Foundations of Chemistry

Physical Changes

Before You Read

What do you think? Read the two statements below and decide whether you agree or disagree with them. Place an A in the Before column if you agree with the statement or a D if you disagree. After you've read this lesson, reread the statements to see if you have changed your mind.

Before	Statement	After
	5. Heating a material decreases the energy of its particles.	
	6. When you stir sugar into water, the sugar and water evenly mix.	

Read to Learn

Physical Changes

How would you describe water? If you think about water in a stream, you might say that it is a cool liquid. If you think about water as ice, you might describe it as a cold solid. How would you describe the change from ice to water? As ice melts, some of its properties change, such as the state of matter, the shape, and the temperature. But its identity does not change. It is still water.

In Lesson 2, you read that substances and mixtures can be solids, liquids, or gases. In addition, substances and mixtures can change from one state to another. *A* **physical change** *is a change in size, shape, form, or state of matter in which the matter's identity stays the same*. During a physical change, the matter does not become something different even though physical properties change.

Change in Shape and Size

Think about changes in the shapes and the sizes of materials you experience each day. When you chew food, you are breaking it into smaller pieces. This change in size helps make food easier to digest. When you pour juice from a bottle into a glass, you are changing the shape of the juice. Changes in shape and size are physical changes. The identity of the matter has not changed.

Key Concepts

- How can a change in energy affect the state of matter?
- What happens when something dissolves?
- What is meant by conservation of mass?

Mark the Text

Make an Outline As you read, highlight the main idea under each heading. Then use a different color to highlight a detail or an example that might help you understand the main idea. Use your highlighted text to make an outline with which to study the lesson.

FOLDABLES®

Make a two-tab book to record specific examples of how adding or releasing thermal energy results in physical change.

Change in State of Matter

Why does ice melt in your hand? Or, why does water turn to ice in the freezer? Matter, such as water, can change state. Recall how the particles in a solid, a liquid, and a gas behave. To change the state of matter, the movement of the particles has to change. To change the movement of particles, thermal energy must be added or removed.

Adding Thermal Energy When thermal energy is added to a solid, the particles in the solid move faster and faster, and the temperature increases. As the particles move faster, they are more likely to overcome the attractive forces that hold them tightly together. When the particles are moving too fast for attractive forces to hold them tightly together, the solid reaches its melting point. The melting point is the temperature at which a solid changes to a liquid.

After the entire solid has melted, the addition of more thermal energy causes the particles to move even faster. The temperature of the liquid increases. When the particles are moving so fast that attractive forces cannot hold them close together, the liquid reaches its boiling point. The boiling point is the temperature at which a liquid changes into a gas and the particles spread out. Some solids change directly to a gas without first becoming a liquid. This is called sublimation.

The figure below shows what happens as thermal energy is added to a material. Temperature increases when the state of matter is not changing. Temperature stays the same during a change of state.

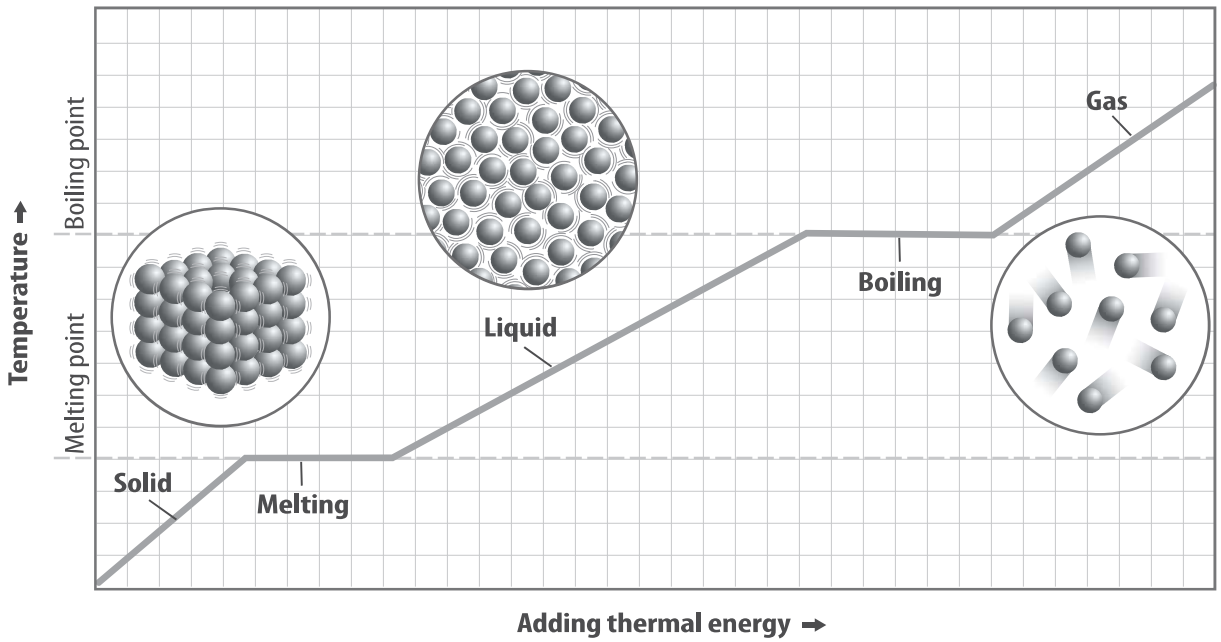
Think it Over

1. Analyze Why does ice melt in your hand?

Visual Check

2. Point Out Circle the parts of the graph line that show a change of state is occurring.

Thermal Energy and the State of Matter



Removing Thermal Energy When thermal energy is removed from a gas such as water vapor, particles in the gas move more slowly and the temperature of the gas decreases. Condensation occurs when the particles are moving slowly enough for attractive forces to pull the particles close together. Recall that condensation is the process that occurs when a gas becomes a liquid.

After the gas has completely changed to a liquid, removing more thermal energy from the liquid causes the particles to move even more slowly. As the motion between the particles slows, the temperature decreases.

Freezing occurs when the particles are moving so slowly that attractive forces between the particles hold them tightly together. Now the particles only can vibrate in place. Recall that freezing is the process that occurs when a liquid becomes a solid.

Freezing and melting are reverse processes, and they occur at the same temperature. The same is true of boiling and condensation. Another change of state is deposition. Deposition is the change from a gas directly to a solid. It is the opposite of sublimation. For example, deposition occurs when water vapor in the air forms frost.

Dissolving

Think about adding salt to water to create a saltwater aquarium. As you add the salt to the water, it gradually disappears. It is still there, but it dissolves, or mixes evenly, in the water. Because the identities of the substances—water and salt—are not changed, dissolving is a physical change.

Like many physical changes, dissolving is usually easy to reverse. If you boil the salt water, the liquid water will change to water vapor, leaving the salt behind. You once again can see the salt because the particles that make up the substances do not change identity during a physical change.

Key Concept Check

3. Explain How can removing thermal energy affect the state of matter?

Key Concept Check

4. Describe What happens when something dissolves?

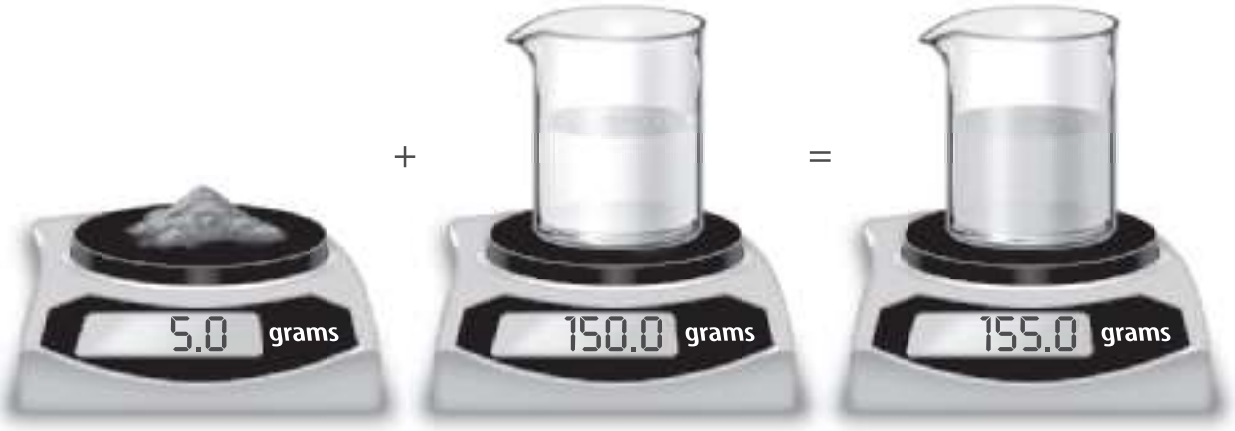
Conservation of Mass

During a physical change, the physical properties of matter change. The particles in matter that are present before a physical change are the same as those present after the physical change. Because the particles are the same before and after a physical change, the total mass before and after the change is also the same, as shown in the figure below. This is known as the conservation of mass. You will read in Lesson 4 that mass also is conserved during another type of change—a chemical change.

Key Concept Check

5. Define What is meant by conservation of mass?

Conservation of Mass



Visual Check

6. Calculate If a sample of water has a mass of 200 g and the final solution has a mass of 230 g, how much solute dissolved in the water?