States of Matter

Name: _____

Date: _____ Per: _____

Getting the Idea

Key Words

state
solid
liquid
gas
melting
evaporation
condensation
freezing

Everything around you is matter. A **state** of matter is the physical form in which matter exists. Sometimes the term *phase* is used to describe the state of matter. On Earth, most matter exists in three states: solid, liquid, and gas. There are examples of these three states all around you. The land is solid, the oceans and rivers are liquid, and the air you breathe is a gas.

Solids, Liquids, and Gases

A **solid** is a substance with a definite shape and volume. A **liquid** is a substance that has a definite volume but no definite shape. Unlike a solid, a liquid takes the shape of its container. A **gas** is a substance that has neither a definite shape nor a definite volume. Like a liquid, a gas may take the shape of the container in which it is placed. Unlike a liquid, a gas does not have a definite volume. Instead, a gas spreads out in all directions. Both liquids and gases are referred to as fluids because both can flow.

The table summarizes the properties of solids, liquids, and gases.

States of Matter and Their Properties

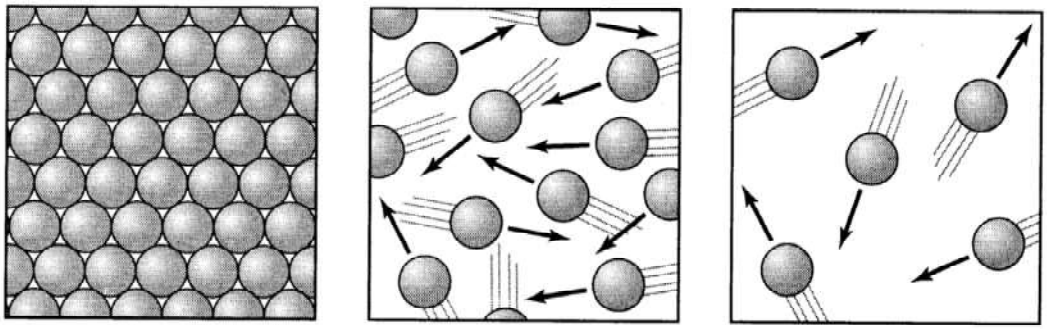
Property	Solid	Liquid	Gas
Shape	Definite shape	No definite shape	No definite shape
Volume	Definite volume	Definite volume	No definite volume
Particle arrangement	Densely packed	Close	Far apart
Energy binding particles	Very strong	Strong	Weak

Did You Know?

Water is an exception to the rule about how removing heat affects density. When water is frozen it becomes less dense than liquid water. Picture a glass of water with ice in it. The ice floats, so you know it is less dense than the liquid.

All matter is made up of particles called atoms and molecules. Recall what you learned about atoms and molecules in Lessons 9 and 11. All particles have energy and are in a constant state of motion. The arrangement and motion of the particles that make up a substance determine its state. The diagram below shows the differences in the arrangements and motion of particles in solids, liquids, and gases.

Molecules in Solids, Liquids, and Gases



Solid Liquid Gas

In a solid, particles are packed together quite closely. The energy binding these particles is very strong. These bonds prevent the particles from moving about freely. Instead, the particles move by vibrating in their positions. The strong bonds give the solid a definite shape and volume.

Particles in a liquid are less densely packed than those in a solid. The energy binding the particles of a liquid is also weaker than that in a solid. As a result, particles in a liquid can move around and slide past one another. The movement of the particles in a liquid stops the liquid from having a definite shape. However, liquids do have a definite volume.

The energy that binds particles in gases together is weak, allowing the particles to move freely. The free movement of gas particles allows a gas to expand or contract. As a result, a gas lacks a definite shape and a definite volume.

The state of matter can be changed by adding or removing heat. Adding heat usually causes particles to move farther apart. This causes the substance to expand, so it becomes less dense. The opposite happens when heat is removed.

Did You Know?

When some substances, such as solid carbon dioxide (dry ice) are heated, they can change from a solid to a gas without first becoming a liquid. A phase change from a solid directly to a gas or from a gas directly to a solid is called *sublimation*.

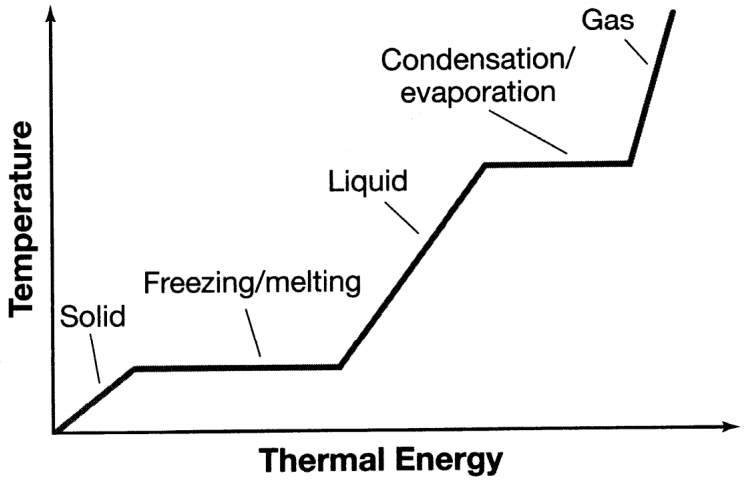
Adding heat to a solid causes the particles of the solid to gain energy. As a result, the particles move faster and spread farther apart. If enough heat is added, the solid will change to a liquid. This is called **melting**.

Particles in a liquid also move faster and spread apart when heat is added. At a certain temperature, the particles gain enough energy that they begin to escape from the liquid's surface and change to a gas. The change from a liquid to a gas is called **evaporation**.

When heat is removed from a substance, its particles lose energy, move more slowly, and pack closer together. If a substance is cooled enough it will change state. **Condensation** is the changing of a substance from a gas to a liquid. The temperature at which a substance condenses is the same as the temperature at which it boils. **Freezing** is a change from a liquid to a solid. The temperature at which a substance freezes is the same as the temperature at which it melts.

The phase-change diagram below shows the relationship between temperature and changes of state. Notice that during a phase change, the temperature remains constant. The temperature changes only after all of a substance has changed from one state to another. The temperature will then rise or fall, depending on whether heat is being added to or removed from a substance.

Progressive Changes in States of Matter



Different substances absorb and release heat at different rates. For example, land absorbs and releases heat faster than water does.

Name:	Class:	Date:

1) Draw a picture to represent what happens to molecules as heat/energy is added to it.

Before heat/energy	After heat/energy is added
heat/energy added	

2) Draw a picture to represent what happens to molecules as heat/energy is removed from it.

With heat/energy	After heat/energy is removed
heat/energy removed	

3) Thermometer observations: carefully make observations and record temperature

Environment	Temperature
At room temperature (on lab bench)	
In hand	
In freezer	

4) Based on your knowledge and data above, explain how a thermometer works.

5) Draw a picture to represent your answer.