Content Outline for Teaching

Solids, Liquids, and Gases

Section 1 Kinetic Theory

Underlined words and phrases are to be filled in by students on the Note-taking Worksheet.

A. States of matter—solid, liquid, gas

1. **Kinetic theory**—explains how particles in matter behave
   - **a.** All matter is composed of small particles.
   - **b.** Particles are in constant, random motion.
   - **c.** Particles collide with each other and walls of their containers.
2. Thermal energy—total energy of a material's particles; causes particles to vibrate in place
3. Average kinetic energy—temperature of the substance, or how fast the particles are moving; the lower the temperature, the slower the particle motion
4. Solid state—particles are closely packed together in a specific type of geometric arrangement.
5. Liquid state—a solid begins to liquefy at the **melting point** as the particles gain enough energy to overcome their ordered arrangement.
   - **a.** Energy required to reach the melting point is called the **heat of fusion**.
   - **b.** Liquid particles have more space between them allowing them to flow and take the shape of their container.
6. Gaseous state—a liquid's particles have enough energy to escape the attractive forces of the other particles in the liquid
   - **a.** **Heat of vaporization** is the energy required for a liquid to change to a gas.
   - **b.** At the **boiling point**, the pressure of the liquid's vapor is equal to the pressure of the atmosphere, and that liquid becomes a gas.
   - **c.** Gas particles spread evenly throughout their container in the process of **diffusion**.
7. Heating curve of a liquid—as a solid melts and a liquid vaporizes, the temperature remains constant; the temperature will increase after the attractive forces of the earlier state have been overcome.
8. **Plasma**—state of matter consisting of high-temperature gas with balanced positively and negatively charged particles.

B. **Thermal expansion**—increase in the size of a substance when the temperature increases

1. The size of a substance will then decrease when the temperature decreases.
2. Expansion and contraction occur in most solids, liquids, and gases.
3. Water is an exception because it expands as it becomes a solid.

Content Outline for Teaching (continued)

C. Some substances do not react as expected when changing states.

1. Amorphous solids—lack the tightly ordered structure found in crystals
   - **a.** Do not have definite temperature at which they change from solid to liquid
   - **b.** Glass, plastic
2. Liquid crystals do not lose their ordered arrangement completely upon melting; used in liquid crystal displays in watches, clocks, calculators, and some notebook computers.

DISCUSSION QUESTION:
How are temperature and kinetic energy related? *Temperature means the average kinetic energy of a substance, or how fast the particles are moving.*

Section 2 Properties of Fluids

A. **Buoyancy**—ability of a fluid (liquid or gas) to exert an upward force on an object immersed in it

1. An object in a fluid will float if its weight is less than the buoyant force acting on it from the fluid.
2. An object in a fluid will sink if its weight is more than the buoyant force acting on it from the fluid.
3. Archimedes' principle—buoyant force on an object is equal to the weight of the fluid displaced by the object.
4. An object will float if its density is less than the density of the fluid it is placed in.

B. Pascal's principle—pressure applied to a fluid is transmitted throughout the fluid

1. **Pressure** is force exerted per unit area.
2. Hydraulic machines use this principle to lift heavy loads.

C. Bernoulli's principle—as the velocity of a fluid increases, the pressure exerted by the fluid decreases; airplanes use this principle to fly.

D. **Viscosity**—a liquid's resistance to flow

1. Molecular structure determines a fluid's viscosity.
2. Increased temperature will lower viscosity.

DISCUSSION QUESTION:
Why do some objects sink and others float in water? *An object's density and its weight determine whether it will float. Objects with density less than the density of water will float in water. Objects that weigh less than the buoyant force will float.*