

Investigating Matter

Textbook pages 16–27

Before You Read

You can describe matter and how it changes by describing its properties. Colour is one property of matter. Write two more properties of matter on the lines below.



Mark the Text

In Your Own Words

Highlight the main idea in each paragraph. Stop after each paragraph and put what you just read into your own words.



Reading Check

1. What are three properties of matter?

What is matter?

Matter is any substance or any object that has mass and volume.

Mass is the amount of matter in a substance or an object.

Volume is the amount of space that a substance or object takes up.

You can describe the mass and volume of matter such as a piece of ice. A small piece of ice might have a mass of 10 g. It might have a volume of 1 cm³. To talk about the piece of ice in more detail, you can describe its other properties. For example, a piece of ice with a mass of 10 g and a volume of 1 cm³ has a density of 10 g/cm³. **Density** is the amount of mass in a certain volume of a substance or object (density equals mass divided by volume).

Other properties of matter include:

- ◆ **state** (whether something is a solid, a liquid, or a gas)
- ◆ **conductivity** (how easily something lets electricity or heat move through it)
- ◆ **boiling point** (the temperature at which a substance changes state from a liquid to a gas)
- ◆ **melting point** (the temperature at which a substance changes state from a solid to a liquid) ✓

What are pure substances and elements?

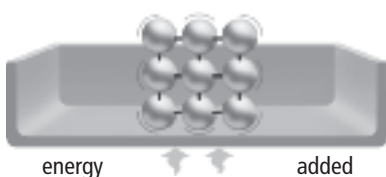
Many types of matter are pure substances, which means that they are made up of only one kind of particle. An **element** is a pure substance whose particles cannot be broken down further and still keep their original properties.

How does the kinetic molecular theory describe changes of state?

Kinetic energy is energy of movement. The particles that make up matter have kinetic energy because they are always moving. The kinetic molecular theory states four important things about matter:

1. All matter is made up of tiny particles.
2. There are empty spaces between the particles.
3. Particles of matter are always moving. Particles of a solid are packed so tightly together that they can only vibrate in place. Particles of a liquid are farther apart and can slide past each other. Particles of a gas are very far apart and move around freely and quickly.
4. The more energy the particles have, the faster they can move and the farther apart they can get.

The kinetic molecular theory describes what happens to the particles of matter during a change of state. It also describes how the particles in solids, liquids, and gases are different. ✓



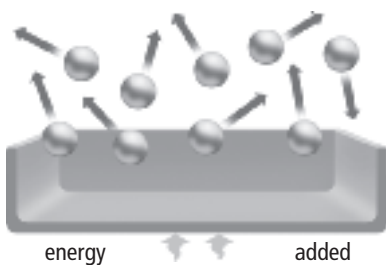
1. Solid gold

Particles are very close to one another, fixed in position, and vibrate.



2. Liquid gold

All particles are still close, but now have enough space to slide past one another.



3. Gaseous gold

All particles are highly energetic and move freely to spread out in their container. Further heating gives particles even more kinetic energy, making the gas spread out faster and farther.

✓ Reading Check

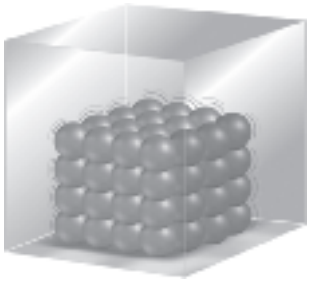
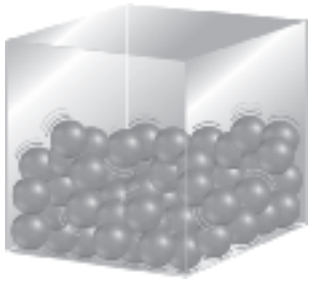
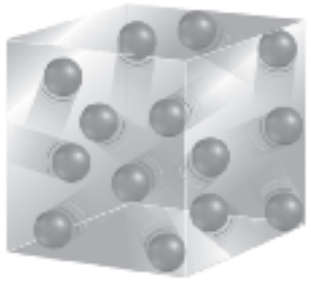
2. What is kinetic energy?

Use with textbook pages 16–27.

What is the matter?

Show what you know about states of matter.

1. Complete the following table by describing the three states of matter.
The table has been partially completed to help guide you.

			
state of matter			
shape	fixed shape		
volume		fixed volume	
spaces between particles			particles are far apart (lots of space between particles)
movement of particles	particles can only vibrate		

2. Which row of the table below correctly describes a solid, a liquid, and a gas? _____

	Solid	Liquid	Gas
A.	has definite shape and volume	has definite volume and takes the shape of the container	shape and volume are determined by its surroundings
B.	shape and volume are determined by its surroundings	has definite volume and takes the shape of the container	has definite shape and volume
C.	shape and volume are determined by its surroundings	has definite shape and volume	has definite volume and takes the shape of the container
D.	has definite shape and volume	has definite shape and volume	has definite volume and takes the shape of the container

Use with textbook pages 16–27.

Matter all around us

Vocabulary

boiling point
change of state
conductivity
density
elements
gas
heat
kinetic
liquid

mass
matter
melting point
movement
particles
properties
solid
states
volume

Use the terms in the vocabulary box to fill in the blanks. Use each term only once. You will not need to use every term.

- _____ is anything that has mass and volume. According to the kinetic molecular theory, all matter is made of very small _____ that are constantly moving.
- _____ is the amount of matter in an object. The amount of space an object occupies is its _____. The ratio of a material's mass to its volume is its _____.
- There are three _____ of matter: solid, liquid and gas. Each of these can change when _____ is added or removed.
- The temperature at which ice turns to water is the _____. The temperature at which water turns to water vapour is the _____.
- _____ describes how easily electricity or heat can move through a material.
- _____ energy is the energy of movement.
- Particles of a _____ are packed so tightly together that they can only vibrate in place. Particles of a _____ are farther apart and can slide past each other. Particles of a _____ are very far apart and move around freely and quickly.
- The kinetic molecular theory describes what happens to the particles of matter during a _____.
- Oxygen and gold are examples of _____, which cannot be broken down or separated into simpler substances.

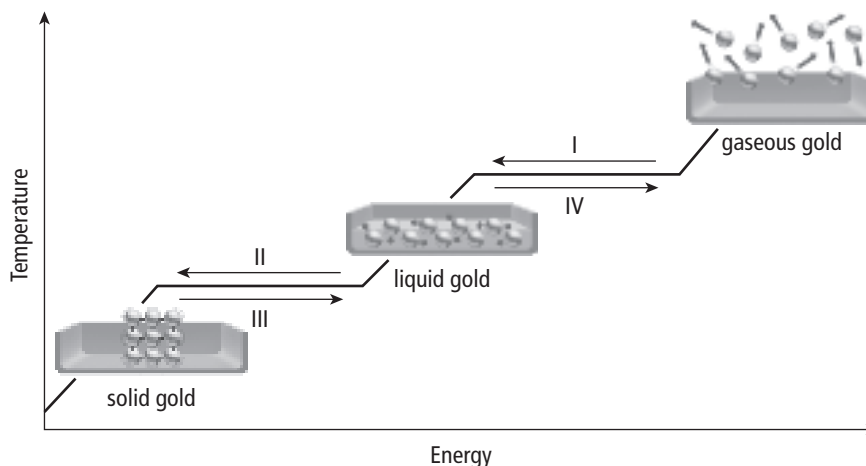
Name _____

Date _____

Use with textbook pages 19–20.

Changes of state in gold

Use the graph to help you answer the questions that follow.



1. What do points **I**, **II**, **III**, and **IV** on the graph shown above represent?

2. What is removed from gaseous gold to cause it to change to a liquid?

3. What change of state occurs at point **I** on the graph?

4. What change of state occurs at point **II** on the graph?

5. What is added to solid gold to cause it to change to a liquid?

6. What happens to the temperature as solid gold turns to a liquid?

7. Describe the change in the kinetic energy as the temperature increases.

8. Describe the change in the arrangement of the gold particles as heat energy is added.

Use with textbook pages 16–27.

Investigating matter

Match each Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.

Term	Descriptor
1. _____ volume	A. amount of mass in a certain volume of a substance
2. _____ density	B. amount of matter in a substance or an object
3. _____ state	C. cannot be broken down into simpler substances
4. _____ conductivity	D. amount of space that a substance or object takes up
5. _____ element	E. measure of how easily electricity or heat can pass through
	F. can be solid, liquid, or gas

Circle the letter of the best answer.

6. Which of the following describes mass?
- A. state of matter
 - B. anything with mass and volume
 - C. amount of matter in an object
 - D. amount of space that an object occupies
7. Which of the following are the main points of the kinetic molecular theory?

I.	Particles are constantly moving.
II.	All matter is made up of very small particles.
III.	There are empty spaces between particles in a substance.

- A. I and II only
- B. I and III only

- C. II and III only
 - D. I, II, and III
8. Which of the following describes what happens when heat is added to a substance?
- A. Particles lose kinetic energy and vibrate faster.
 - B. Particles gain kinetic energy and vibrate faster.
 - C. Particles gain kinetic energy and vibrate slower.
 - D. Particles lose kinetic energy and vibrate slower.
9. Which of the following changes of state require the removal of heat?

I.	melting
II.	boiling

- A. I only
 - B. II only
 - C. both I and II
 - D. neither I nor II
10. Which of the following is the temperature at which a solid changes into a liquid?
- A. boiling point
 - B. melting point
 - C. both A and B
 - D. neither A nor B
11. Which of the following is the temperature at which a liquid changes into a gas?
- A. boiling point
 - B. melting point
 - C. both A and B
 - D. neither A nor B