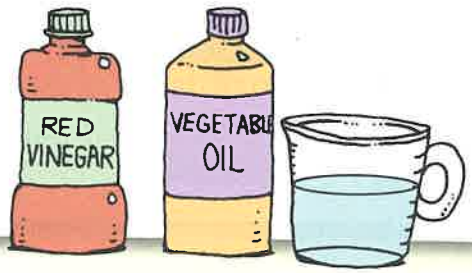
Which of three liquids has the greatest mass?

Materials

- clear measuring cup
- water
- oil
- red vinegar

Procedure

1. Will water float on oil? Or will oil float on water? Predict which liquid will float on the other.



2. Pour some water into the measuring cup.
3. Add some oil. Observe what happens to the oil. Write down your observations. Was your prediction correct?
4. Will the vinegar float on the water? Make a prediction.
5. Pour some red vinegar into the measuring cup. Let it stand still for five minutes. Write down your observations.

Draw Conclusions

The lightest liquid floats on the others. List the liquids from lightest to heaviest.

Chapter 1 Review and Test Preparation

Vocabulary Review

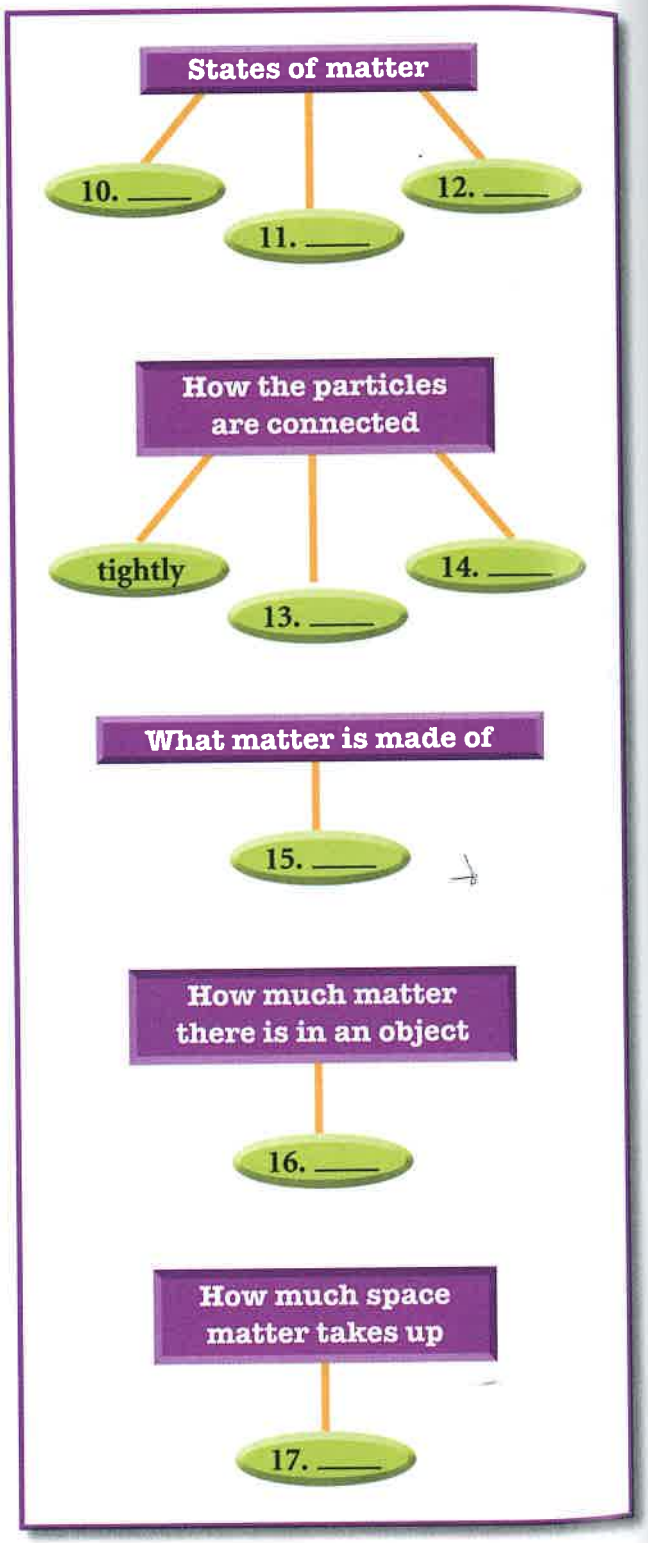
Use the terms below to complete the sentences 1 through 9. The page numbers in ( ) tell you where to look in the chapter if you need help.

matter (E6)
physical property (E6)
solid (E11)
liquid (E12)
gas (E12)
atoms (E16)
evaporation (E18)
volume (E22)
mass (E24)

1. A ___ is matter that has a definite shape.
2. All matter is made of ___.
3. Stickiness is a ___ of matter.
4. ___ is the amount of matter in an object.
5. Everything that takes up space is ___.
6. The amount of space that matter takes up is its ___.
7. A ___ has particles that are not tightly connected.
8. A ___ has no definite shape and no definite volume.
9. When a liquid changes into a gas, the process is called ___.

Connect Concepts

Write the terms needed to complete the concept map.



Check Understanding

Write the letter of the best choice.

18. There are two jars that are the same size. One is filled with peanut butter, and the other is filled with jelly. They have the same volume, but they may not have the same —

A heat
B mass
C evaporation
D gas

19. One physical property that a football and a soccer ball share is that both —

F bounce
G stretch
H fold
J crackle

20. Syrup pours because its atoms are —

A tightly connected
B not connected
C loosely connected
D split

21. A shallow pond can dry up because of —

F ice
G cold weather
H heat and evaporation
J snow falling during the winter

Critical Thinking

22. Explain what happens to a liquid when heat is added to it.

23. A solid has a definite shape. Sand can take the shape of its container. Then why is sand a solid?

Process Skills Review

Write *True* or *False*. If a statement is false, change the underlined words to make it true.

24. **Predicting** means explaining what happened in the past.

25. **Measuring** is using tools to find the volume or mass of something.

26. **Observing** means watching something for a second.

Performance Assessment

Make Models

Make clay models of the particles in a solid, a liquid, and a gas. Make the models small, but be sure each one looks different. Use an index card to make a label for each model. Place the labels in front of the models.