UNIT 5

The Nature of Matter

FLORIDA BIG IDEA 8

Properties of Matter

FLORIDA BIG IDEA 9

Changes in Matter

Divers can see the bright colors of the coral reef.

I Wonder Why

Why are some kinds of materials better than others for making diving suits? ***Turn the page to find out.***

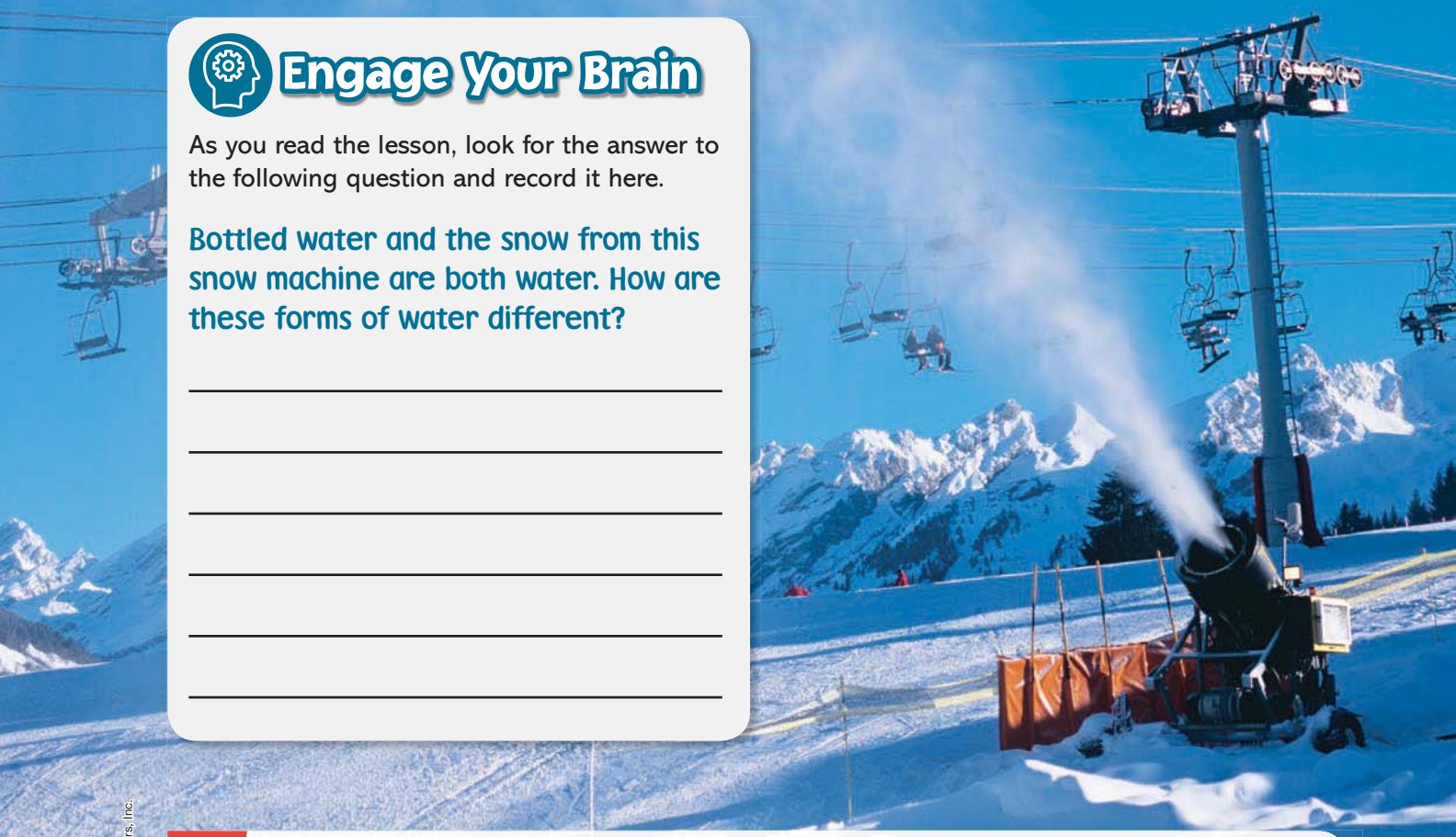
Here's Why

Suits for scuba diving come in a variety of materials. Divers need suits to protect them against scrapes and stings. They also may need the suit to keep them warm in cold waters. The properties of the material used to make the suit will help divers choose the best suit for their purposes.

Essential Questions and Florida Benchmarks

ESSENTIAL **QUESTION**

What Are Solids, Liquids, and Gases?



Engage Your Brain

As you read the lesson, look for the answer to the following question and record it here.

Bottled water and the snow from this snow machine are both water. How are these forms of water different?

ACTIVE **READING**

Lesson Vocabulary

List the terms. As you learn about each one, make notes in the Interactive Glossary.

Compare and Contrast

Many ideas in this lesson involve comparisons and contrasts—how things are alike and different. Active readers stay focused on comparisons and contrasts when they ask themselves, How are these things alike? How are they different?

What's the Matter?

The large pencil has more matter than the smaller pencils. It has more mass and more volume.

This book is made of matter, and so are you. You might think that matter can be seen and felt. But did you know that air is matter also? What is matter?

ACTIVE **READING** As you read these two pages, draw two lines under each main idea.

Breathe in and out. Can you feel air hitting your hand? You can't see air, and you can't grab it. Yet air is **matter** because it has mass and it has volume. Matter cannot be created or destroyed. It might change form, but it is still matter.

Mass is the amount of matter in something. Each of the tiny particles that make up matter has mass, even though the particles are so small you cannot see them. **Volume** is the amount of space something takes up. When air is blown into a balloon, you can see that it has volume.

Name That Matter

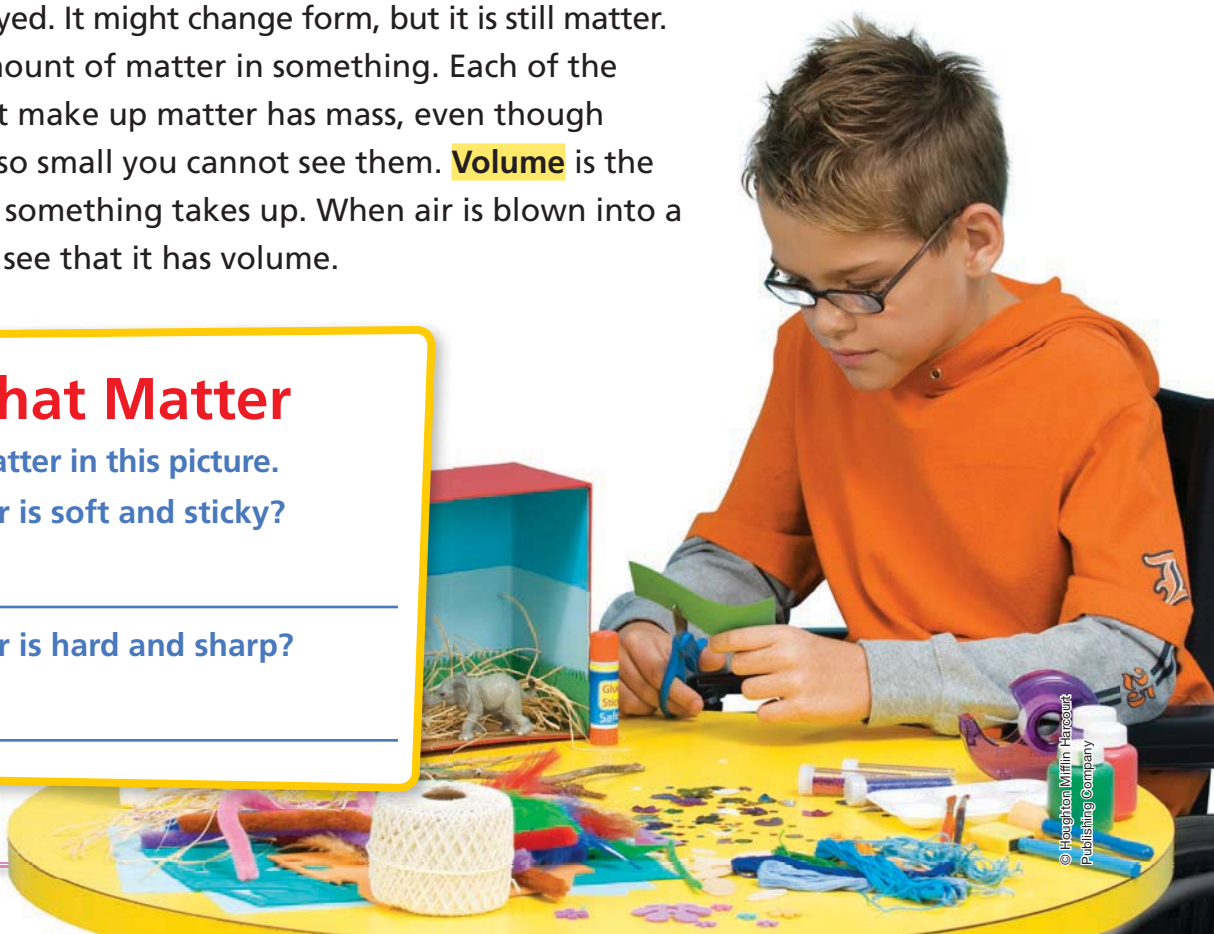
Look at the matter in this picture.

1. What matter is soft and sticky?

_____

2. What matter is hard and sharp?

_____



Odor

Texture

Matter Has Properties

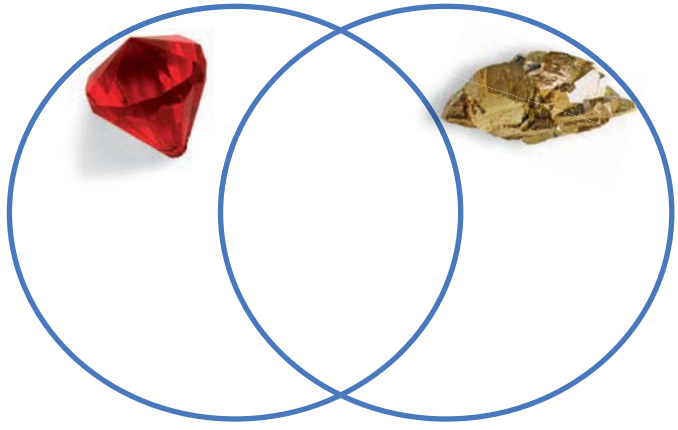
You might say that apple juice is gold in color, tastes sweet, and pours easily. These are properties of the juice, which means they are characteristics used to describe or identify it. All matter has properties.

All the properties shown on this page are physical properties. You can observe a physical property without changing the matter into a new substance. For example, texture is how something feels. In observing that sandpaper has a rough texture, you don't change the sandpaper.

Color

Comparing Stones

Complete the Venn diagram by comparing and contrasting the properties of the two stones.



More Properties

Color, texture, and odor are just a few physical properties. What are some other properties of matter?

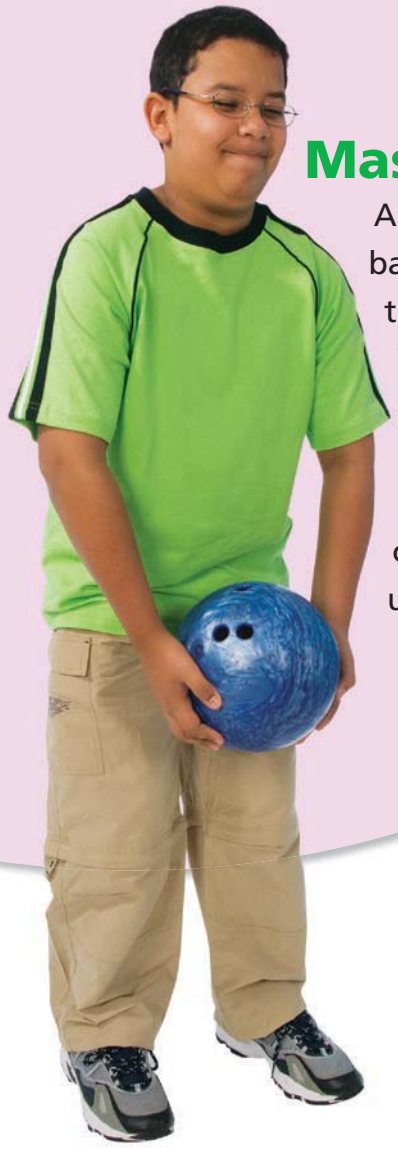
ACTIVE READING As you read these two pages, circle common, everyday words that have a different meaning in science.

Temperature

Temperature is a measure of the energy of motion of the particles in matter. Melted glass has a very high temperature. Temperature can be measured by using a thermometer.

Volume

The food in the small bowl has less volume than the food in the large bowl because it takes up less space. Many tools can be used to measure volume.



Mass

A bowling ball and a basketball have about the same volume. The bowling ball has a greater mass because it contains more matter. Mass can be measured by using a balance.

Density

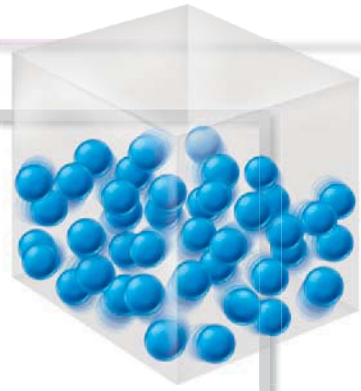
Density is found by dividing the mass of an object by its volume. The density of the gas in this balloon is less than the density of the air around it. That is why the balloon "floats" in air.

DO THE MATH

Use Division

Use the data to find the density of each of these foods.

Determining Densities of Foods			
Food	Mass (g)	Volume (cm3)	Density (g/cm^3)
gelatin	75	100	
pudding	90	100	
whipped cream	50	100	



Liquids

A **liquid** is a substance that has a definite volume but does not have a definite shape. The particles in a liquid move slower than the particles in a gas, and they slide by each other.

States of Matter

Another physical property of matter is its state. Solid, liquid, and gas are the most common states of matter on Earth.

ACTIVE READING As you read these two pages, draw boxes around the names of the three things that are being compared.

Gases

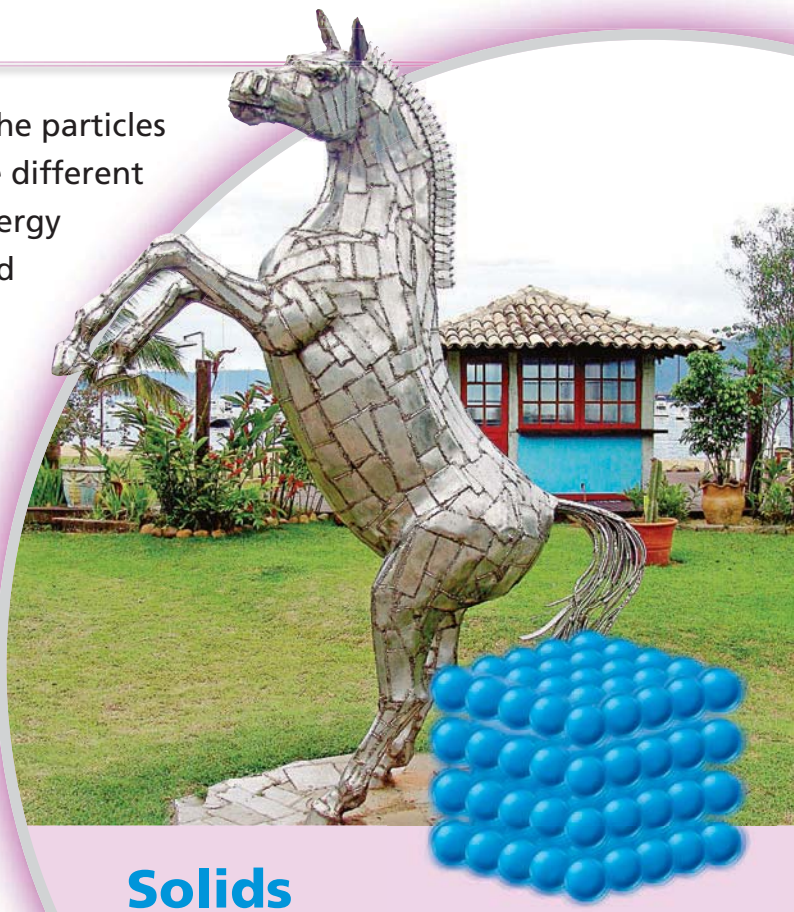
A **gas** is a substance that does not have a definite shape or volume. The particles in a gas move very quickly and are far apart from each other.

Matter is made of tiny particles. The particles in solids, liquids, and gases have different amounts of energy. The amount of energy affects how fast the particles move and how close together they are.

The shape and volume of something depends on its state. Because each particle in a gas is affected little by the other particles, gas particles are free to move throughout their container. Gases take both the shape and the volume of their container.

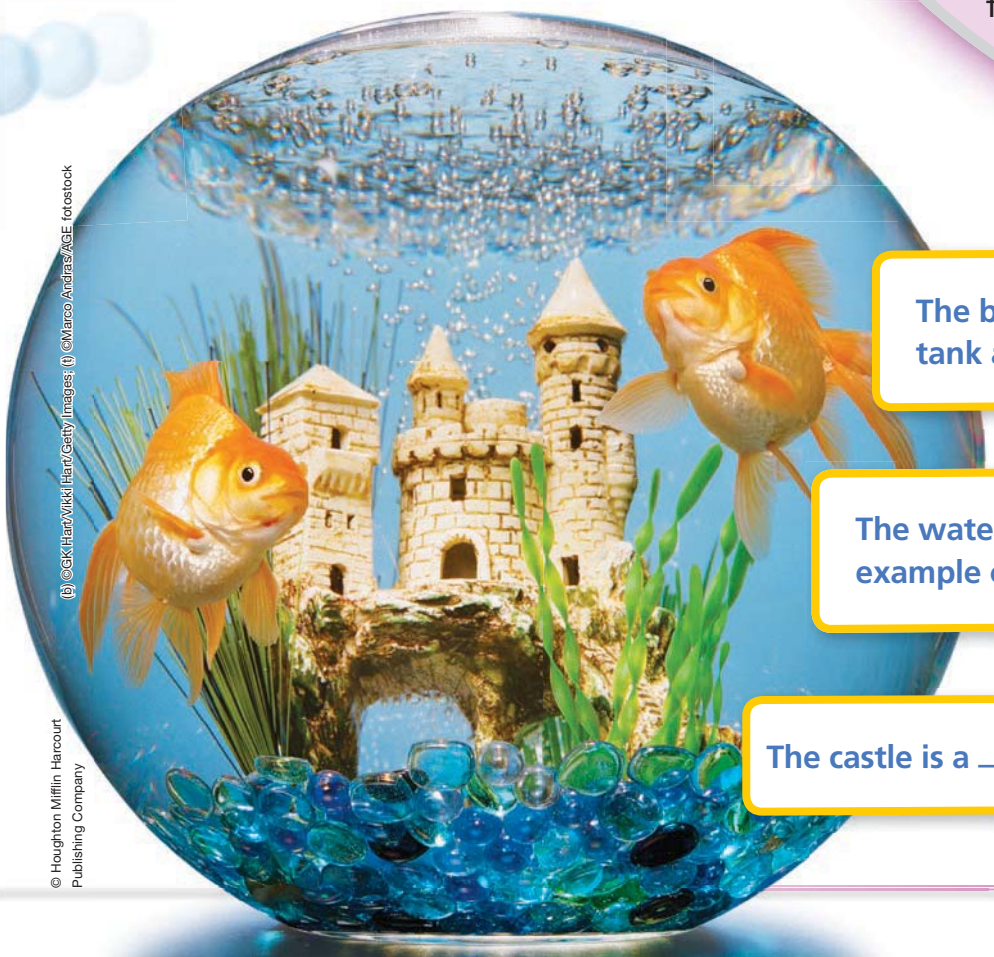
Particles in a liquid cannot move as freely. A sample of a liquid keeps the same volume no matter what container it is in. However because the particles slide by each other, a liquid takes the shape of its container.

The particles in a solid do not move from place to place, so solids keep the same shape and volume.



Solids

A **solid** is a substance with a definite shape and volume. The particles in a solid are very close to each other. They don't move from place to place. They just vibrate where they are.



The bubbles in the tank are a _____.

The water is an example of a _____.

The castle is a _____.

A Matter of Temperature

On a hot day, an ice cube melts. This change is caused by a change in temperature. When matter changes state, the type of matter is not changed.

ACTIVE READING As you read these two pages, draw one line under a cause. Draw two lines under the effect.

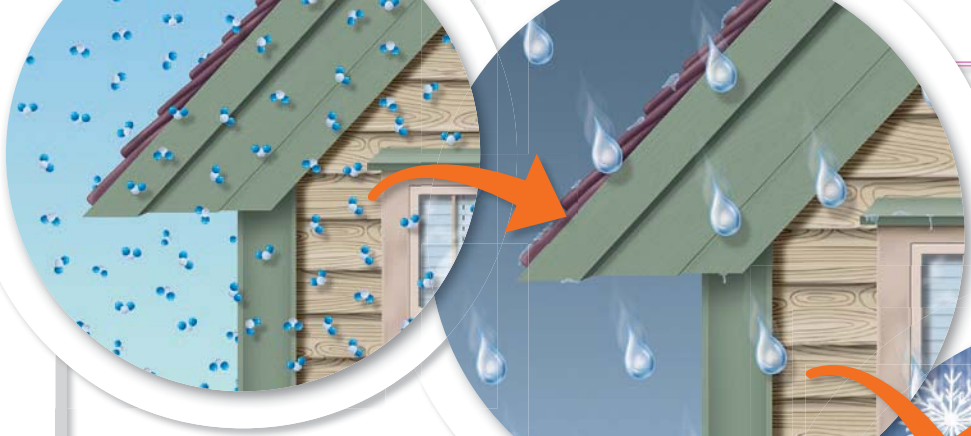
When matter takes in or releases energy, its temperature changes. When enough energy is taken in or released, matter can change state.

When a gas releases energy, its temperature goes down until it *condenses,* or changes to a liquid. When a liquid releases energy, its temperature goes down until it *freezes,* or changes to a solid.

When a solid takes in energy, its temperature rises until it *melts*, or changes to a liquid. When a liquid takes in energy, its temperature rises until it *evaporates*, or changes to a gas. Evaporation and boiling are similar—both turn liquids into gases. Evaporation is slower and happens only at a liquid's surface. Boiling is faster and happens throughout the liquid.

When a solid absorbs enough energy, the solid melts, changing to a liquid.

When a liquid absorbs enough energy, the liquid *boils*, or rapidly changes to a gas.



When a gas releases enough energy, the gas condenses, changing to a liquid. Particles of water vapor condense and form raindrops and dew.

When a liquid releases enough energy, the liquid freezes, changing to a solid. Dripping water that freezes can form icicles.

The temperature at which a certain type of matter freezes or melts is the same. The temperature at which a type of matter condenses or boils is also the same. For water, the melting and freezing points are 0 °C. The condensation and boiling points are 100 °C. Evaporation can happen at temperatures below the boiling point.

Lava is hot, melted rock that erupts from a volcano. Lava releases energy as it cools and becomes solid rock.

▶ Complete this graphic organizer.

As a solid takes in energy, its temperature _____. Eventually, it will _____, changing to a _____.

If the liquid takes in enough _____, it will _____, changing to a _____.

Properties of Solids, Liquids, and Gases

Each different material has its own unique properties. However, properties can change depending on the state of the material.

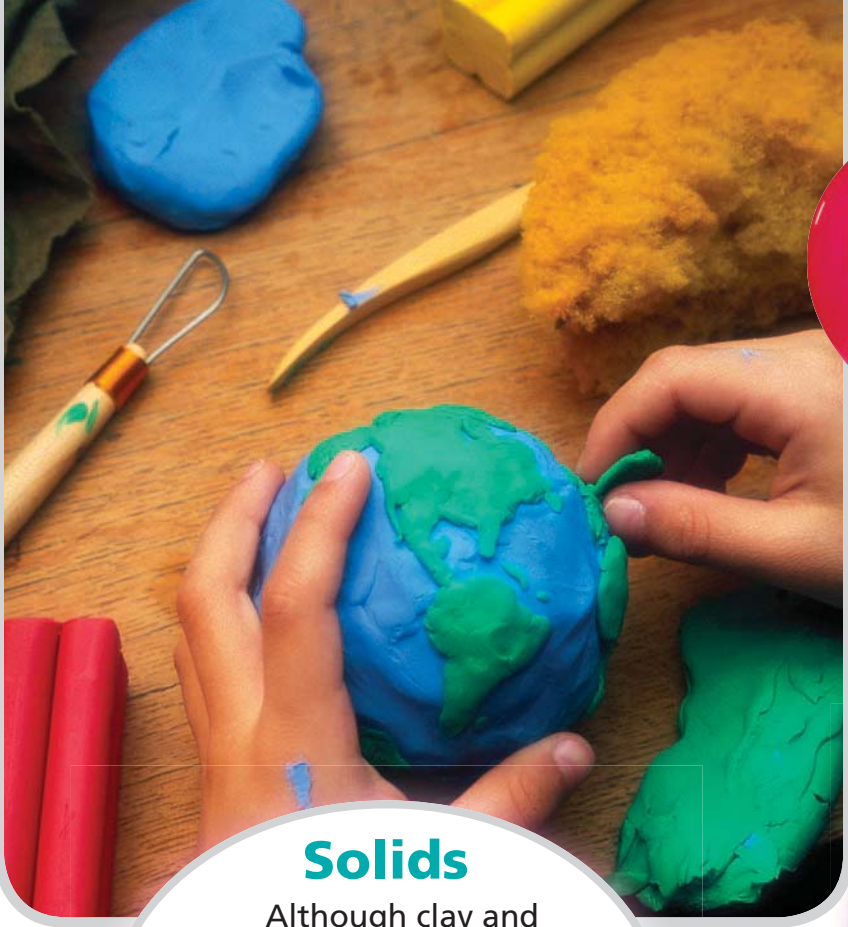
ACTIVE READING As you read these two pages, find and underline facts about each state of matter.

Each state of matter has different physical properties. Liquids and gases both flow, moving from place to place. Gases can expand, taking up more space, or compress, taking up less space. Solids have definite textures.

Liquid water flows much more quickly than honey.

Liquids

All liquids flow from one place to another. Different liquids may flow at different rates.



Solids

Although clay and a wooden table are both solids, each one feels different. All solids have a shape, but the shape of some solids can be changed easily.

Gases

A lot of gas has been compressed in this tank. It is under high pressure. Compressed gas from the tank expands, filling many balloons.

▶ **Complete this main-idea-and-details graphic organizer.**

Main Idea

_____

Liquids	Gases	_____
Motor oil and milk _____ at different rates.	When you push on the sides of a balloon, the gas inside is _____.	Glass and sandpaper have different _____.

Sum It Up »

Read the summary statements below. Each one is incorrect. Change the part of the summary in blue to make it correct.

1. A property is a characteristic of matter that is used to determine the state of the matter.

_____

2. A sample of ice has a volume of 1.0 cm^3 and a mass of 0.9 g. The density of the ice is 1.1 g/cm^3.

_____

3. The particles in a solid are close together, but they can slide past each other.

_____

4. A solid changes to a liquid during a process known as freezing.

_____

5. Solids and liquids can be compressed when put under pressure.

_____

6. The mass of an object can be measured by using a measuring cup.

_____

Read the properties below. Write S for solid, G for gas, and L for liquid. Some properties may have more than one answer.

7. Has a definite texture and shape ____
8. Can melt ____
9. Can freeze ____
10. Can boil ____
11. Takes the volume of its container ___
12. Can condense ____
13. Can flow _____
14. Takes the shape of its container ____
15. Has a definite volume _____

Brain Check

Name _____

Vocabulary Review

1 **Use the clues below to fill in the words in the puzzle.**

1.To squeeze a gas into a smaller space

2.A physical property that describes how something feels

3.The state of matter that keeps its shape and volume when it is placed in a different container

4.The measure of the energy of motion of particles of matter

5.Anything that has mass and volume

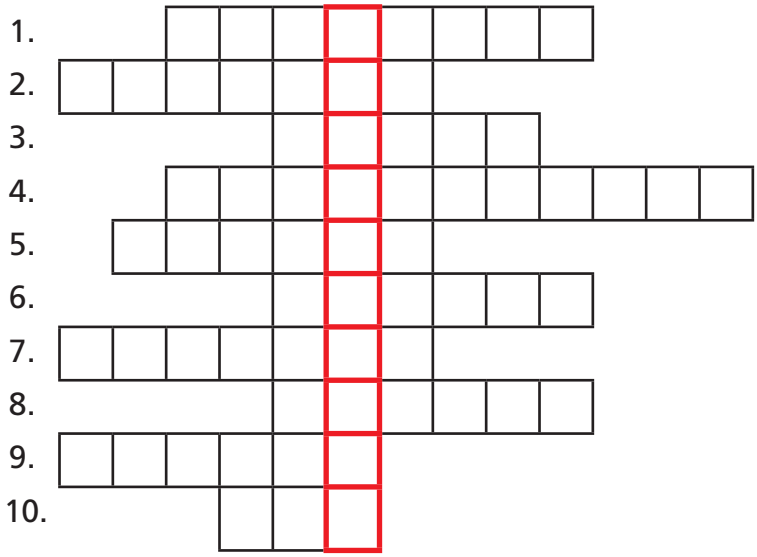
6.What happens to a liquid when it releases enough energy

7.Calculated by dividing mass by volume

8.The state of matter that has particles that slide by each other

9.The amount of space something takes up

10.The state of matter that expands to fill its container



Read down the squares with red borders. The word you find will complete the riddle below.

Perry the porcupine's portrait perfectly portrayed his pestering personality and prickly __ __ __ __ __ __ __ __ __ __.

Apply Concepts

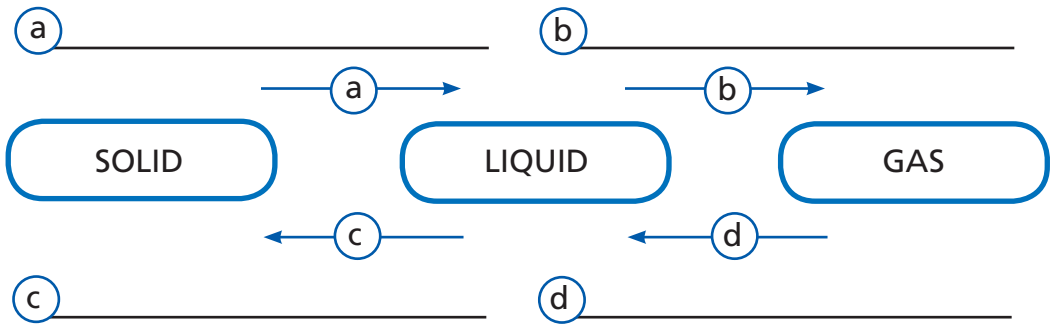
2 Tell what property each of the following tools is used to measure.

_____ _____ _____

3 Complete these descriptions of the different states of matter.

_____	_____	Solids
_____	Particles are closer together and move past each other.	Particles are very close and vibrate in place.
_____	Examples: _____	Examples: _____
Examples: air; helium in balloons; oxygen in a tank	_____	_____

4 Fill in the name of the processes (such as freezing) that are represented.



Take It Home! See *ScienceSaurus*® for more information about matter.

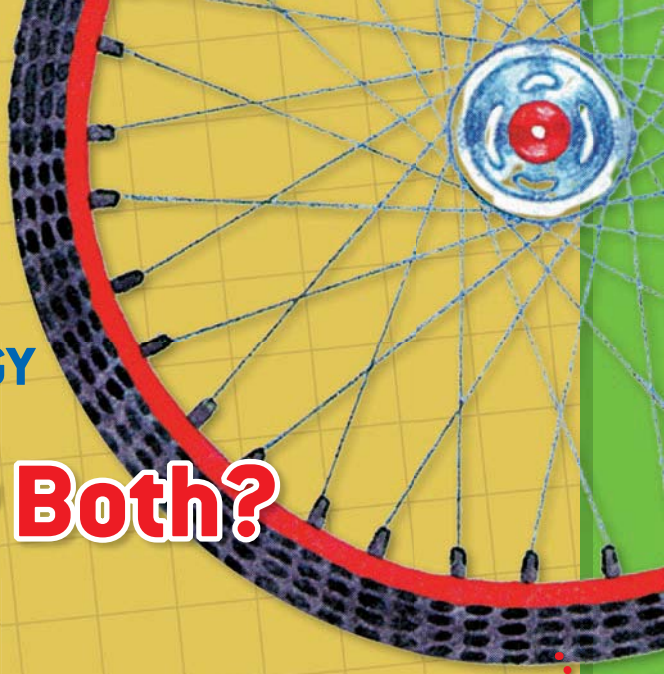
SC.5.N.1.3 Recognize and explain the need for repeated experimental trials.

S.T.E.M.

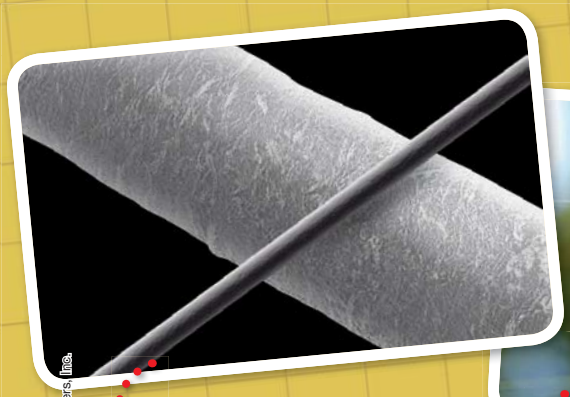
ENGINEERING & TECHNOLOGY

Strong, Light, or Both?

A bicycle wheel has to be strong to be safe. You also want it to be lightweight so it takes less energy for you to pedal the bike. You could easily bend one of these wheel spokes all by itself, but arranged together, they make the wheel strong enough to support your weight and more!

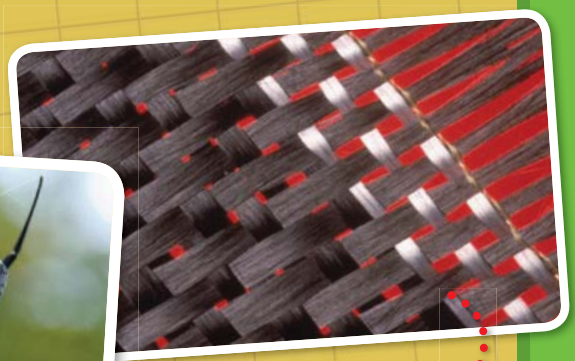


Carbon fiber is used to make this bike wheel strong and lightweight.



Carbon fiber is smaller and stronger than a human hair!

Spider silk is the strongest, lightest natural material. It is stronger than steel! Carbon fiber is a strong, human-made thread that can be woven into fabric. A single carbon fiber is much finer than a human hair. Carbon fiber is one of the strongest and lightest materials made by people.



Carbon fiber threads are woven into fabric.

CRITICAL THINKING

Circle a natural material. Put an X on a manufactured material. What are two ways these materials are alike?

_____

_____

_____

S.T.E.M. continued

Every design has its upside and its downside. When a design for an object is chosen to meet one purpose, other features may not be as good. A quality that a designer must give up in order to get a desired quality is called a design trade-off. A designer needs to think of both the upside and the downside of a particular design.

Look at these shoes. List two examples of the upside and two of the downside for each shoe. Think of another type of shoe. Draw it in the empty space and explain the trade-offs.

Upside	Downside

Upside	Downside

Upside	Downside

Upside	Downside

ENGINEERING DESIGN CHALLENGE

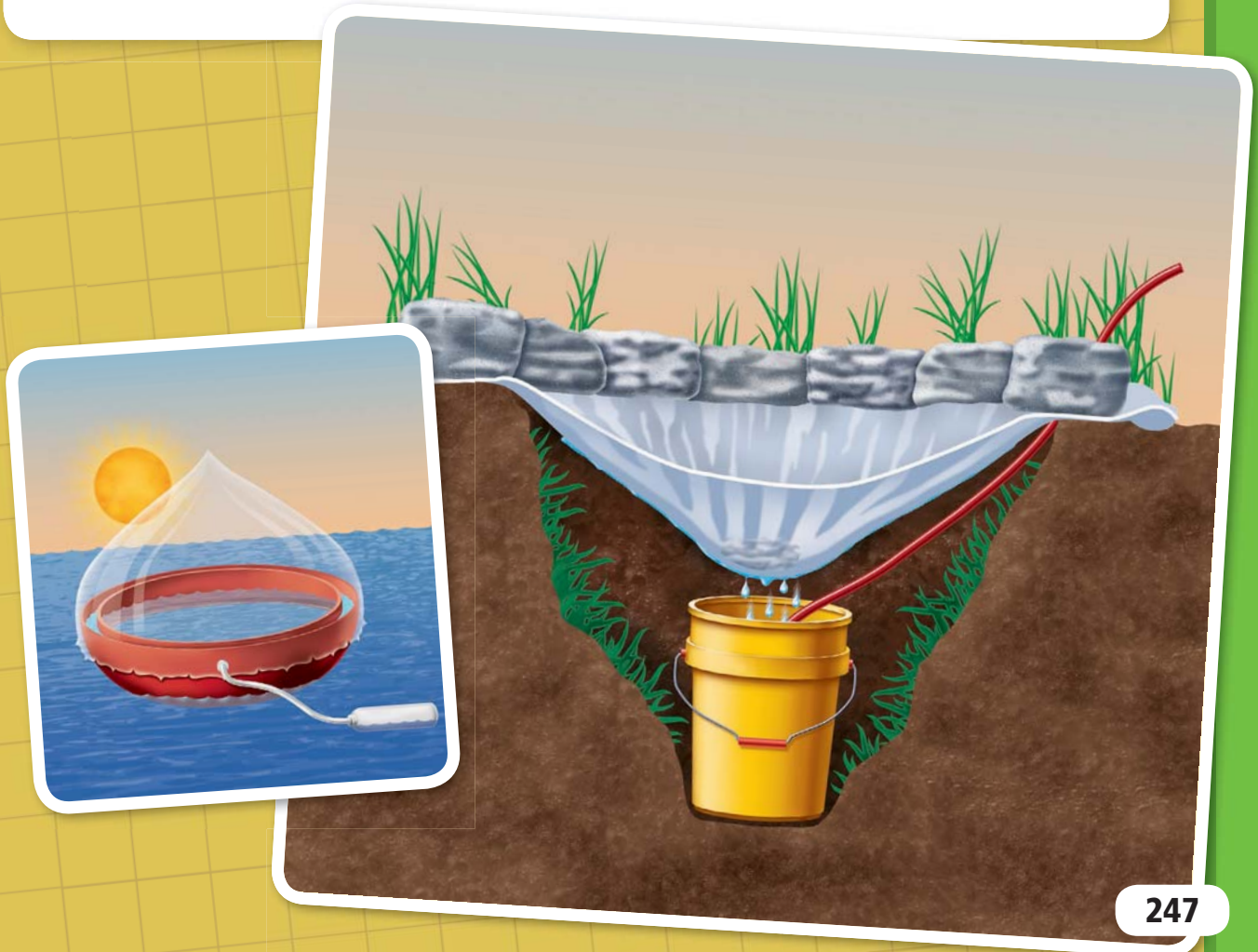
Design It:
Distillation Device

When salt dissolves in water, it spreads out into its tiniest particles. These particles are too small to be seen or to be removed by ordinary filters.

Distillation is a process that separates salt from salt water. When water is boiled, it evaporates, changing into a gas called water vapor. When water vapor comes in contact with a cool surface, it changes back into liquid water. Since salt does not easily evaporate, the water droplets that form don't contain salt.

As distillation continues, all of the water will evaporate from the saltwater solution. The only substance left behind will be pure salt crystals.

Can you develop a way to remove salt from water without boiling it?

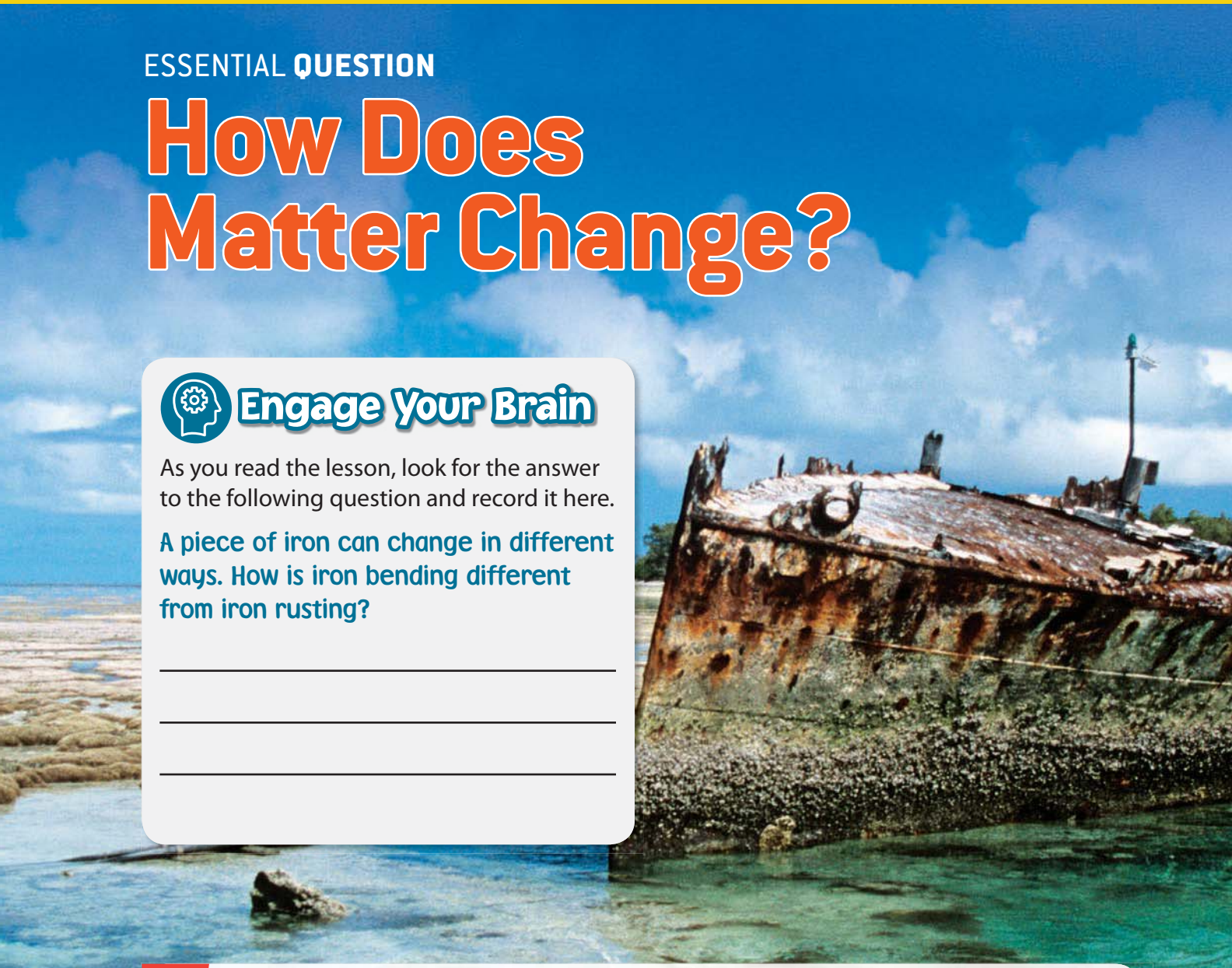


What to Do:

1. Learn about solutions and dissolving.
2. Find out how distillation separates salt water into salt and pure water.
3. Learn about different distillation devices and how they are used to meet certain needs.
4. Find out what classroom materials you can use to build a distillation device. List them.
5. Based upon your research and available materials, make a diagram of your distillation device design.
6. Build and test your design. Use a measuring cup to find out how much water it distills in a day. Record this amount.
7. Continue improving or redesigning your device until you are satisfied with the final product.
8. Keep a record of your work in your Science Notebook.

ESSENTIAL **QUESTION**

How Does Matter Change?



Engage Your Brain

As you read the lesson, look for the answer to the following question and record it here.

A piece of iron can change in different ways. How is iron bending different from iron rusting?

_____

_____

_____

ACTIVE READING

Lesson Vocabulary

List the terms. As you learn about each one, make notes in the Interactive Glossary.

_____

_____

_____

_____

Main Idea and Details

Detail sentences give information about a topic. The information may be examples, features, characteristics, or facts. Active readers stay focused on the topic when they ask, What fact or information does this sentence add to the topic?

Classifying Change

▲ Slicing apples and cracking eggs are physical changes.

Matter has properties, but matter also undergoes changes. How many different ways does matter change?

ACTIVE **READING** Each visual on these two pages has an empty bubble. Write a C if the visual shows a chemical change. Write a P if it shows a physical change.

Matter has physical properties that can be observed without changing the type of matter. Matter can also change in ways that do not affect the type of matter. These changes are called **physical changes**.

When you sharpen a pencil, the pencil goes through a physical change. The wood shavings and bits of graphite don't look like a pencil any more. But the wood is still wood, and the graphite is still graphite.

When an apple pie cooks, chemical changes occur. Cooked apples do not have the same properties as a raw apple.

▲ Slicing a pie is another physical change.

▲ The properties of the ash and gases that form when wood burns are different from the properties of wood.

▲ When iron rusts, it undergoes a chemical change.

Matter has other properties that cannot be observed without changing the identity of the matter. These properties are chemical properties. For example, you don't know if a type of matter will burn unless you burn it. When matter burns, it changes identity.

In the same way, **chemical changes** result in a change in the identity of matter. When a strawberry rots, it undergoes chemical change. The rotten strawberry's properties are quite different from those of a fresh strawberry. A chemical **reaction** is the process in which new substances are formed during a chemical change.

◀ When you eat apple pie, chemical changes in your body digest the food.

▶ Place a *P* by each physical change and a *C* by each chemical change.

Change	Type
Bacteria decompose leaves.	
A newspaper turns yellow in sunlight.	
Water evaporates.	
Gasoline burns in a car engine.	

Swelling and Shrinking

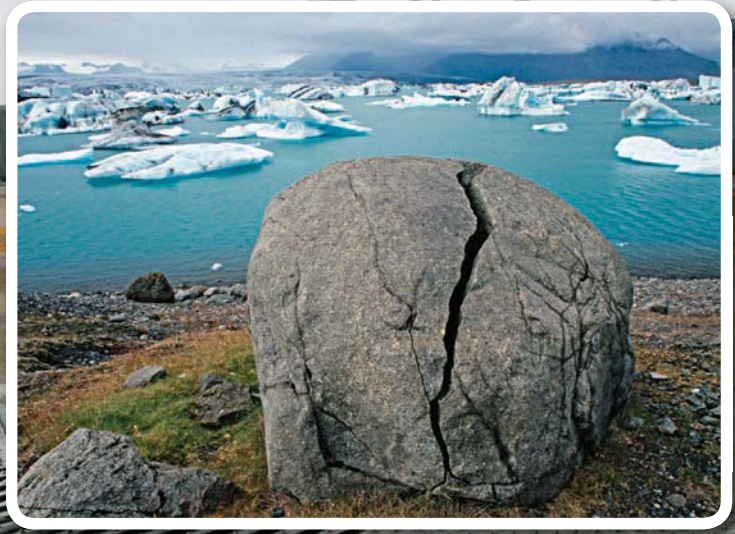
Why do you think many car owners use one tire pressure in summer and another one in winter? When temperature differs, volume often differs.

ACTIVE READING As you read this page, draw two lines under each main idea. Circle an example of matter expanding when it becomes warmer.

Most matter expands when the temperature goes up and contracts when the temperature goes down. Some kinds of matter expand and contract more than others. People may run hot water over the metal lid of a glass jar. This expands the lid so that it's easier to take off the jar.

One exception is water. It expands when it freezes. Because ice takes up more volume than the same amount of liquid water, ice is less dense than water. That's why ice floats in a glass of water. In winter, ice first forms at the surface of a lake.

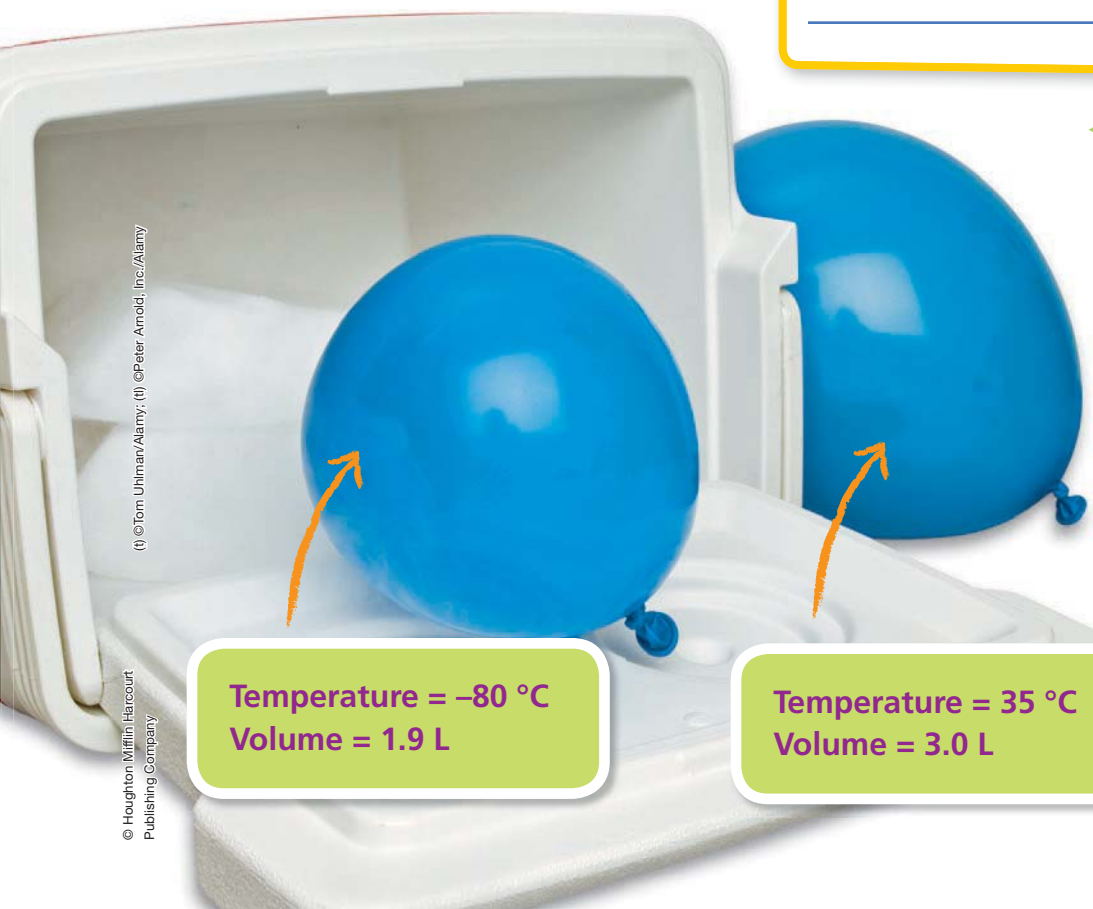
One of water's unique properties is that it expands when it freezes.



Sometimes water flows into cracks in rocks and freezes. The expanding water makes the cracks in the rock larger and breaks large rocks into smaller pieces.

Expansion Joints

Explain why bridges have expansion joints in them.



This photo shows the same balloon at two different temperatures. The size of a sample of gas depends on its temperature. The gas in a balloon expands when it is warmed. The gas compresses when it is cooled.

Tampering with Temperature

When a burner on a stove is really hot, it glows red. A change in color is just one way temperature can affect matter.

ACTIVE READING As you read this page, underline examples of how temperature affects physical changes in matter.

Some physical changes, such as tearing a piece of paper, are not affected by temperature. Other physical changes happen faster or slower at different temperatures. How quickly a change occurs is called the rate of change.

For example, ice on a lake will melt if the air temperature is above 0 °C. It will melt even faster if the air temperature is warmer. In the same way, water condenses more quickly on the outside of a very cold soft drink can than it does on a cool can.

Hot! Hot! Hot!
As iron is heated, it glows red or yellow.

WOW! This metal rod has been heated to more than 500 °C (932 °F).

OUCH! The filament of a light bulb is made of a metal called tungsten. It is glowing because it is heated to 2,500 °C!

DO THE MATH

Graph Data

The data table shows how long it takes identical ice cubes to melt when placed in equal amounts of water at different temperatures. Make a line graph of these data.

Temperature of water (°C)	Melting time of ice (sec)
14	450
19	300
27	170
42	140
48	90
70	25

When grass and the air around it cool at night, water vapor in the air might condense, forming dew. As morning sunlight warms the air, the dew evaporates. In this photograph, the grass in the shade is wet but the grass in the sun has dried.

Adding it Up!

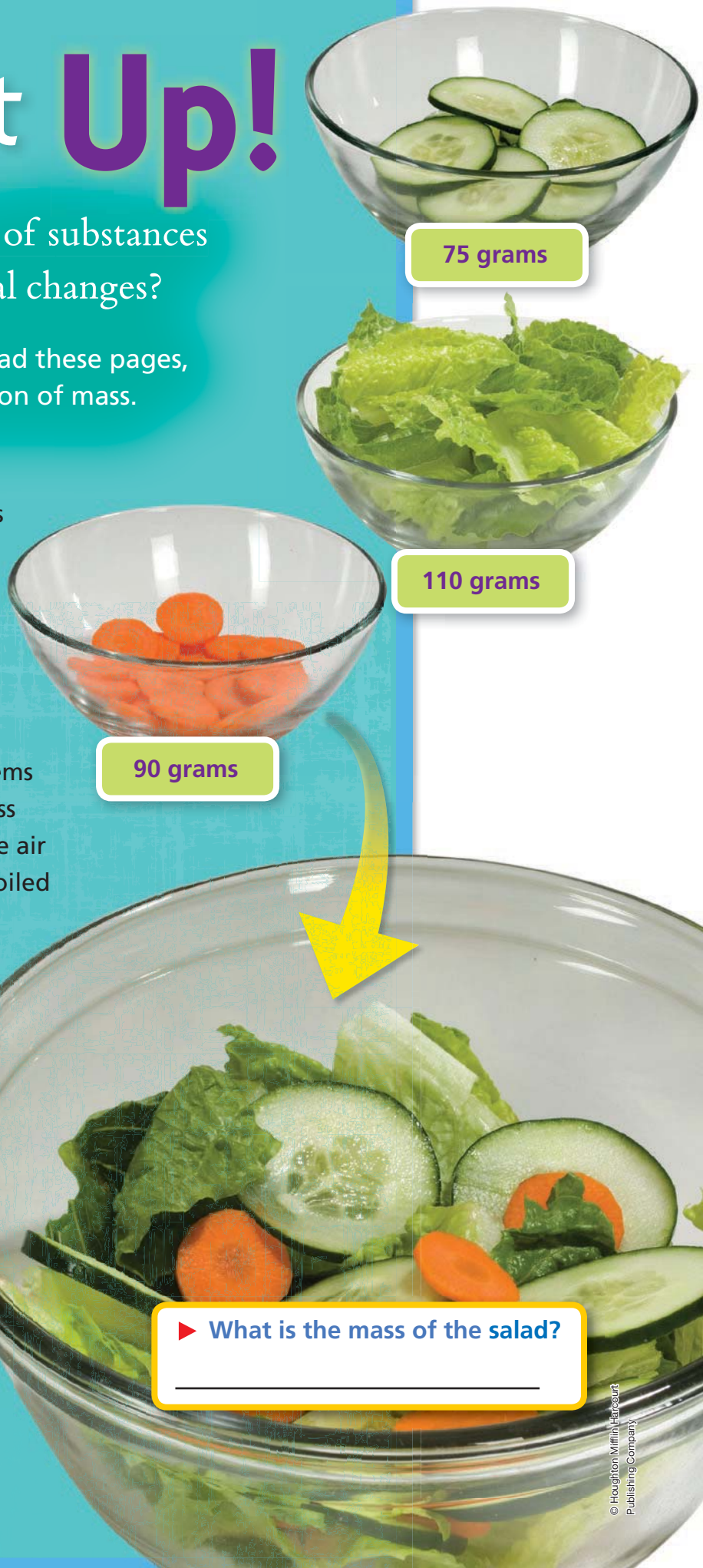
What happens to the mass of substances during physical or chemical changes?

ACTIVE READING As you read these pages, underline examples of conservation of mass.

During physical and chemical changes, matter may change its appearance or its identity. In either type of change, the total mass of the matter before and after the change remains the same. This is called **conservation of mass**. To *conserve* means "to save."

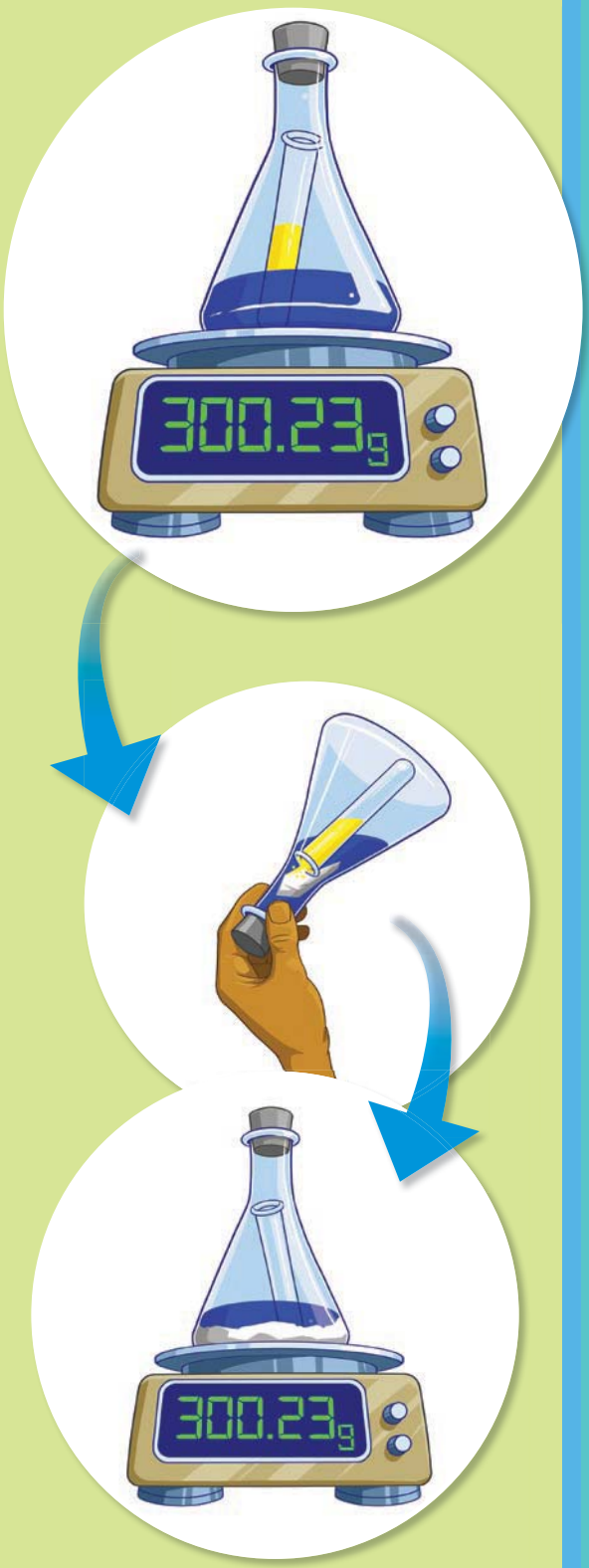
For example, as water boils, it seems to disappear. However, the total mass of the particles of water vapor in the air equals the mass of the water that boiled away. Suppose you tear a 100-gram cardboard box into pieces. The total mass of all the pieces will also be 100 grams. The mass of the cardboard box stays the same. In this example, however, the volume of the cardboard box changes because tearing it into pieces causes it to lose its shape.

The total mass of the mixed salad is the sum of the masses of the vegetables in it.



▶ What is the mass of the salad?

_____



During this chemical reaction, the flask is sealed. Nothing can enter or leave, so the final mass equals the starting mass.

A chemical change turns one kind of matter into another. However, the mass of the matter stays the same. It can be tricky to compare, though. First, you must collect and measure the mass of everything you begin with. Then, you must collect and measure the mass of everything you are left with.

When wood burns, it combines with oxygen from the air. Burning produces ashes, smoke, and other gases. The mass of the wood and oxygen equals the mass of the ashes, smoke, and gases that are produced.

DO THE MATH

Solve Problems

In a physical change, sugar is dissolved in water to form sugar water. In a chemical change, iron combines with oxygen to form rust. Fill in the missing values in the table.

Physical Change	**Mass (grams)**
sugar	125
water	
sugar water	198
Chemical Change	
iron	519
oxygen	23
rust	

Faster or Slower?

Temperature affects the rate at which chemical changes occur, too. Read to find out how.

ACTIVE READING As you read this page, circle two clue words or phrases that signal a detail such as an example or an added fact.

Increasing temperature often speeds up the rate of a chemical change. For example, increasing oven temperature speeds up the chemical changes that occur when a cake bakes or a potato cooks.

Decreasing temperature usually slows down the rate of chemical change. This is why food stays fresh longer when it is kept cool. Also, unused batteries stay charged longer when kept in the refrigerator.

The chemical changes that make food spoil are slowed down by keeping the food in the refrigerator.

An effervescent antacid tablet reacts more quickly with warm water than it does with cold water.

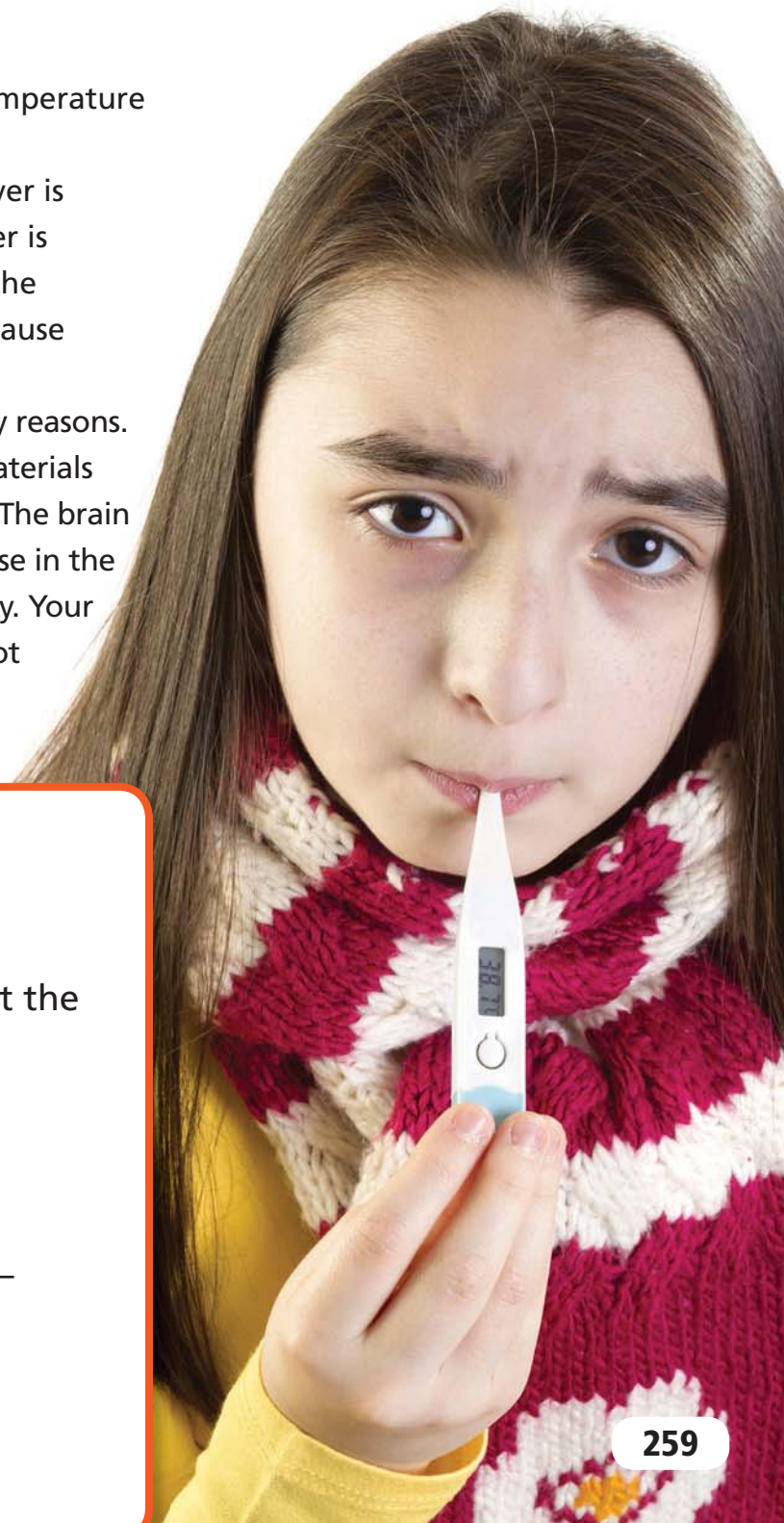
Why It Matters

Fevers

You feel awful. Your head hurts, and you have a fever. Why might having a fever be a good thing?

When you have a fever, your temperature rises above your normal body temperature (about 37 °C). A low fever is between 38 °C and 39 °C. A high fever is greater than 40 °C. Low fevers help the body fight disease. High fevers can cause severe problems.

Temperature can increase for many reasons. For example, certain bacteria have materials that your brain identifies as harmful. The brain sends out signals that cause an increase in the chemical changes that produce energy. Your temperature increases. Bacteria cannot survive at this higher temperature.

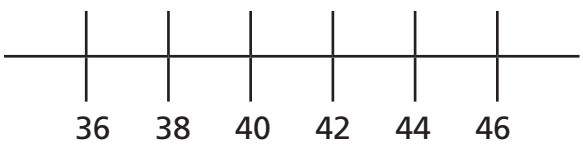


DO THE MATH

Use a Number Line

On the number line below, plot the following values in °C.

a. normal body temperature
b. a slight fever
c. a high fever



Sum It Up »

The outline below is a summary of the lesson. Complete the outline.

I. Matter undergoes changes.

A. One type of change is a (1) _____.

1. Matter does not change identity.

2. Example: (2) _____

B. (3) _____

1. Matter changes identity.

2. Example: (4) _____

II. Temperature affects matter.

A. When temperature increases,

1. the speed of a chemical change (5) _____.

2. the rate of melting and boiling (6) _____.

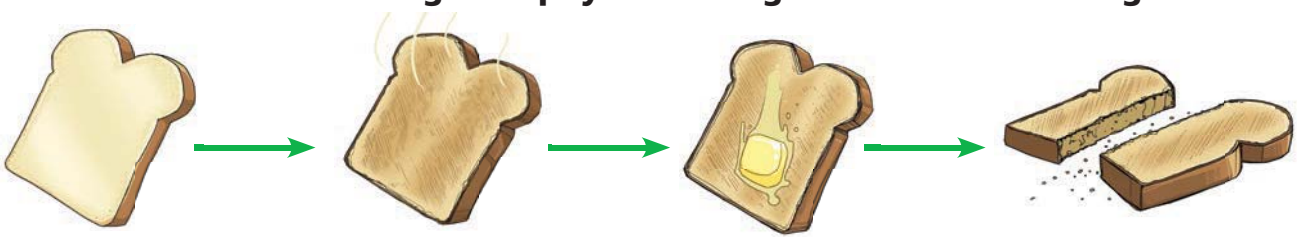
B. When temperature decreases,

1. the speed of a chemical change (7) _____.

2. the rate of freezing or condensing (8) _____.

III. During physical or chemical changes, the total mass of matter (9) _____.

Tell whether each change is a physical change or a chemical change.



(10) _____ (11) _____ (12) _____

Brain Check

Name _____

Vocabulary Review

1 It's easy to get tongue-tied when talking about how matter changes. Look at the statements below. Switch the red words from one sentence to another until each statement makes sense.

A. In a chemical change, the identity of matter does not change. _____

B. Water will melt faster on a very cold soft drink can than it will on a cool soft drink can. _____

C. Another name for a chemical change is a chemical property. _____

D. Ice will condense more slowly in cold water than in warm water. _____

E. In a physical change, the identity of the matter changes. _____

F. When water freezes, its mass decreases. _____

G. A reaction of matter will stay the same during a physical change. _____

H. When water freezes, it contracts. _____

Challenge The words in the boxes below are jumbled. Put them in the correct order to make a meaningful sentence.

changes are rusting and chemical burning _____ _____	is physical and mass changes in chemical conserved _____ _____

Apply Concepts

2 Each of the pictures shows a change. Write a *P* by the pictures that show physical changes and a *C* by the pictures that show chemical changes.

3 Make a list of physical changes and chemical changes that you observe or see the effects of in your school.

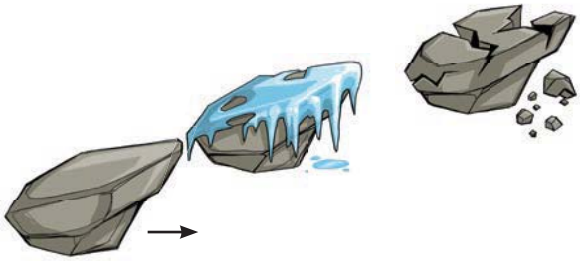
Physical Changes

Chemical Changes

4 What would make each of the following processes happen faster? On each line, write *increase in temperature* or *decrease in temperature*.

Ice cream melting _____	Boiling water to cook potatoes _____
Water condensing on the outside of a glass _____	Water freezing overnight on a street _____

5 Explain what is happening in these pictures. Tell whether the changes are physical or chemical.



_____

_____

_____

_____

_____

_____

_____

6 Why is it important to follow the instructions on this jar of food?

_____

_____

_____

_____

_____

_____

_____

7 Draw a picture of a chemical reaction. Then explain what happens and why mass is conserved during the reaction.

_____

_____

_____

_____

_____

_____

8 Explain why most sidewalks have built-in cracks every few feet.

_____

_____

_____

_____

_____

_____

_____

_____

9 Explain what happens in a campfire.

Wood is made of cellulose, lignin, and other substances.

↓

The wood is set on fire, and a _____ change occurs.

↓

The cellulose and lignin are changed into other substances, including _____ and _____.

Take It Home!

Ask an adult to help you practice taking the temperature of someone in your family. Determine whether any of your family members have a fever. Explain to family members why people get fevers.

Name _____

ESSENTIAL **QUESTION**

How Can Temperature Change Matter?

Materials

- safety goggles
- lab apron
- graduated cylinder
- 3 balloons
- 3 plastic tubs
- room-temperature water
- measuring spoons
- funnel
- dry yeast
- sugar
- hot water
- ice water
- string
- ruler

EXPLORE

Turn the heat up! In this activity, you and your classmates will explore how temperature affects the rate of a chemical change.

Before You Begin—Preview the Steps

1. **CAUTION:** Wear safety goggles and an apron. Don't touch the hot water. Use the funnel to add one teaspoon of yeast, a half teaspoon of sugar, and 50 mL of room-temperature water to each balloon.
2. Tie the balloons closed. Gently knead each balloon to mix the ingredients. Place one balloon into each tub.
3. Pour ice water into the first tub, and add the same amount of room-temperature water to the second tub.
4. Have your teacher pour the same amount of hot water into the third tub.
5. After 30 minutes, remove all three balloons from the water. Use the string and ruler to measure the distance around each balloon.

Set a Purpose

What will you learn from this experiment?

State Your Hypothesis

Write your hypothesis, or testable statement.

Think About the Procedure

Why do you need to add equal amounts of yeast, sugar, and water to each balloon?

How will you be sure that you measure the distance around each balloon in the same way?

Name _____

Record Your Data

In the space below, make a table in which you record your results.

Draw Conclusions

Plot your data on a line graph.

What conclusion can you draw?

_____

_____

Claims • Evidence • Reasoning

1. What are some reasons you might want to repeat this experiment several more times and compare your results to those in other groups?

2. How do the results of this experiment help you understand what happens when bread bakes? Explain your reasoning.

3. Write a claim for why food spoils faster when it is not refrigerated. Support your claim with evidence.

4. Think of other questions you would like to ask about how temperature relates to the rate of a chemical reaction.

SC.5.P.8.2 Investigate and identify materials that will dissolve in water and those that will not and identify the conditions that will speed up or slow down the dissolving process. **SC.5.P.8.3** Demonstrate and explain that mixtures of solids can be separated based on observable properties of their parts such as particle size, shape, color, and magnetic attraction.

LESSON 4

ESSENTIAL **QUESTION**

What Are Mixtures and Solutions?

Engage Your Brain

As you read the lesson, look for the answer to the following question and record it here.

How are a smoothie and a salad alike? How are they different?

ACTIVE **READING**

Lesson Vocabulary

List each term. As you learn about each one, make notes in the Interactive Glossary.

Problem and Solution

Ideas in this lesson may be connected by a problem-solution relationship. Active readers mark a problem with a *P* to help them stay focused on the way information is organized. When multiple solutions are described, they mark each solution with an *S*.

Matter Mix-Up

A box of colored pencils. A basket of footballs, tennis balls, and hockey pucks. A toy box full of toys. All these things are mixtures. But what is a mixture?

ACTIVE READING As you read the next page, draw two lines under the conclusion. Draw one line under each fact that leads to the conclusion.

This fruit salad is a mixture of different pieces of fruit.

Look at the mixtures on these pages. They have a few things in common. First, two or more substances or objects were combined. The fruit salad has several types of fruit. The laundry pile has several types of clothing. Second, each type of matter in a mixture keeps its own identity. The peach in the fruit salad is the same type of matter as it was before it was mixed into the fruit salad. The jeans in the laundry pile are still jeans.

By now, you've probably figured out that a **mixture** is a combination of two or more substances that keep their identities. The parts of a mixture don't undergo a chemical change. Making a mixture is a physical change.

A carbonated beverage is a mixture of water, gases, and other ingredients.

▶ **These clothes are all jumbled together. How do you know this pile of laundry is a mixture?**

_____

_____

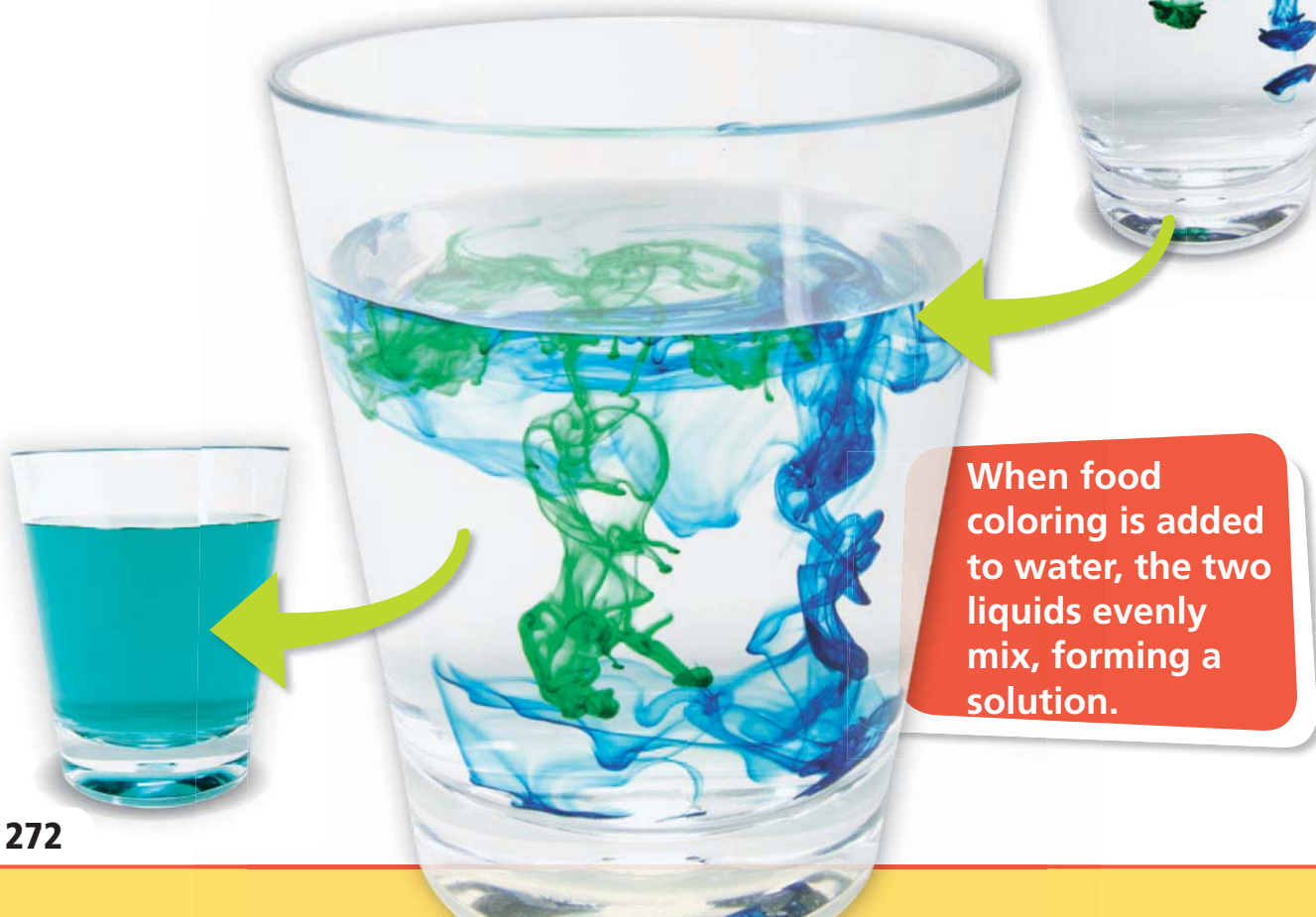
_____

Find a Solution!

In some mixtures, it's easy to see the individual pieces that are mixed together. In other mixtures, small parts are very evenly mixed. What are these special mixtures?

ACTIVE READING As you read these two pages, underline lesson vocabulary words each time they are used.

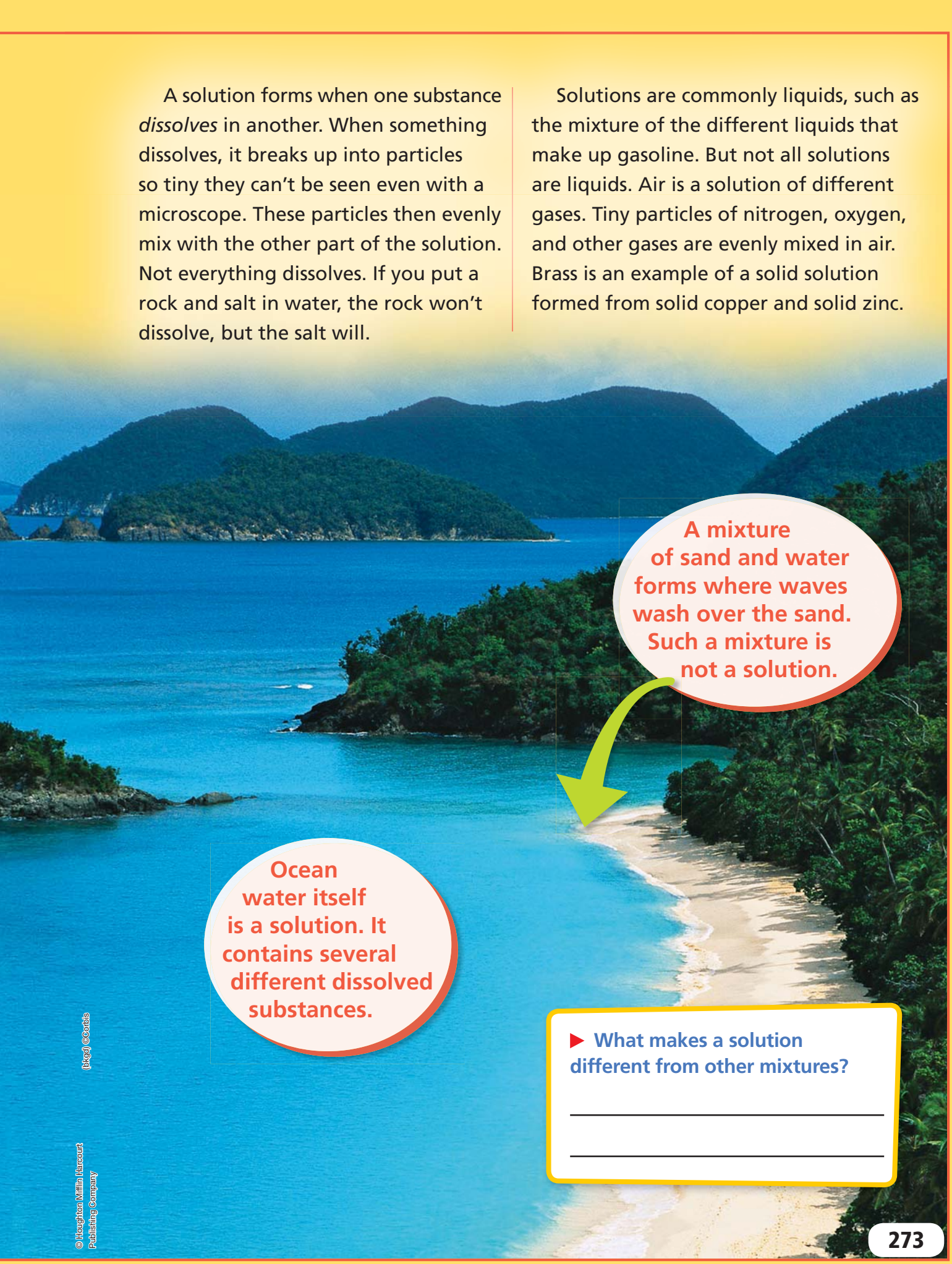
Each bite of fruit salad contains different combinations of fruit. You can separately taste peaches and different kinds of berries. But what do you notice when you drink a glass of lemonade? Every sip tastes the same. This is because lemonade is a solution. A **solution** is a mixture that has the same composition throughout.



When food coloring is added to water, the two liquids evenly mix, forming a solution.

A solution forms when one substance *dissolves* in another. When something dissolves, it breaks up into particles so tiny they can't be seen even with a microscope. These particles then evenly mix with the other part of the solution. Not everything dissolves. If you put a rock and salt in water, the rock won't dissolve, but the salt will.

Solutions are commonly liquids, such as the mixture of the different liquids that make up gasoline. But not all solutions are liquids. Air is a solution of different gases. Tiny particles of nitrogen, oxygen, and other gases are evenly mixed in air. Brass is an example of a solid solution formed from solid copper and solid zinc.



A mixture of sand and water forms where waves wash over the sand. Such a mixture is not a solution.

Ocean water itself is a solution. It contains several different dissolved substances.

▶ What makes a solution different from other mixtures?

_____

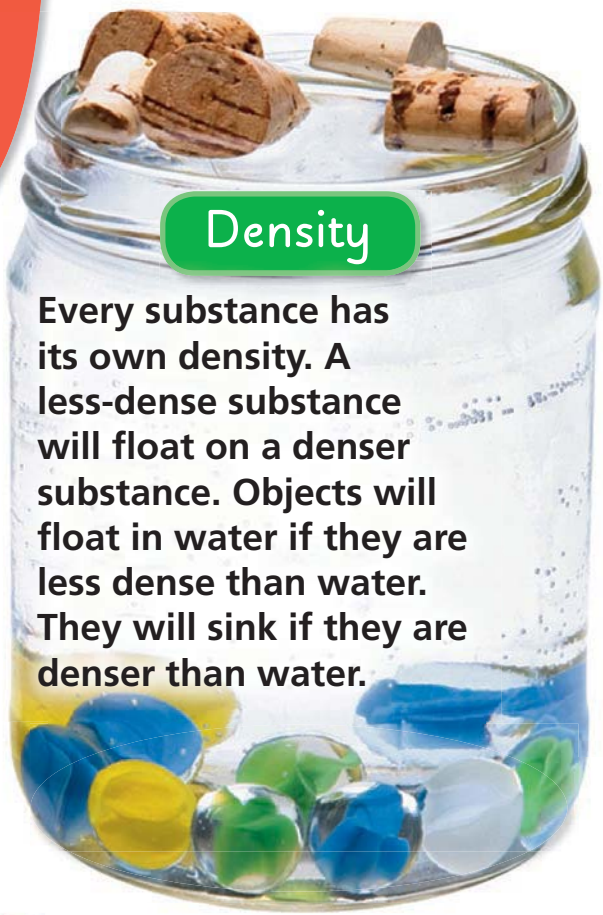
_____

Separating Mixtures

Suppose you really don't like olives. How are you going to get them off that deluxe pizza your friend ordered? Sometimes you need to separate the components of a mixture.

ACTIVE READING As you read this page, put brackets [ ] around the sentence that describes the problem and write *P* next to the sentence. Underline the sentence that describes the solution and write *S* next to it.

Mixtures are not always easy to separate. But since mixing is a physical change, each component in a mixture keeps most of its physical properties. Physical properties such as color, size, melting point, boiling point, density, and ability to dissolve can be used to separate mixtures. Separating a mixture can be very simple. Or it can involve several, complex steps when one method is not enough.



Density

Every substance has its own density. A less-dense substance will float on a denser substance. Objects will float in water if they are less dense than water. They will sink if they are denser than water.

▶ **What property was used to separate the items on this tray?**

_____

A magnet takes away bits of iron.

When One Isn't Enough

sieve/mesh screen

A sieve or mesh screen has holes that matter can pass through. Matter that is smaller than the holes passes through the mesh screen while matter that is larger than the holes stays above the mesh screen.

magnetic force

A magnet attracts matter that contains iron, separating it from the other parts of the mixture.

filtration

A filter works like a mesh screen with very tiny openings, or pores. Only the smallest bits of matter—like water particles and dissolved particles of salt—can pass through the pores.

evaporation/boiling

Boiling is when a liquid rapidly changes to a gas at the boiling point of the liquid. Evaporation also changes a liquid to a gas, but it occurs at temperatures below the boiling point. During these processes, only the liquid particles leave the solution. Dissolved particles stay behind.

Water is added. Then the filter removes the soil.

The water is boiled away. Only salt is left behind.

Why It Matters

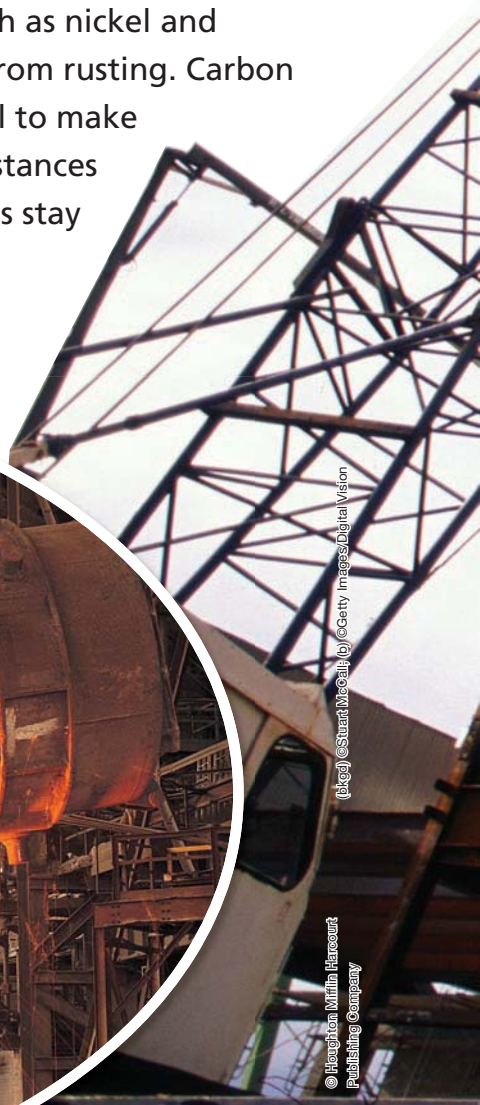
Proportions and Properties

When you make lemonade, it's important to get the amounts of lemon and sugar right. If it's too sweet or too sour, it doesn't taste right. How do proportions affect the properties of a mixture?

Mixtures of metals are called *alloys*. The properties of the alloy depend on how much of each metal is in the mixture. Chemists first decide on the properties they need their alloy to have. Then they decide how much of which metals will give them those properties.

Steel is an alloy. It is made from iron and other substances. Different substances give steel different properties. For example, adding chromium will make steel shiny. Metals such as nickel and titanium can keep it from rusting. Carbon is often added to steel to make it stronger. Other substances help steel used in tools stay sharp or keep from wearing down.

To make an alloy, metals and other elements are melted together and then allowed to harden.



▶ For each steel object on this page, list at least two properties that the steel must have.

Kettle

Sculpture

Steel Building Frame

DO THE MATH

Use Graphs

Compare and contrast the metals and other substances in stainless steel and tool steel by making two circle graphs.

Substance	Stainless Steel %	Tool Steel %
Iron	74	94
Chromium	18	0
Nickel	8	1
Carbon	0	1
Other	0	4

Sum It Up »

Write *S* if the photo and caption describe a mixture that is a solution. Write *M* if they describe a mixture that is NOT a solution.

____ (1) When you combine ingredients to make a sandwich, each ingredient keeps its identity. You could easily separate them.

____ (2) Soft drinks are made by dissolving a gas and other ingredients in water. The dissolved particles are much too small to be seen.

____ (3) The solid bits of orange pulp do not dissolve in the liquid. Because the pulp particles are large, they will eventually settle out.

____ (4) Particles of several different gases make up air. Air on one side of a room is just like the air on the other side.

Fill in the missing words to tell how to separate mixtures.

To sort the items in your junk drawer, you'd use observable (5) _____ such as size, color, shape, and (6) _____ attraction. But how would you separate table sugar, sand, and pebbles? Because the pebbles are (7) _____ than the grains of sugar and sand, you could remove them using a sieve, or mesh (8) _____.

You could then add water and shake until the sugar (9) _____.

If you poured this mixture through a coffee (10) _____ into a beaker, the (11) _____ would be left on the filter, but the sugar solution would pass through. Adding heat would cause the water to (12) _____ , leaving solid sugar behind.

Brain Check

Name _____

Vocabulary Review

1 Use the words in the box to complete each sentence.

1. Another name for a mesh screen is a _____.
2. During a _____ change, there is no formation of a new kind of matter.
3. A _____ is a tool that attracts objects that contain iron.
4. An object that is less dense than water will _____ when it is placed in water.
5. A _____ is an object used to separate very small particles from a mixture.
6. The amount of matter in a given volume is called _____.
7. _____ is a physical property of an object; for example, round, square, rectangular, or flat.
8. The process by which a liquid changes slowly to a gas is _____.
9. A _____ is a kind of mixture that has the same composition thorughout.
10. A combination of two or more substances that keep their individual identities is a _____.

sieve	shape	evaporation	solution*	physical
magnet	mixture*	float	filter	density

* Key Lesson Vocabulary

Apply Concepts

2 Circle the substances below that are solutions.


brass trumpet


trail mix


shells


sandwich


drink from a mix

3 Make a list of solid mixtures in your classroom.

_____ _____

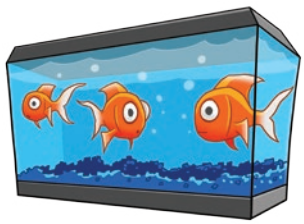
_____ _____

_____ _____

_____ _____

_____ _____

4 Draw and label a diagram to show how you would separate each mixture.



5 Answer these questions in terms of what you know about mixtures.

a. How would changing the proportions of substances in an alloy change its properties?

_____

_____

_____

b. Why is it possible to use physical properties to separate a mixture?

_____

_____

c. Recycling help us conserve resources. Draw a line connecting each piece of garbage in a mixed bag with the bin it should be thrown in.

milk jug | soup can | envelope | cardboard box | soda can | water bottle | broken pencil

Garbage | Plastic | Aluminum and Tin | Paper

6

Salt seems to disappear when it is poured into water. Use the terms mixture, solution, and dissolve to explain what happens.

_____

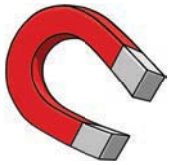
_____

_____

_____

7 Tell how you would use one or more of these tools to separate the mixtures.






Rice from dried soup mix

Salt from saltwater

Nails from gravel

8 Tell what would happen if you stirred each of these cups faster.

Take It Home! Share what you have learned about mixtures with your family. With a family member, identify examples of mixtures at mealtime, or in places in your home.

Name _____

ESSENTIAL **QUESTION**

What Affects the Speed of Dissolving?

EXPLORE

In this activity, you will explore how to make a solid dissolve in water faster.

Materials

- safety goggles
- table salt
- lab apron
- stopwatch
- cold tap water
- 2 spoons
- 3 clear containers
- coarse salt
- measuring spoon
- warm water

Before You Begin—Preview the Steps

1. **CAUTION:** Wear goggles and an apron. Use a stopwatch to measure how long it takes for salt to completely dissolve. Stop timing if it has not dissolved after two minutes. Empty and rinse the containers between steps.

2. Measure equal amounts of tap water into three containers. Add a spoonful of table salt to each container. Do not stir one container. Stir one at a moderate rate, and the other at a fast rate.

3. Measure equal amounts of tap water into two containers. Add a spoonful of coarse salt to one and a spoonful of table salt to the other. Stir both at the same rate.

4. Pour some cold water into a container, and pour an equal amount of warm water into another. Add a spoonful of table salt to both containers. Stir both at the same rate.

Set a Purpose

What will you learn from this experiment?

State Your Hypothesis

Write your hypothesis, or testable statement.

Think About the Procedure

Why do you need to rinse the containers between steps?

Would it affect the conclusions for this activity if two different groups stirred at different rates? Why?

What is the control group in Step 2 of this investigation? Why is a control important?

Name _____

Record Your Data

Record your results in the data table below.

Time It Takes to Dissolve	
Treatment	Time(sec)
No Stirring	
Stirring Slowly	
Stirring Quickly	
Coarse Salt	
Table Salt	
Cold Water	
Warm Water	

Draw Conclusions

Make a bar graph to display how your test data showed that stirring affects the rate of dissolving.

What conclusion can you draw?

_____

_____

Claims • Evidence • Reasoning

1. You're adding sugar to a glass of iced tea. Cite evidence for how you might speed up how quickly the sugar dissolves.

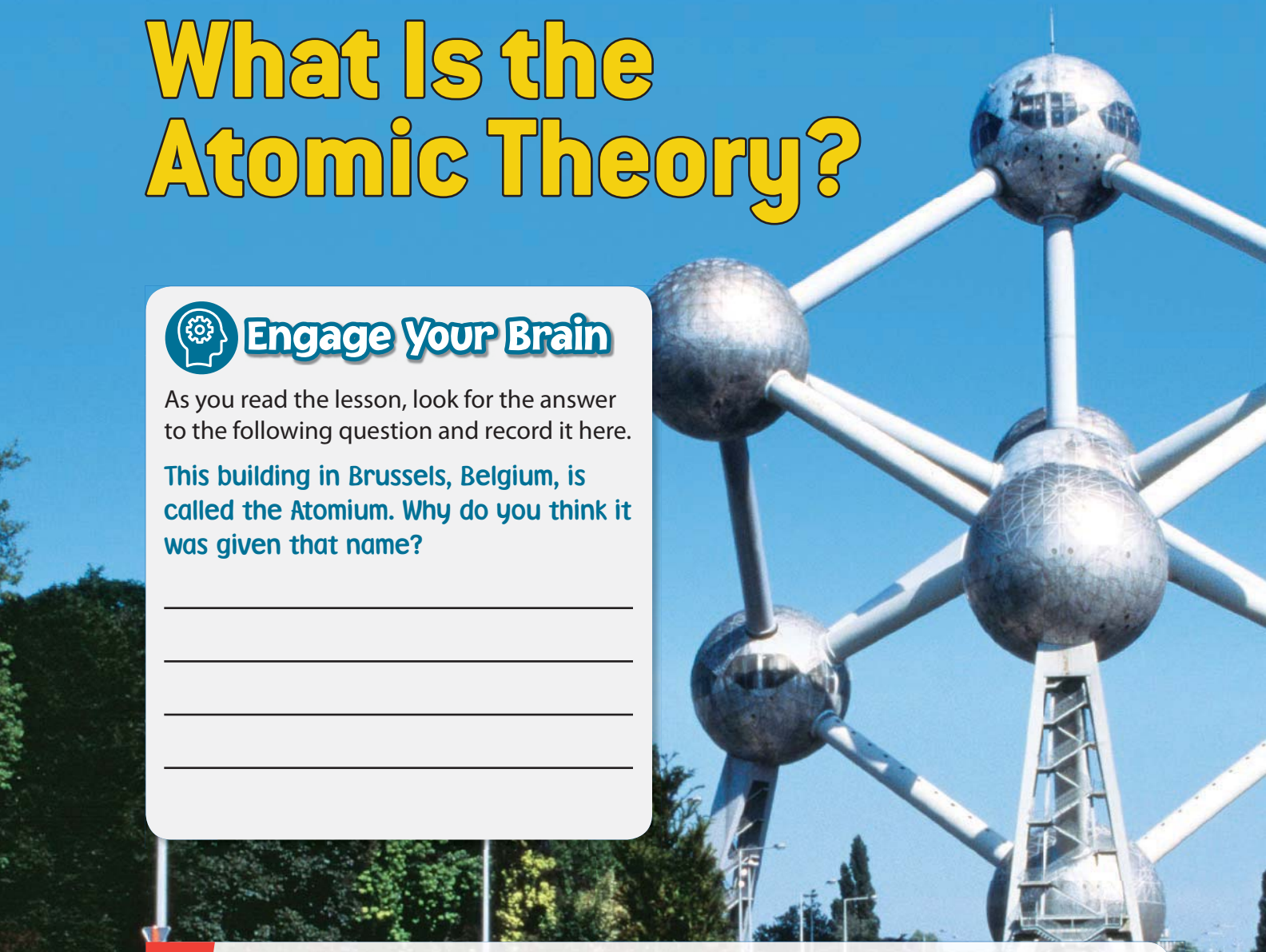
2. Minerals dissolve in river water. Would you expect minerals to dissolve faster in a fast-moving river or one that moves slowly? Explain your reasoning.

3. A water softener is a device that uses salts to remove certain substances from water. Most home water softeners use salt pellets or rock salt, both of which are chunks of salt. Provide evidence for why you wouldn't want to use table salt in a softener.

4. Think of other questions you would like to ask about the rate of dissolving a solid in water.

ESSENTIAL QUESTION

What Is the Atomic Theory?



Engage Your Brain

As you read the lesson, look for the answer to the following question and record it here.

This building in Brussels, Belgium, is called the Atomium. Why do you think it was given that name?

_____

_____

_____

_____

ACTIVE READING

Lesson Vocabulary

List the terms. As you learn about each one, make notes in the Interactive Glossary.

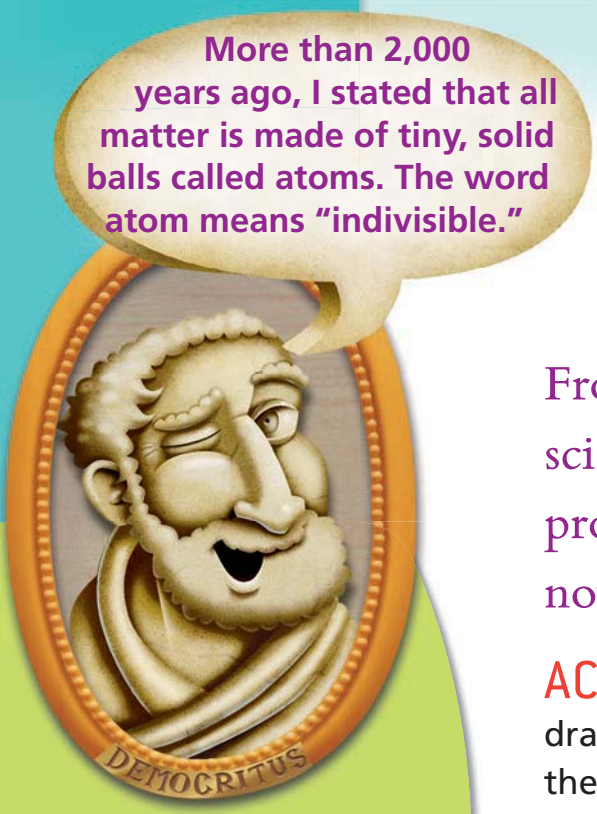
_____ _____

_____ _____

_____

Visual Aids

A diagram adds information to the text that appears on the page with it. Active readers pause their reading to review the diagram and decide how the information in it adds to what is provided in the text on the pages.



A Teeny Tiny Theory

From the time of Democritus, scientists have studied matter and proposed theories about it. What do we now think about what makes up matter?

ACTIVE READING As you read the next page, draw a line from each part of the atom diagram to the sentences that describe it.

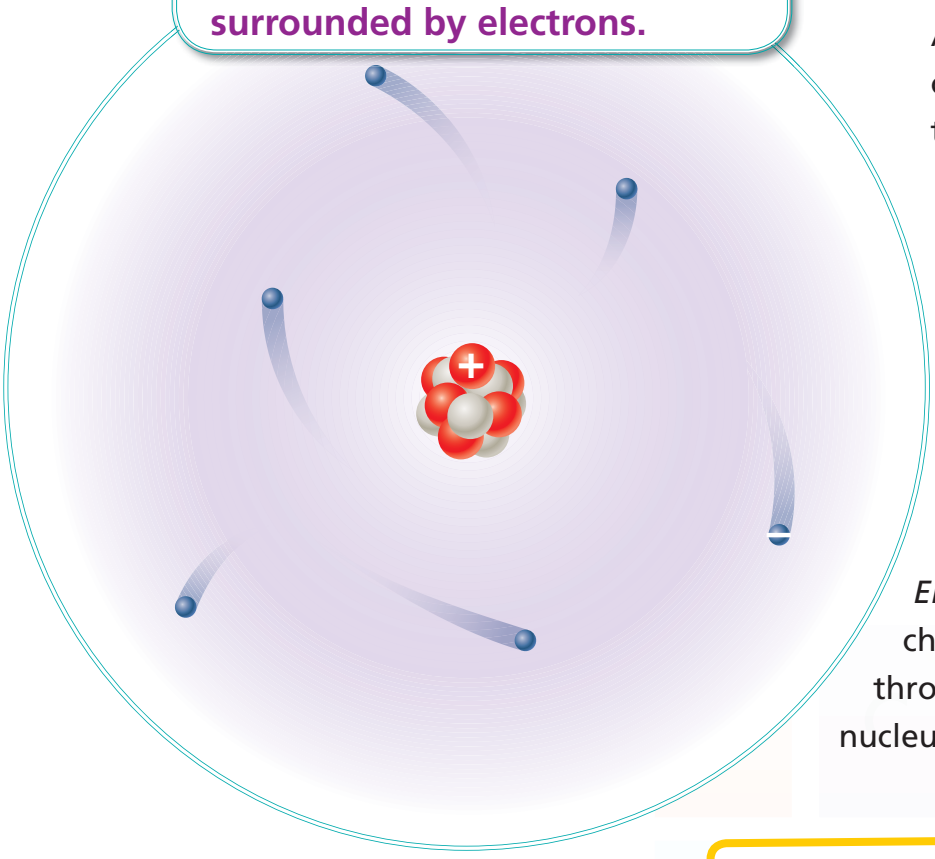
Suppose you could break a silver chain into smaller and smaller pieces. The pieces would become so small that you couldn't see them without a microscope. How small could the pieces get before they were no longer silver? The answer—one silver atom. An **atom** is the smallest unit of an element that maintains the properties of that element.

The **atomic theory** is a scientific explanation of the structure of atoms and how they interact with other atoms. Democritus first suggested that the smallest part of matter is an atom. Over the years, theories that scientists made about atoms have changed as scientists learn more about atoms.

Gold is one type of matter.

Atoms are the building blocks of all matter.

Current atomic theory states that an atom is mostly empty space. At its center, there is a small, dense core called the nucleus. The nucleus is surrounded by electrons.



Proton

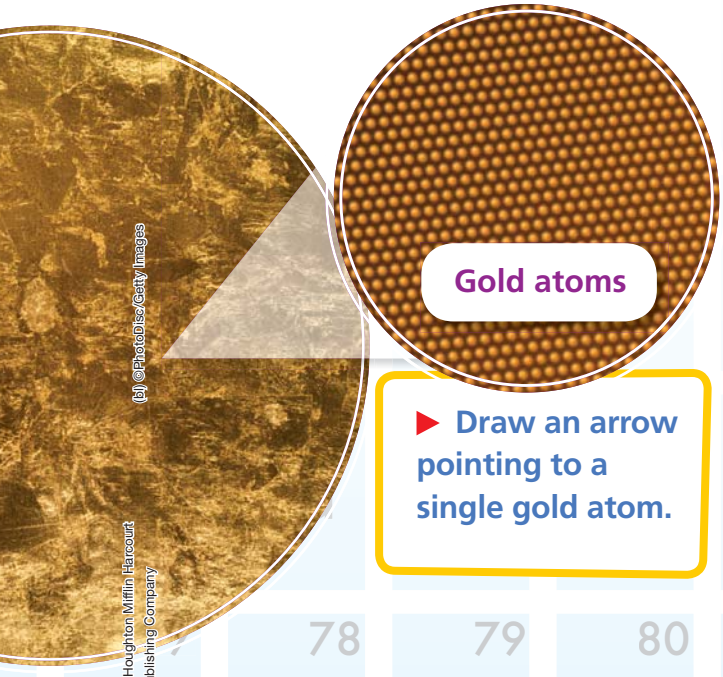
A *proton* is a positively charged particle found in the nucleus of an atom.

Neutron

Neutrons are also particles found in the nucleus, but a neutron has no charge.

Electron

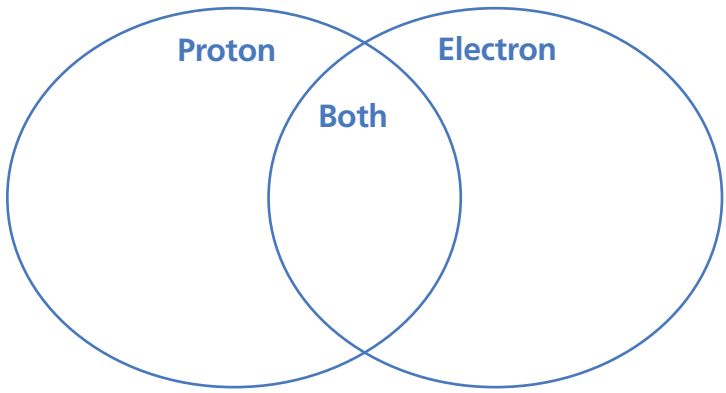
Electrons are negatively charged particles that speed through an area around the nucleus called the electron cloud.



Gold atoms

▶ Draw an arrow pointing to a single gold atom.

▶ Use the Venn diagram to compare and contrast electrons and protons.



In the mid-1800s, I organized all known elements by their properties and increasing mass. Scientists still organize elements based on my work.

It's Elementary!

Copper, oxygen, and mercury have one thing in common. They are all elements. Exactly what is an element?

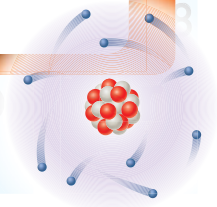
ACTIVE READING As you read these two pages, draw a large *E* next to the names of five elements that are described.

There are many kinds of matter. An **element** is the type of matter made of just one kind of atom. All atoms of an element have the same number of protons. For example, boron is an element. Every atom of boron contains exactly five protons. No other element has atoms with exactly five protons.

What's so special about protons? Electrons are far from the nucleus, so they can be gained or lost. Also, different atoms of the same element can contain different numbers of neutrons. Protons stay the same.

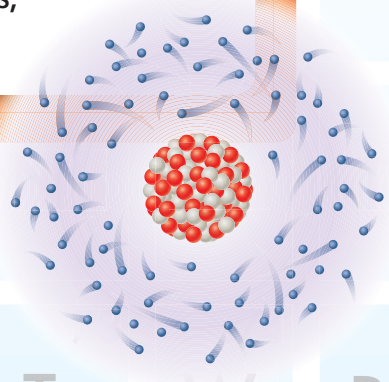
Neon

Protons: 10
Uses: neon signs, helium-neon lasers, television tubes, refrigerant



Mercury

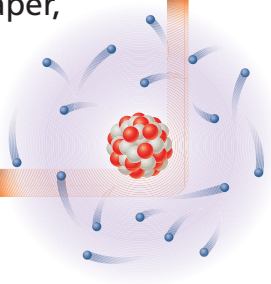
Protons: 80
Uses: laboratory instruments, thermostats, dental fillings, pesticides



Elements are substances that can't be broken into simpler substances.

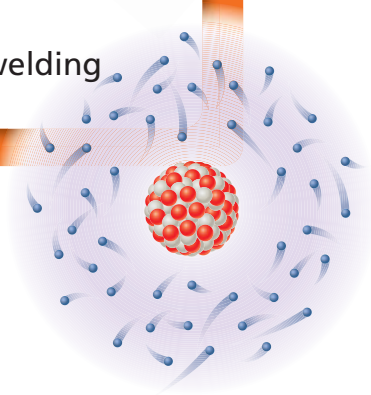
Chlorine

Protons: 17
Uses: disinfecting water; making paper, paints, plastics, and dyes



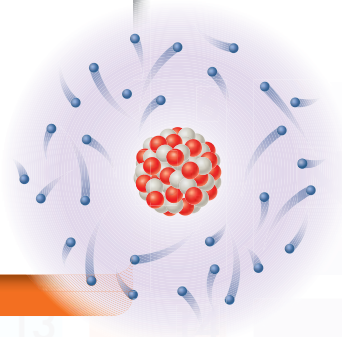
Silver

Protons: 47
Uses: jewelry, silverware, photography, welding solder, mirrors



Copper

Protons: 29
Uses: plumbing, coins, electrical wires, making brass and bronze



Draw and Label a Carbon Atom

Use the information provided to draw and label a carbon atom.
Protons: 6
Neutrons: 6
Electrons: 6

Part of my atomic theory stated that different types of atoms combine to form chemical compounds.

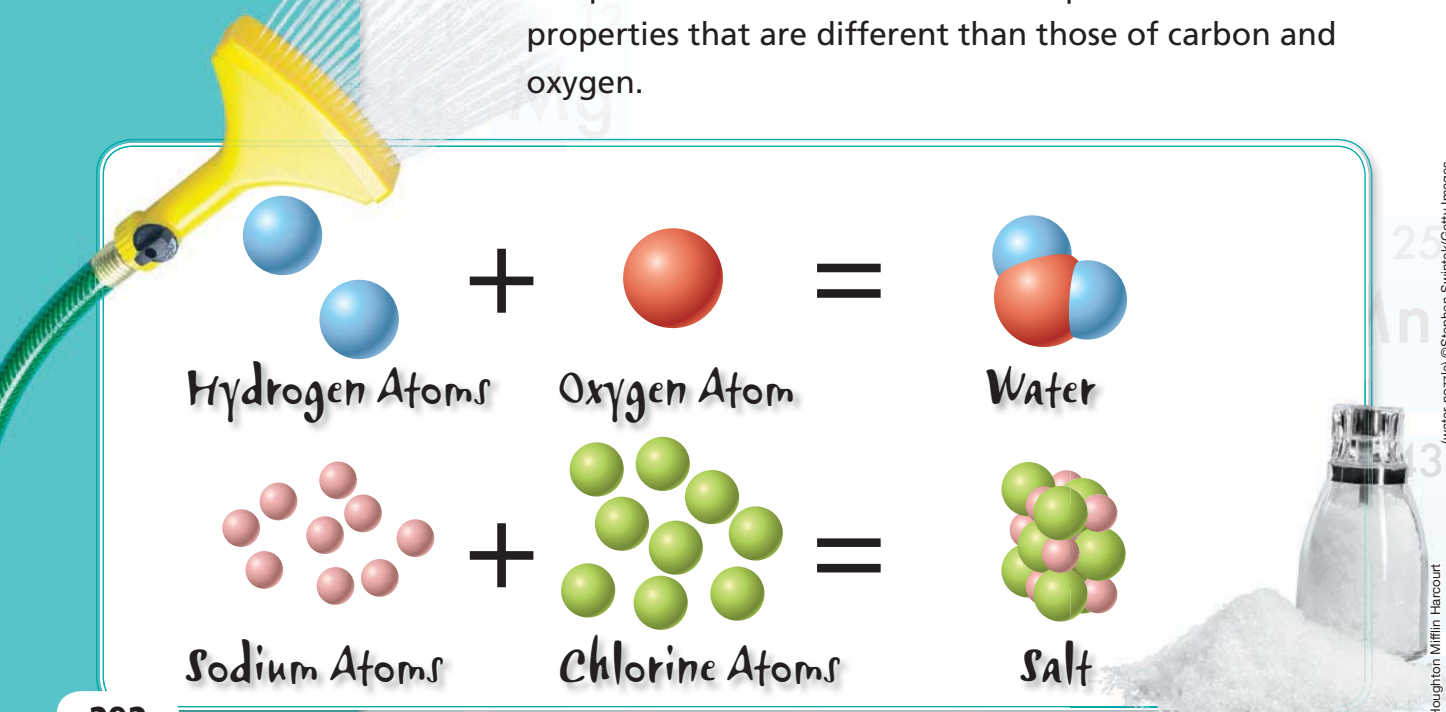
Putting It All Together

There are more than 100 elements, but you can see that there are many more types of matter than that. What are these other types?

ACTIVE READING As you read this page, draw boxes around the names of the two things that are being compared.

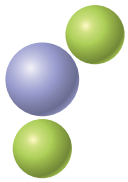
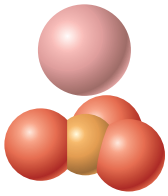
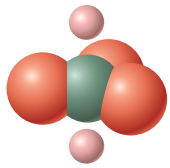
Many atoms go through chemical change with a different type of atom and form molecules. A **molecule** is made up of two or more atoms joined together chemically. A **compound** is a substance formed by atoms from two or more elements.

The properties of a compound are often different from the properties of the elements that form it. For example, atoms of carbon and oxygen will react, forming the compound carbon dioxide. This compound has its own properties that are different than those of carbon and oxygen.

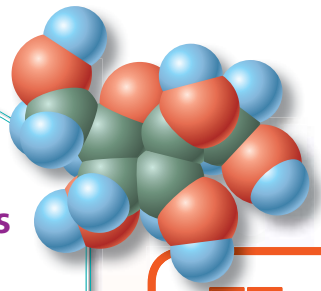


Compounds are made of atoms of at least two different elements.

Firework Colors

Orange	Yellow	Red
calcium chloride	sodium nitrate	lithium carbonate
		
1 calcium 2 chlorine	1 sodium 1 nitrogen 3 oxygen	2 lithium 1 carbon 3 oxygen

Some of the colors in fireworks come from compounds. For example, calcium chloride, which contains one calcium atom for every two chlorine atoms, results in an orange color.



Fructose is often called fruit sugar. For every 6 atoms of carbon in the compound, there are 12 hydrogen atoms and 6 oxygen atoms.

DO THE MATH

Use Fractions

Add the total number of atoms in fructose. In lowest terms, what fraction of fructose consists of:

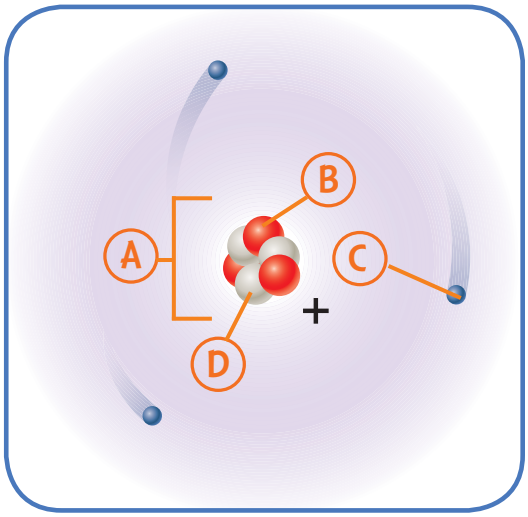
1.carbon atoms? _____

2.hydrogen atoms? _____

3.oxygen atoms? _____

Sum It Up »

1 Label the parts of this atom.



Ⓐ _____

Ⓑ _____

Ⓒ _____

Ⓓ _____

2 Sequence the following from smallest to largest.

____ Ⓐ atom ____ Ⓑ proton ____ Ⓒ molecule ____ Ⓓ nucleus

3 Fill in the blanks.

An atom is the smallest particle of an Ⓐ _____ that has its properties. Our current Ⓑ _____ is the result of the ideas of many scientists over many years. Scientists currently theorize that atoms contain a dense core that is called the Ⓒ _____ . It contains positively charged particles called Ⓓ _____, and Ⓔ _____ , which have no charge. Particles called Ⓕ _____ move around the center of the atom. The identity of an element is determined by the number of Ⓖ _____ in one atom of the element. When two or more atoms are joined together, Ⓗ _____ form.

Brain Check

Name _____

Vocabulary Review

1 For each jumbled term, unscramble the letters to form a term from this lesson. Use the clues to help you.

1. tasmo
   _ _ _ _ ◯
   The smallest particles of an element

2. ueotnrn
   _ _ ◯ _ _ _ _
   The particle in an atom that has no charge

3. retelocn
   _ _ _ _ _ ◯ _ _
   Moves around the outside of an atom

4. omdocpun
   _ _ _ ◯ _ _ _ _
   Formed from at least two types of chemically combined atoms

5. onropt
   _ ◯ _ _ _ _
   The positively charged part of the nucleus

6. mitoca rohety
   _ _ _ _ ◯ _ _ _ _ _ _ _ _
   Changed through history as scientists learned more about atoms

7. cnluseu
   _ _ _ _ _ _ ◯
   The dense, central part of an atom

8. nemtele
   ◯ _ _ _ _ _ _ _
   Contains only one kind of atom

Riddle Put the circled letters into the riddle in the order they are circled.

What did the chemistry teacher get for her birthday?

the element of _ _ _ _ _ _ _ _

Apply Concepts

2 Draw and label a diagram of a nitrogen atom. It should have 7 protons, 7 neutrons, and 7 electrons.

3 Use the terms *atom* and *element* to explain what makes silver and gold different.

_____

_____

4 Complete the table.

Compound	Atoms	Fraction of each type of atom
methane	5 total: 1 carbon, 4 hydrogen	
propane	11 total: _____	$\frac{3}{11}$ carbon, $\frac{8}{11}$ hydrogen
hydrogen peroxide	4 total: 2 hydrogen, 2 oxygen	
carbon dioxide	3 total: _____	$\frac{1}{3}$ carbon, $\frac{2}{3}$ oxygen

Take It Home! Check the ingredient lists on labels of several household products. Find the names of two different compounds. Use reference books or the Internet to find out what elements are in the compounds.

SC.5.P.8.4 Explore the scientific theory of atoms (also called atomic theory) by recognizing that all matter is composed of parts that are too small to be seen without magnification.

Meet the Atomic All-Stars

Marie Curie

Marie Curie worked as a scientist in France. She discovered that some elements are radioactive. That means energy radiates, or comes out, of the elements. In 1903, Marie Curie became the first woman ever to win a Nobel Prize. In 1911, she won another. She is one of the most famous female scientists of all time.

In some of Marie Curie's early work on radioactivity, she studied this type of uranium mineral, known as pitchblende.

Inés Triay

Inés Triay is a scientist who works with radioactive materials, too. She works to clean up dangerous wastes that are produced when radioactive elements are used in nuclear power plants. In 2009, President Barack Obama assigned Triay to an important job in the U.S. Department of Energy. She was head of the team that properly disposes of nuclear waste.

The symbol on this sign warns of radioactivity that could be dangerous to your health.

Complete a Timeline

Fill in the boxes with information about Marie Curie and Inés Triay. For each entry you add, draw a line to the correct location on the timeline.

1898 Marie Curie discovers two new radioactive elements, called radium and plutonium.

1908 Hans Geiger invents a tool now called the "Geiger counter." It measures radioactivity.

1951 For the first time, electricity is generated using radioactive elements.

_____

_____

_____

_____

1896 Marie Curie's teacher, Henri Becquerel, first discovers radioactivity.

_____

_____

_____

_____

1934 Marie Curie dies from a disease caused by radiation. No one knew that radioactivity can be very bad for human health.

1979 Two scientists, Godfrey Hounsfield and Allan McLeod Cormack, win the Nobel Prize in Medicine for the C.T. scan machine. It uses small amounts of radiation and takes pictures of the inside of the human body.

Think About It!

How did Marie Curie's work lead to improved health care?

_____

_____

_____

_____

UNIT 5 Benchmark Review

Name _____

Vocabulary Review

Use the terms in the box to complete the sentences.

chemical changes
compound
liquid
physical changes
solution

1. Matter that has a definite volume but no definite shape is a(n) _____.

2. A mixture that has the same composition throughout is called a(n) _____.

3. Changes to the identity of matter are called _____.

4. Changes in which the form or shape of a substance changes but the substance is still the same type of matter are called _____.

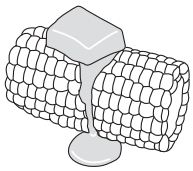
5. Matter that cannot be broken into a simpler substance is a(n) _____.

Science Concepts

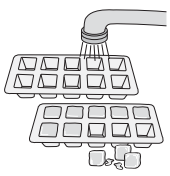
Fill in the letter of the choice that best answers the question.

6. Joseph put water, sugar, and yeast into a balloon. Then he put the balloon in a warm place for 1 hour. Which of the following is most like the change happening in Joseph's balloon?

Ⓐ 

Ⓒ 

Ⓑ 

Ⓓ 

7. Daniel put water, sugar, and yeast into a balloon. Then he measured the mass of the balloon. He put the balloon in a warm place for 2 hours. Then he measured the mass again. He repeated his experiment three times to get more data. Predict how the mass of the balloon changed.

Ⓕ same mass
Ⓖ less mass
Ⓗ more mass
Ⓘ no more mass

8. Which of these correctly describes a change in the state of water?

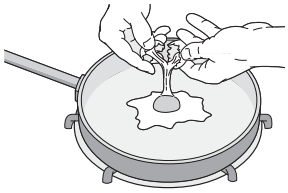
   Ⓐ liquid water ⟶ melts ⟶ solid water

   Ⓑ liquid water ⟶ boils ⟶ water vapor

   Ⓒ solid water ⟶ condenses ⟶ liquid water

   Ⓓ water vapor ⟶ evaporates ⟶ liquid water

9. When an egg is cracked and put in a hot pan, it flows easily. After it cooks for a minute, the egg becomes solid.



   Why does the egg change?

   Ⓕ Breaking the shell is a physical change in the egg that makes it solid.

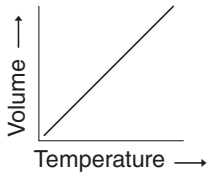
   Ⓖ Breaking the shell is a chemical change that makes the egg become solid.

   Ⓗ Heating the egg on the stove causes the egg to evaporate and become solid.

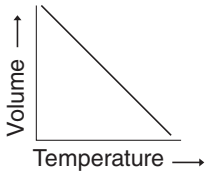
   Ⓘ Adding heat causes a chemical change in the particles of the egg that makes it solid.

10. The volume of a given mass of gas is one of its physical properties that can change. Which graph shows how the volume of a gas changes as the temperature of the gas increases?

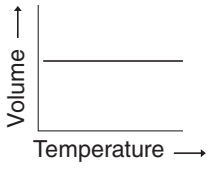
Ⓐ



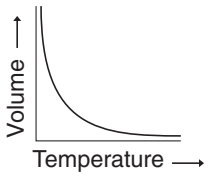
Ⓒ



Ⓑ



Ⓓ



11. Stacey tried to remove a metal lid from a glass jar, but the lid was too tight. Her mother held the jar so that the lid was in hot water for a minute. Then Stacey was able to turn the lid easily. How did the hot water make the lid easier to remove?

   Ⓕ Heating the glass jar made it expand, so the lid turned easily.

   Ⓖ As the metal lid was heated, it expanded so that it was not as tight.

   Ⓗ Water on the metal lid made it easier to hold, so it was easier to turn.

   Ⓘ The water corroded the metal, so it did not hold as tightly to the glass.

12. Which of these statements best describes the effect of temperature on chemical changes?

   Ⓐ Chemical changes generally happen faster at higher temperatures.

   Ⓑ Chemical changes generally happen slower at higher temperatures.

   Ⓒ Chemical changes are not affected by a change in temperature.

   Ⓓ Chemical changes happen only if the temperature is very hot.

13. What does the modern atomic theory state?

   Ⓕ An atom is mostly empty space.

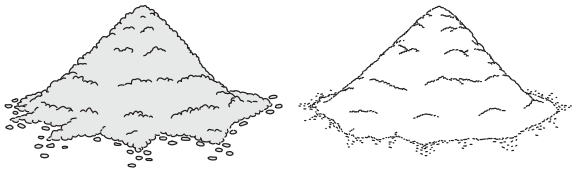
   Ⓖ All atoms are made up of hundreds of smaller particles.

   Ⓗ Atoms of different elements are exactly the same.

   Ⓘ Atoms of different kinds combine to form different elements.

Name _____

14. Claire is studying how quickly sugar dissolves in warm and cold water. First, she dissolves a 4 g sample of raw sugar, as shown in the following figure, in both warm and cold water. Then she dissolves a 4 g sample of white sugar, as shown in the following figure, in both warm and cold water.



Raw sugar White sugar

In which of the following solutions would the sugar dissolve the slowest?

Ⓐ raw sugar, cold water
Ⓑ raw sugar, warm water
Ⓒ white sugar, cold water
Ⓓ white sugar, warm water

15. Mrs. Lopez is a chemist who is studying salt crystals. She wants to slow the rate at which the crystals dissolve in a solution of water. What could she do to slow the dissolving rate?

Ⓕ Crush the salt.
Ⓖ Heat the solution.
Ⓗ Cool the solution.
Ⓘ Stir the solution.

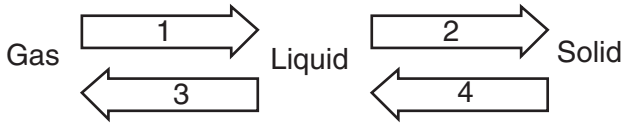
16. Nadia has a mixture of oil and water. She wants to separate the mixture. How can she do this?

Ⓐ by using a magnet to attract the oil
Ⓑ by pouring the mixture through a sieve
Ⓒ by evaporating the water from the mixture
Ⓓ by letting the oil float to the top and skimming it off

17. A container holds a mixture of glass shards and iron filings. What is the best way to separate the glass shards from the iron filings?

Ⓕ Use a magnet.
Ⓖ Heat the mixture.
Ⓗ Sort them by size.
Ⓘ Separate them by shape.

18. This diagram shows what happens when water changes state.



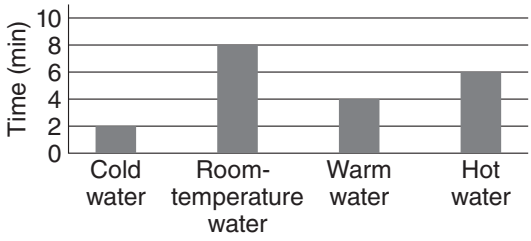
Which statement correctly explains some of the changes shown in the diagram?

Ⓐ Temperature increases in steps 1 and 2.
Ⓑ Energy of water particles decreases in steps 1 and 2.
Ⓒ Energy of water particles decreases in steps 3 and 4.
Ⓓ Motion of water particles decreases in steps 3 and 4.

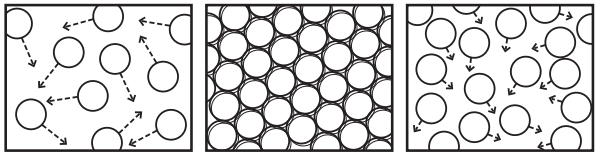
Apply Inquiry and Review the Big Idea

Write the answer to these questions.

19. Kym tested how quickly 10 g of sugar dissolved in 1 L of water at different temperatures. A graph of her results is shown here. What were Kym's variables? Based on her graph, make a claim about whether she correctly labeled her beakers of water. Use evidence and reasoning to support your claim.



20. Frank was learning about states of matter in science class. He made some drawings but forgot to label them. Describe what each of Frank's drawings shows below.



21. Tam was given four equal-sized cubes with different masses, as listed below.
copper: 71.2 g balsa wood: 1.6 g brass: 68.0 g plastic: 9.6 g

What did Tam observe about the volumes of the cubes? Explain.

Tam used these data to order the cubes according to the amount of matter they contain, from least to greatest. What order did she give, and why?