

► **Key Question: What are the three states of matter?**

Snow and rain are made of the same kind of matter. The snowflake in Figure 1 is made of the same kind of matter as a drop of water. They are both made of water particles. Water particles can form ice, water, and water vapour.



Figure 1 This snowflake can melt into a drop of water.

THREE STATES OF MATTER

All forms of matter can exist in three different states:

1. solid
2. liquid
3. gas

The particles are exactly the same in each state. For example, ice (solid), water (liquid), and water vapour (gas) all contain water particles.

solid

a state of matter with a definite volume and a definite shape

volume

a measure of the quantity of space occupied by an object

liquid

a state of matter with a definite volume, but no definite shape; a liquid takes the shape of its container

gas

a state of matter that does not have a definite volume or a definite shape; a gas takes the shape and volume of its container

1. Solids

A **solid** has a definite shape and a definite volume. **Volume** is how much space something takes up. A coin is a solid (Figure 2). Its shape and volume stay the same.



Figure 2 A coin keeps the same volume and shape.

2. Liquids

A **liquid** has a definite volume. It does not have a definite shape. A liquid takes the shape of its container.

Water is a liquid (Figure 3). If you have 150 mL of water in a glass, the water's volume is 150 mL. If you pour the water into a bowl, the volume is still 150 mL. However, the water's shape will change.



Figure 3 Each of these containers contain 150 mL of coloured water. The water takes the shape of the container.

3. Gases

A **gas** does not have a definite volume or a definite shape. A gas takes the shape and volume of its container.

When a balloon is filled with air, the air particles take the shape of a sphere (Figure 4). The volume of the air particles inside the balloon is equal to the volume of the balloon.



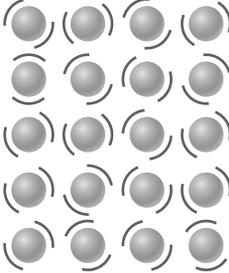
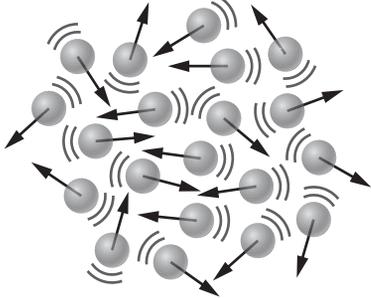
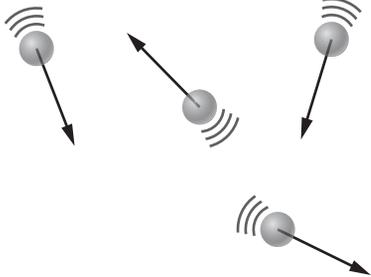
Figure 4 The air inside a balloon is a gas.

PARTICLES OF SOLIDS, LIQUIDS, AND GASES

The particles of a sample of matter always stay the same in all three states of matter (Table 1). The difference between solids, liquids, and gases is in

- the movement of particles
- the arrangement of particles

Table 1 The Movement and Arrangement of Matter Particles

	Particle movement	Particle arrangement	Illustration
Solids	stay in the same position but move, or rotate, a little	very close together	
Liquids	move around in all directions	close together	
Gases	have lots of energy and move very quickly in all directions	far apart	

PARTICLE ATTRACTION

Particles of matter attract each other. When particles are close together, forces of attraction hold the particles together. The volume of liquids and solids does not change much because the particles are close together.

When particles are far apart, the forces of attraction cannot hold the particles together. The volume of gases changes because the particles are far apart.

CHANGES IN STATE

Matter can change from one state to another. A change in state can happen when matter is heated or cooled.

Ice changes to water when it is heated. The heat causes the water particles to move faster and spread apart to become a liquid. More heat makes the water change to a gas (Figure 5).

If a gas is cooled, the particles move slower. The gas changes into a liquid. If cooled further, the liquid may freeze into a solid.

When matter changes state, the particles stay the same. The number of particles also stays the same. Only the arrangement and movement of the particles change.

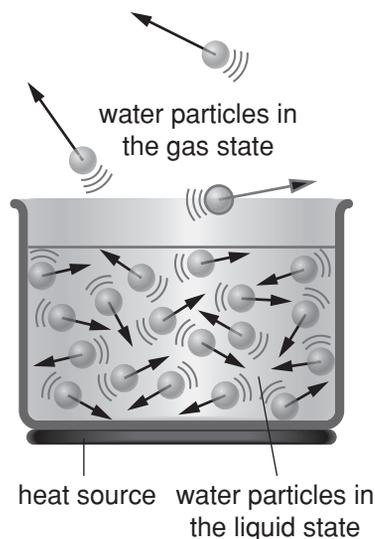


Figure 5 As liquid water is heated, the water particles move farther apart. The water changes to water vapour.

Name: _____ Date: _____



CHECK YOUR UNDERSTANDING

1. What are the three states of matter?

2. What is the state of each of the following materials?

- (a) a rock _____
- (b) grape juice _____
- (c) air _____

3. Why does water change from a solid to a liquid when heated?

4. Which states of matter have a definite volume? Why do they keep the same volume?

5. Think back to the Key Question. What makes solids, liquids, and gases different from each other?
