

Lesson 2

Matter and Its CHANGES

ESSENTIAL QUESTIONS



How are physical changes different from chemical changes?



How do physical and chemical changes affect mass?

Vocabulary

physical change p. 200

chemical change p. 202

law of conservation of mass
p. 205



Florida NGSSS

LA.8.2.2.3 The student will organize information to show understanding or relationships among facts, ideas, and events (e.g., representing key points within text through charting, mapping, paraphrasing, summarizing, or comparing/contrasting).

within text through charting, mapping, paraphrasing, summarizing, or comparing/contrasting).

SC.8.P.8.3 Explore and describe the densities of various materials through measurement of their masses and volumes.

SC.8.P.8.4 Classify and compare substances on the basis of characteristic physical properties that can be demonstrated or measured; for example, density, thermal or electrical conductivity, solubility, magnetic properties, melting and boiling points, and know that these properties are independent of the amount of the sample.

SC.8.P.9.1 Explore the Law of Conservation of Mass by demonstrating and concluding that mass is conserved when substances undergo physical and chemical changes.

SC.8.P.9.2 Differentiate between physical changes and chemical changes.

SC.8.N.1.1 Define a problem from the eighth grade curriculum using appropriate reference materials to support scientific understanding, plan and carry out scientific investigations of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.



Launch Lab

10 minutes



SC.8.P.9.2



What does a change in the color of matter show?

Matter has many different properties. Chemical properties can be observed only if the matter changes from one type to another. How can you tell if a chemical property has changed? Sometimes a change in the color of matter shows that its chemical properties have changed.

Procedure

- 1 Read and complete a lab safety form.
- 2 Obtain the **red indicator sponge** and the **red acid solution** from your teacher. Predict what will happen if the red acid solution touches the red sponge.

red sponge.

- 3 Use a **dropper** to remove a few drops of acid solution from the **beaker**. Place the drops on the sponge. ⚠️ *Be careful not to splash the liquid onto yourself or your clothing.*
- 4 Record your observations.

Data and Observations

Think About This

- 1 **Compare** the properties of the sponge before and after you placed the acid solution on the sponge. Was your prediction correct?

- 2 **Key Concept Identify** How do you know that physical properties and chemical properties changed?





Inquiry Why is it orange?

1. Streams are usually filled with clear freshwater. What happened to this water? Chemicals from a nearby mine seeped through rocks before flowing into the stream. How does the orange color form as these chemicals and metals from the rocks combine?

Changes of Matter

Imagine going to a park in the spring and then going back to the same spot in the fall. What changes do you think you might see? The changes would depend on where you live. An example of what a park in the fall might look like in many places is shown in **Figure 4**. Leaves that are soft and green in the spring might turn red, yellow, or brown in the fall. The air that was warm in the spring might be cooler in the fall. If you visit the park early on a fall morning, you might notice a thin layer of frost on the leaves. Matter, such as the things you see at a park, can change in many ways. These changes can be either physical or chemical.

Active Reading

2. **Describe** What are some changes that occur around you? How do the physical and chemical properties change?

Figure 4 The physical and chemical properties of matter change in a park throughout the year.





What are physical changes?

A change in the size, shape, form, or state of matter that does not change the matter's identity is a **physical change**. You can see an example of a physical change in **Figure 5**. Recall that mass is an example of a physical property. Notice that the mass of the modeling clay is the same before and after its shape is changed. When a physical change occurs, the chemical properties of the matter stay the same. The substances that make up matter are exactly the same before and after a physical change.



Figure 5 Changing the shape of the modeling clay does not change its mass.

Dissolving

One of the physical properties you read about in Lesson 1 was solubility—the ability of one material to dissolve, or mix evenly, in another. Dissolving is a physical change because the identities of the substances do not change when they are mixed. As shown in **Figure 6**, the identities of the water molecules and the sugar molecules do not change when sugar crystals dissolve in water.

Active Reading

3. Defend In the text, find and underline the explanation of why dissolving is classified as a physical change.

Click below.

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Support | Show Answers | Flag

Dissolving—A Physical Change

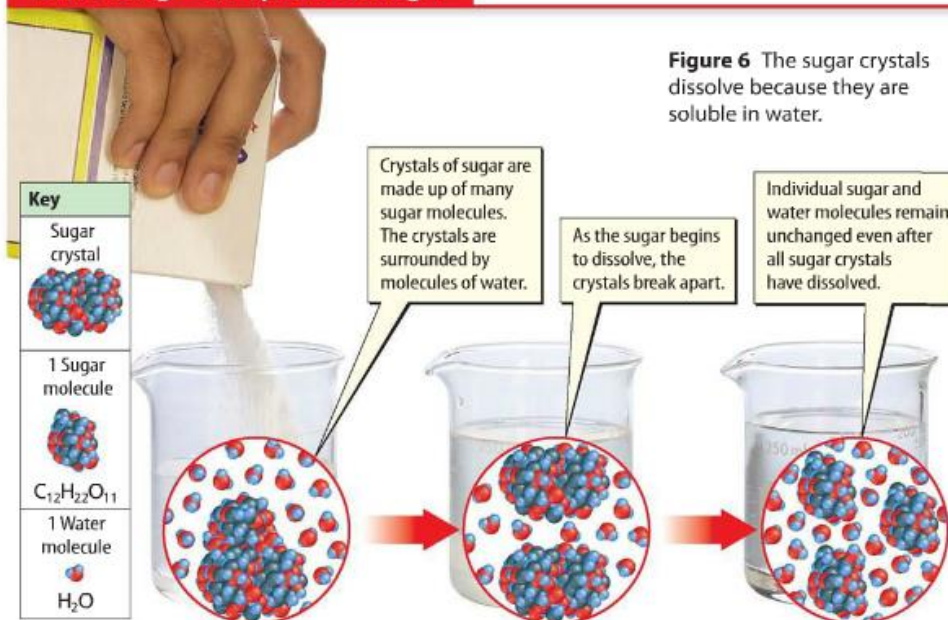


Figure 6 The sugar crystals dissolve because they are soluble in water.



Changing State

In Lesson 1 you read about three states of matter—solid, liquid, and gas. Can you think of examples of matter changing from one state to another? Changes in the state of matter are physical changes.

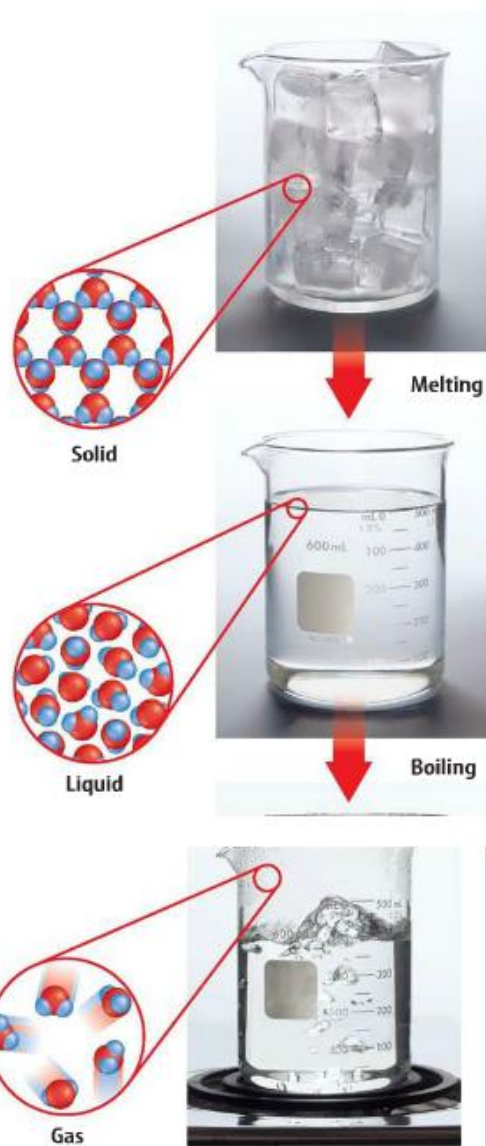
Melting and Boiling If you heat ice in a pot on the stove, the ice will melt, forming water that soon begins to boil. When a material melts, it changes from a solid to a liquid. When it boils, it changes from a liquid to a gas. The substances that make up the material do not change during a change in the state of matter, as shown in **Figure 7**. The particles that make up ice are the same as the particles that make up water as a liquid or gas.

Energy and Change in State The energy of the particles and the distances between the particles are different for a solid, a liquid, and a gas. Changes in energy cause changes in the state of matter. For example, energy must be added to a substance to change it from a solid to a liquid or from a liquid to a gas. Adding energy to a substance can increase its temperature. When the temperature reaches the substance's melting point, the solid

changes to a liquid. At the boiling point, the liquid changes to a gas.

What would happen if you changed the rate at which you add energy to a substance? For example, what would happen if you heated an ice cube in your hand instead of in a pot on the stove? The ice would reach its melting point more slowly in your hand. The rate at which one state of matter changes to another depends on the rate at which energy is added to or taken away from the substance.

Figure 7 The particles that make up ice (solid water), liquid water, and water vapor (water in the gaseous state) are the same.



Active Reading

4. Assess What changes occur to the particles of a material during a change in state?

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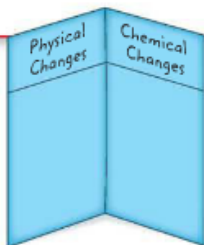
Lesson 2 • EXPLAIN 201



Active Reading**FOLDABLES®**

LA.8.2.2.3

Make a half book from a sheet of paper. Use it to record and compare information about physical and chemical changes.



What are chemical changes?

Some changes in matter involve more than just changing physical properties. A **chemical change** is a change in matter in which the substances that make up the matter change into other substances with different chemical and physical properties. Recall that a chemical property is the ability or inability of a substance to combine with or change into one or more new substances. During a physical change, only the physical properties of matter change. However, the new substance produced during a chemical change has different chemical and physical properties. Another name for a chemical change is a chemical reaction. The particles that make up two or more substances react, or combine, with each other and form a new substance.



5. NGSSS Check Describe How do chemical changes and physical changes differ? **SC.8.P.9.2**

Figure 8 A forest fire causes a chemical change in the trees, producing new substances.

Active Reading

6. Explain Why is the smoke produced during a forest fire a sign of a chemical change?

Signs of a Chemical Change

How can you tell that the burning of the trees in **Figure 8** is a chemical change? The reaction produces two gases—carbon dioxide and water vapor—even though you cannot see them. After the fire, you can see that any part of the trees that remains is black, and you can see ash—another new substance. But with some changes, the only new substance formed is a gas you cannot see. As trees burn in a forest fire, light and heat are signs of a chemical change. For many reactions, changes in physical properties, such as color or state of matter, are signs that a chemical change has occurred. However, the only sure sign of a chemical change is the formation of a new substance.

Chemical Change

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Light and heat during a forest fire are signs that a chemical change is occurring.



After the fire, the formation of new substances shows that a chemical change has taken place.



Formation of Gas Bubbles of gas can form during both a physical change and a chemical change. When you heat a substance to its boiling point, the bubbles show that a liquid is changing to a gas—a physical change. When you combine substances, such as the medicine tablet and the water in **Figure 9**, gas bubbles show that a chemical change is occurring. Sometimes you cannot see the gas produced, but you might be able to smell it. The aroma of freshly baked bread, for example, is a sign that baking bread causes a chemical reaction that produces a gas.

Formation of a Precipitate Some chemical reactions result in the formation of a precipitate (prih SIH puh tut). As shown in the middle photo in **Figure 9**, a precipitate is a solid that sometimes forms when two liquids combine. When a liquid freezes, the solid formed is not a precipitate. A precipitate is not a state change from a liquid to a solid. Instead, the particles that make up two liquids react and form the particles that make up the solid precipitate, a new substance.

Color Change Suppose you want your room to be a different color. You would simply apply paint to the walls. The change in color is a physical change because you have only covered the wall. A new substance does not form. But notice the color of the precipitate in the middle photo of **Figure 9**. In this case, the change in color is a sign of a chemical change. The photo in the bottom of the figure shows that marshmallows change from white to brown when they are toasted. The change in the color of the marshmallows is also a sign of a chemical change.

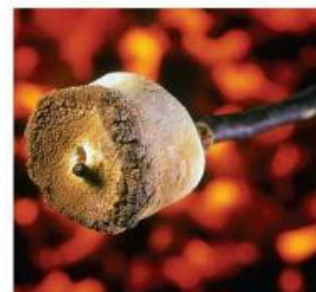
Figure 9 The photographs below show several signs of chemical changes.



Formation of gas bubbles



Formation of a precipitate



Color change

Active Reading

7. Identify Fill in the graphic organizer with five types of chemical changes.

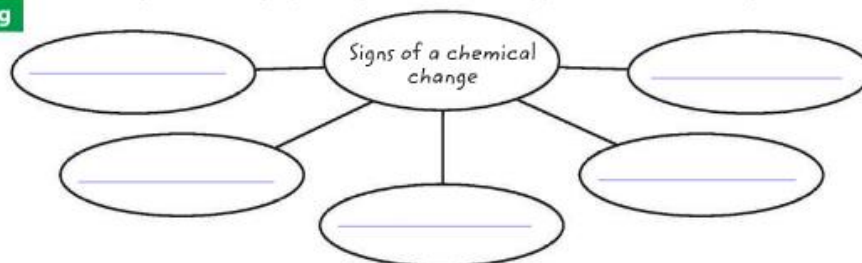




Figure 10 The flames, the lights, and the sounds of a fireworks display over Miami are signs of chemical changes.

Figure 11 Thermal energy is needed for this chemical reaction.



Energy and Chemical Change

Think about a fireworks show. Again and again, you hear loud bangs as the fireworks burst into a display of colors, as in **Figure 10**. The release of thermal energy, light, and sound are signs that the fireworks result from chemical changes. All chemical reactions involve energy changes.

Suppose you want to bake pretzels, as shown in **Figure 11**. What would happen if you placed one pan of unbaked pretzel dough

on the kitchen counter? Only the dough in the hot oven would become pretzels. Thermal energy is needed for the chemical reactions to occur that bake the pretzels.

Energy in the form of light is needed for other chemical reactions. Photosynthesis is a chemical reaction by which plants and some unicellular organisms produce sugar and oxygen. This process only occurs if the organisms are exposed to light. Many medicines also undergo chemical reactions when exposed to light. You might have seen some medicines stored in orange bottles. If the medicines are not stored in these light-resistant bottles, the ingredients can change into other substances.

Active Reading

8. Select On the lines below, list two familiar chemical changes, such as "burning a candle." In the boxes, describe the matter before and after adding energy.

Before	→ Add Energy →	After
Before	→ Add Energy →	After



Think again about the way matter changes form during a fireworks display. Once the chemicals combine and cause the explosions, you cannot get back the original chemicals. Like most chemical changes, the fireworks display cannot be reversed.

Click
below.

abc

Conservation of Mass

Physical changes do not affect the mass of substances. When ice melts, for example, the mass of the ice equals the mass of the resulting liquid water. If you cut a piece of paper into strips, the total mass of the paper remains the same. Mass is conserved, or unchanged, during a physical change.

Inquiry

LAB STATION

Try It!

MiniLab Is mass conserved during a chemical reaction?

at connectED.mcgraw-hill.com

After you complete the lab, write a response to the following situation.

-
-
-

[illegible]

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Active Reading

- Active Reading** **10. Describe** During a physical change, does the total mass of the matter decrease, increase, or stay the same? What about during a chemical change?

Physical change: _____

Chemical change:

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Active Reading 11. **Write** What are some clues you can use to decide if a change is physical or chemical?


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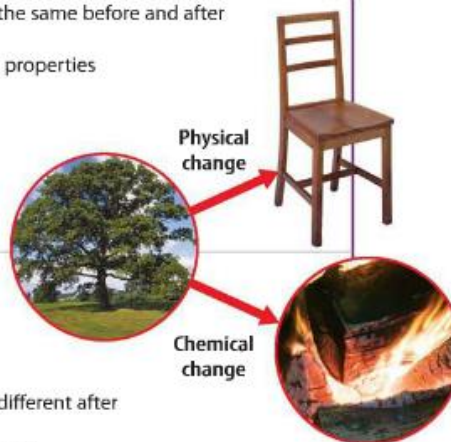
Table 4 Chemical changes produce a new substance, but physical changes do not.

Comparing Physical and Chemical Changes

Suppose you want to explain to a friend the difference between a physical change and a chemical change. What would you say? You could explain that the identity of matter does not change during a physical change, but the identity of matter does change during a chemical change. However, you might not be able to tell just by looking at a substance whether its identity changed. You cannot tell whether the particles that make up the matter are the same or different.

Sometimes deciding if a change is physical or chemical is easy. Often, however, identifying the type of change is like being a detective. You have to look for clues that will help you figure out whether the identity of the substance has changed. For example, look at the summary of physical changes and chemical changes in **Table 4**. A change in color can occur during a chemical change or when substances are mixed (a physical change). Bubbles might indicate the formation of gas (a chemical change) or boiling (a physical change). You must consider many factors when comparing physical and chemical changes.

Table 4 Comparing Physical and Chemical Changes 		
Type of Change	Examples	Characteristics
Physical change	<ul style="list-style-type: none"> melting boiling changing shape mixing dissolving increasing or decreasing in temperature 	<ul style="list-style-type: none"> Substance is the same before and after the change. Only physical properties change.
Chemical change	<ul style="list-style-type: none"> changing color burning rusting formation of gas formation of a precipitate spoiling food tarnishing silver digesting food 	<ul style="list-style-type: none"> Substance is different after the change. Both physical and chemical properties change.



Lesson Review 2

Visual Summary



The identity of a substance does not change during a physical change such as a change in the state of matter.



A new substance is produced during a chemical change.



The law of conservation of mass states that the mass of a material does not change during a chemical change.



Use Vocabulary

- 1 The particles that make up matter do not change during a(n) _____.

Understand Key Concepts

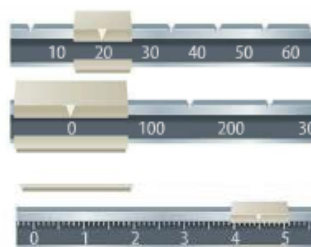
- 2 **Explain** how physical and chemical changes affect the mass of a material. **SC.8.P.9.1**

- 3 Which is a physical change? **SC.8.P.9.2**

- (A) burning wood (C) rusting iron
(B) melting ice (D) spoiling food

Interpret Graphics

- 4 **Analyze** Suppose you mix 12.8 g of one substance with 11.4 g of another. The picture shows the mass you measure for the mixture. Is this reasonable? Explain.



- 5 **Organize Information** List an example of each type of change. **LA.8.2.2.3**

Type of Change	Examples
Physical change with formation of bubbles	_____
Chemical change with formation of bubbles	_____

Critical Thinking

- 6 **Consider** Suppose you mix baking soda and white vinegar. What signs might indicate that a chemical change is occurring? **SC.8.P.9.2**

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Chapter 5

Study Guide



Think About It! Physical and chemical properties give a substance its unique identity. The matter that makes up a substance can change physically or chemically.

Key Concepts Summary

Vocabulary

LESSON 1 Matter and Its Properties



- Particles of a **solid** vibrate about a definite position. Particles of a **liquid** can slide past one another. Particles of a **gas** move freely within their container.
- A **physical property** is a characteristic of matter that you can observe without changing the identity of the substances that make it up. A **chemical property** is the ability or inability of a substance to combine with or change into one or more new substances.
- Some properties of matter do not depend on size or amount of the sample. You can identify a substance by comparing these properties to those of other known substances.

volume p. 188
solid p. 188
liquid p. 188
gas p. 188
physical property p. 190
mass p. 190
density p. 191
solubility p. 192
chemical property p. 195

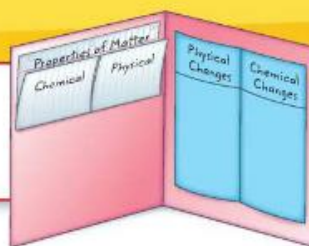
LESSON 2 Matter and Its Changes

- A change in the size, shape, form, or state of matter in which the identity of the matter stays the same is a **physical change**. A change in matter in which the substances that make it up change into other substances with different chemical and physical properties is a **chemical change**.
- The **law of conservation of mass** states that the total mass before a chemical reaction is the same as the total mass after the reaction.

physical change p. 200
chemical change p. 202
law of conservation of mass
p. 205



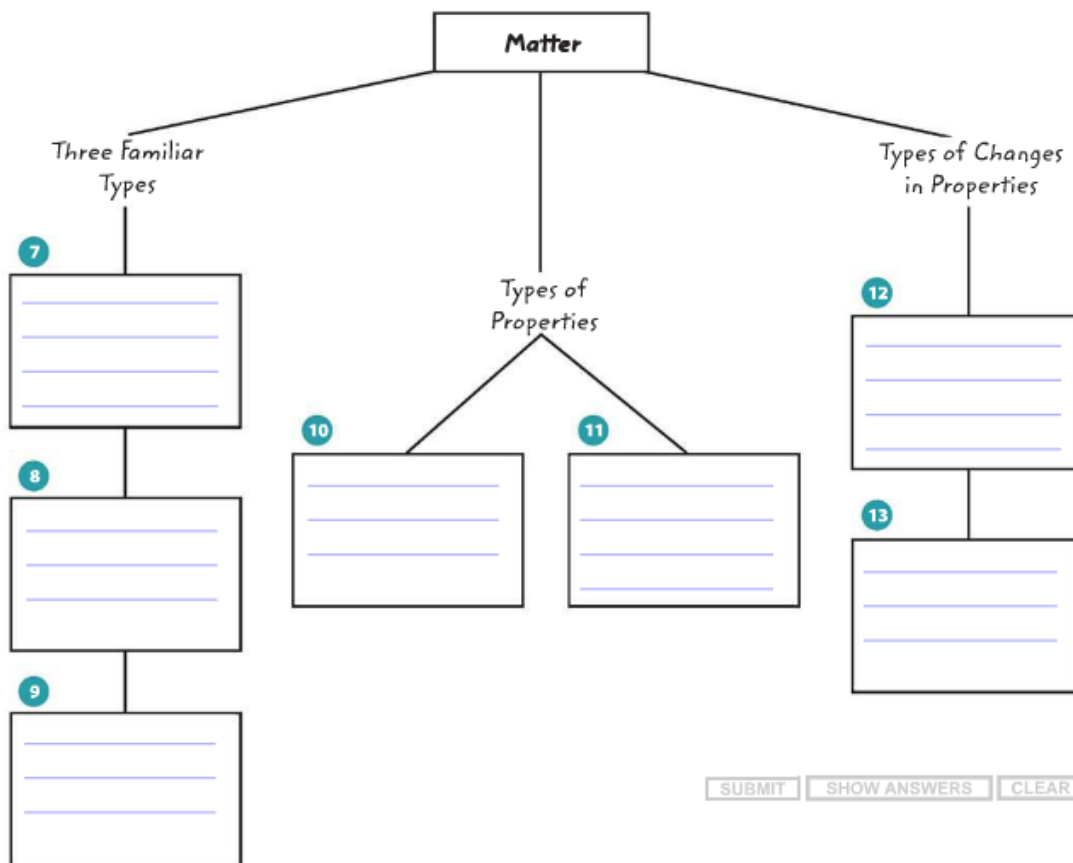
Assemble your lesson Foldables as shown to make a Chapter Project. Use the project to review what you have learned in this chapter.

**Use Vocabulary**

- 1 A state of matter with a definite volume and a definite shape is a _____.
- 2 Flammability is an example of a _____ of wood because when wood burns, it changes to different materials.
- 3 A drink mix dissolves in water because of its _____ in water.
- 4 The rusting of a metal tool left in the rain is an example of a _____.
- 5 According to the _____, the mass of an untoasted marshmallow equals its mass after it is toasted plus the mass of any gases produced as it was toasting.
- 6 Slicing an apple into sections is an example of a _____ that cannot be reversed.

Link Vocabulary and Key Concepts

Use vocabulary terms from the previous page to complete the concept map.



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Chapter 5

Review

Fill in the correct answer choice.

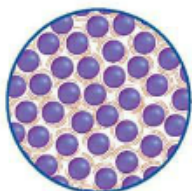
Understand Key Concepts

- 1 Which is a property of all solids? **SC.8.P.8.1**
- (A) Particles are far apart.
 - (B) Particles vibrate in all directions.
 - (C) Volume and shape can easily change.
 - (D) Weak forces exist between particles.

- 2 Which characteristic is a chemical property? **SC.8.P.9.2**
- (A) highly flammable
 - (B) mass of 15 kg
 - (C) woolly texture
 - (D) golden color

- 3 Which property of an object depends on its location? **SC.8.P.8.2**
- (A) density
 - (B) mass
 - (C) volume
 - (D) weight

- 4 How are the particles of a gas different from the particles of a liquid shown here? **SC.8.P.8.1**



- (A) They move more slowly.
 - (B) They are farther apart.
 - (C) They have less energy.
 - (D) They have stronger attractions.
- 5 Which is a physical change? **SC.8.P.9.2**
- (A) burning natural gas
 - (B) chopping onions
 - (C) digesting food
 - (D) exploding dynamite
- 6 Which stays the same when a substance changes from a liquid to a gas? **SC.8.P.9.1**
- (A) density
 - (B) mass
 - (C) forces between particles
 - (D) distance between particles

Critical Thinking

- 7 **Apply** Suppose you find a gold-colored ring. Explain why you could use some physical properties but not others to determine whether the ring is actually made of gold. **SC.8.P.8.4**

- 8 **Reason** You make lemonade by mixing lemon juice, sugar, and water. Is this a physical change or a chemical change? Explain. **SC.8.P.9.2**

- 9 Give an example of a physical change you might observe at your school that is reversible and a physical change that is not reversible. **SC.8.P.9.2**

- 10 **Defend** A classmate defines a liquid as any substance that can be poured. Use the picture below to explain why this is not an acceptable definition. **SC.8.P.8.1**



Florida Chapter Review

- 11 Suggest** a way that you could use displacement to determine the volume of a rock that is too large to fit into a graduated cylinder. **LA.8.2.2.3**

- 12 Hypothesize** A scientist measures the mass of two liquids before and after combining them. The mass after combining the liquids is less than the sum of the masses before. Where is the missing mass? **SC.8.P.9.1**

Math Skills

MA.6.A.3.6

- 16** Use what you have learned about density to complete the table below. Then, determine the identities of the two unknown metals.

Metal	Mass (g)	Volume (cm ³)	Density (g/cm ³)
Iron	42.5	5.40	<hr/>
Lead	28.8	2.55	<hr/>
Tungsten	69.5	3.60	<hr/>
Zinc	46.4	6.50	<hr/>
<hr/>	61.0	5.40	<hr/>
<hr/>	46.4	2.40	<hr/>

Writing in Science

- 13 Write** a four-sentence description on a separate sheet of paper of an object in your home or classroom. Be sure to identify both physical properties and chemical properties of the object. **LA.8.2.2.3**

Big Idea Review

- 14** What gives a substance its unique identity? **SC.8.P.9.1**

- 15** What are some physical and chemical properties that an airplane manufacturer must consider when choosing materials to be used in constructing the shell of the aircraft shown in the chapter opener? **SC.8.P.9.2**

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Florida NGSSS

Benchmark Practice

Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

Multiple Choice

- 1 Which describes the particles in a substance with no definite volume or shape? **SC.8.P.8.1**

(A) Particles are close but can move freely.
(B) Particles are close but can vibrate in all directions.
(C) Particles are far apart and cannot move.
(D) Particles are far apart and move freely.

- 2 Which diagram shows a chemical change? **SC.8.P.9.2**

(F)



(G)



(H)



(I)



- 3 Which is NOT true about firewood that burns completely? **SC.8.P.9.1**

(A) Ashes and gases form from the substances in the wood.
(B) Oxygen from the air combines with substances in the wood.
(C) The total mass of substances in this process decreases.
(D) The wood gives off thermal energy and light.

- 4 How do weight and mass differ? **SC.8.P.8.2**

(F) Weight depends on the location of an object, but mass does not.
(G) Weight does not depend on the location of an object, but mass does.
(H) Weight and mass depend on the location of an object.
(I) Weight and mass do not depend on the location of an object.

- 5 Which is true when an ice cube melts? **SC.8.P.8.1**

(A) Volume and mass increase.
(B) Volume and mass do not change.
(C) Volume decreases, but mass does not change.
(D) Volume increases, but mass decreases.

Use the table below to answer question 6.

Volume (mL)	Mass (g)
200	180
300	270
400	360

- 6 A liquid of unknown density is studied. Based on the data, what is the density of the liquid? **SC.8.P.8.3**

(F) 1.1 g/mL
(G) 0.9 g/mL
(H) 1.1 mL/g
(I) 0.9 mL/g

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NGSSS for Science Benchmark Practice

- 7 Which physical property CANNOT be measured? **SC.8.P.8.4**

(A) melting point
(B) density
(C) conductivity
(D) color

- 8 A spoonful of sugar with a mass of 8.8 g is poured into a 10-mL graduated cylinder. The volume is 5.5 mL. What is the density of the sugar? **SC.8.P.8.3**

(F) 1.6 g/mL
(G) 0.6 g/mL
(H) 1.6 mL/g
(I) 0.6 mL/g

- 9 Which is a sign of a physical change? **SC.8.P.9.2**

(A) Bread gets moldy with age.
(B) Ice forms on a puddle in winter.

(C) The metal on a car starts to rust.
(D) Yeast causes bread dough to rise.

- 10 When a newspaper is left in direct sunlight for a few days, the paper begins to turn yellow. What is this change in color? **SC.8.P.9.2**

(F) physical property
(G) chemical property
(H) physical change
(I) chemical change

- 11 Suppose a candle is burned in a closed system where matter cannot enter or leave. Given this situation, what is equal to the mass of the original candle? **SC.8.P.9.1**

(A) the mass of the burned candle
(B) the mass of all gases in the closed system
(C) the mass of the gases released while the candle is burned
(D) the mass of the burned candle plus the mass of the gases released while the candle is burned

Use the table below to answer question 12.

Material	Density (g/cm ³)
Aluminum	2.7
Iron	7.9
Gold	19.3

- 12 Densities of some metals are shown in the table. Find the density of an alloy that is 50% aluminum and 50% gold by weight. **SC.8.P.8.3**

(F) 22 g/cm³
(G) 13.6 g/cm³
(H) 5.3 g/cm³
(I) 11 g/cm³

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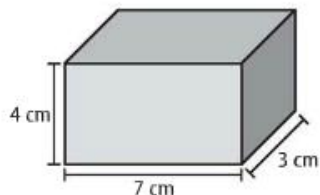
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NEED EXTRA HELP?

If You Missed Question...	1	2	3	4	5	6	7	8	9	10	11	12
Go to Lesson...	1	2	2	1	1,2	1	1	1	2	2	2	1

**Benchmark Mini-Assessment****Chapter 5 • Lesson 1**

Multiple Choice *Bubble the correct answer.*



1. The block shown above has a mass of 105 g. What is the density of the block?

SC.8.P.8.2

- (A) 0.80 g/cm^3
(B) 1.25 g/cm^3
(C) 7.50 g/cm^3
(D) 21.0 g/cm^3
2. A rock has which of these properties?

SC.8.P.8.3

- (F) a changing shape and volume
(G) a fixed shape and volume
(H) a changing shape but a fixed volume
(I) a changing volume but a fixed shape

3. Which physical property would NOT be useful for finding the difference between baking soda and cornstarch? SC.8.P.8.2

- (A) density
(B) mass
(C) melting point
(D) solubility

4. Which formula below can be used to calculate the density of an object? SC.8.P.8.3

- (E) $D = \text{volume/mass}$
(G) $D = \text{mass/volume}$
(H) $D = \text{volume/weight}$
(I) $D = \text{weight/mass}$



Benchmark Mini-Assessment

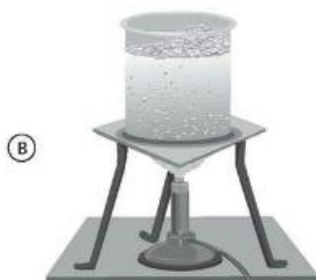
Chapter 5 • Lesson 2



Multiple Choice Bubble the correct answer.

1. Which image shows a physical change?

SC.8.P.9.2



2. You dissolve a white powder in a beaker of water. It is NOT likely that a chemical change took place if the water

SC.8.P.9.2

- (F) gets hotter.
- (G) remains clear.
- (H) starts to bubble.
- (I) turns orange.

3. Which of these describes a chemical change?

SC.8.P.9.2

- (A) baking cookies
- (B) melting ice
- (C) cutting apple slices
- (D) mowing the grass

Exp. No.	Description
1	Cardboard is cut into small pieces.
2	Bread is browned in a toaster.
3	Soapy water is whipped into foam.
4	Cheese is grated onto pasta.

4. In which of the experiments listed above can the change to the original substance be reversed?

SC.8.P.9.2

- (F) Experiment 1
- (G) Experiment 2
- (H) Experiment 3
- (I) Experiment 4

SUBMIT

SHOW ANSWERS

CLEAR