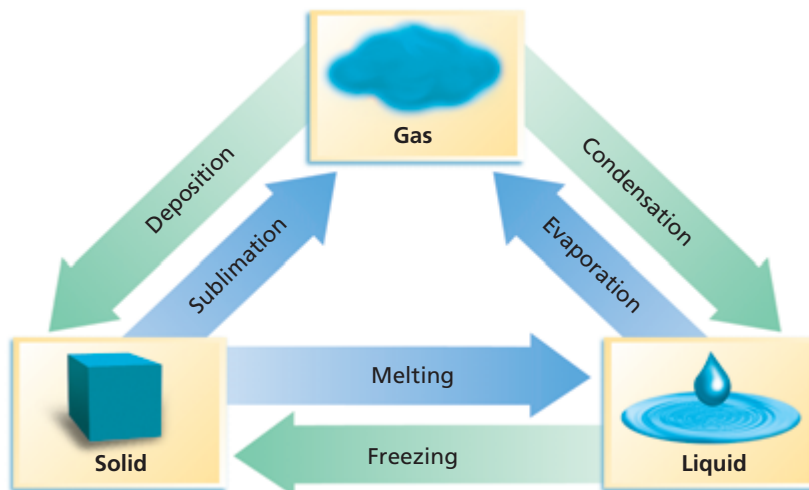


FIGURE 17 Solids, liquids, and gases can undergo various changes of state. The changes shown in green are exothermic, and those shown in blue are endothermic.



extension

Chemistry in Action

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Keyword: HC6STMX

temperature, water cannot be liquefied, no matter how much pressure is applied. The **critical pressure** (P_c) is the lowest pressure at which the substance can exist as a liquid at the critical temperature. The critical pressure of water is 217.75 atm.

The phase diagram in **Figure 16** indicates the normal boiling point and the normal freezing point of water. It also shows how boiling point and freezing point change with pressure. As shown by the slope of line AD, ice melts at a higher temperature with decreasing pressure. Below the triple point, the temperature of sublimation decreases with decreasing pressure. Foods are freeze-dried by freezing the food and then lowering the pressure to cause the ice in the food to sublime rather than melt. **Figure 17** summarizes the changes of state of solids, liquids, and gases.

SECTION REVIEW

1. What is equilibrium?
2. What happens when a liquid-vapor system at equilibrium experiences an increase in temperature? What happens when it experiences a decrease in temperature?
3. What would be an example of deposition?
4. What is the equilibrium vapor pressure of a liquid? How is it measured?
5. What is the boiling point of a liquid?
6. In the phase diagram for water, what is meant by the triple point and the critical point?

Critical Thinking

7. **INTERPRETING GRAPHICS** Refer to the phase diagram for water on page 347 to answer the following questions.
 - a. Describe all the changes a sample of solid water would undergo when heated from -10°C to its critical temperature at a pressure of 1.00 atm.
 - b. Describe all the changes a sample of water vapor would undergo when cooled from 110°C to 5°C at a pressure of 1.00 atm.
 - c. At approximately what pressure will water be a vapor at 0°C ?
 - d. Within what range of pressures will water be a liquid at temperatures above its normal boiling point?