

Solids, Liquids, and Gases ▪ *Section Summary*

Changes of State

Key Concepts

- What happens to a substance during changes between solid and liquid?
- What happens to a substance during changes between liquid and gas?
- What happens to a substance during changes between solid and gas?

The physical state of a substance is related to its thermal energy. Particles of a liquid have more thermal energy than particles of the same substance in solid form. As a gas, the particles have even more thermal energy. A substance changes state when its thermal energy increases or decreases sufficiently.

The change in state from a solid to a liquid is called **melting**. In most pure substances, melting occurs at a specific temperature called the **melting point**. As a solid absorbs thermal energy, its molecules vibrate faster raising their temperature. **At its melting point, the particles of a solid substance are vibrating so fast that they break free from their fixed positions.** The temperature of the substance stops increasing. The added energy is changing the arrangement of particles from a solid to a liquid.

Freezing is the change of state from liquid to solid—the reverse of melting. **At its freezing temperature, the particles of a liquid are moving so slowly that they begin to form regular patterns.** The liquid becomes a solid.

The change from a liquid to a gas is called **vaporization**. **Vaporization takes place when the particles in a liquid gain enough energy to form a gas.** When vaporization takes place only on a liquid's surface, the process is called **evaporation**. When vaporization takes place throughout a liquid, the process is called **boiling**. Each liquid boils only at a certain temperature, called its **boiling point**. The boiling point of a liquid also depends on the pressure of air above a liquid. Lower air pressure decreases the boiling point of a liquid. Higher pressure increases the boiling point.

The opposite of vaporization is called **condensation**. **Condensation occurs when particles in a gas lose enough thermal energy to form a liquid.** Clouds usually form when water vapor in the atmosphere condenses into liquid droplets. It rains when the droplets get heavy enough.

Sublimation occurs when the surface particles of a solid gain enough energy to become a gas. **During sublimation, particles of a solid do not pass through the liquid state as they form a gas.** Dry ice is solid carbon dioxide that changes directly into a gas. As it changes state, the carbon dioxide absorbs thermal energy. This is why dry ice is used to keep materials cold.