# **Chemistry and Matter Discussion Guide (for use during or after reading)**

1. Describe matter and its role in the study of chemistry. (Introduction, Chemicals, p. 4-9)
   1. Matter refers to all the materials that make up the world. Matter is comprised of tiny particles called atoms. Chemistry is the study of how substances behave under different conditions. Chemistry studies how matter changes.
2. What makes up atoms and molecules? (Atoms, Molecules, p. 11-13)
   1. Atoms are tiny little particles that make up all matter. All atoms are made up of even tinier particles. Atoms contain a nucleus at their center which consists of protons (positive charge) and neutrons (no charge). Electrons are negatively charged and move freely around the nucleus. Molecules are combinations of two or more atoms. Molecules made of only one type of atom are called elements. Molecules can also be made of many types of atoms; those are called compounds.
3. Describe the three main states of matter, including how their molecules move. (States of Matter, p. 14-17)
   1. Typically, matter exists in three main states. Matter in solid form has a definite shape because its molecules are packed closely together and vibrate in place. Matter in liquid form does not have a definite shape, rather it takes on the shape of its container. In liquids, molecules move freely past one another. Finally, matter in gaseous form also does not have a definite shape, but it does expand to fill its container. Gases contain molecules that are always zipping around and crashing into one another.
4. What are physical properties of matter? What attributes are considered physical properties? Provide at least three examples. (Physical Properties of Matter, p. 18-21)
   1. The physical properties of matter refer to the things you can see and measure. For example, color, size, and shape are all physical properties.
   2. Discuss the following types of properties, clarifying any misconceptions as needed: weight, mass, volume, density, temperature, and viscosity.
5. What are chemical properties of matter? What are chemical reactions? (Chemical Properties of Matter, p. 22-23)
   1. Chemical properties of matter can be observed in a chemical reaction. Chemical reactions are processes by which one or more substances are chemically converted into one or more different substances. For example, one chemical property of a substance is its reactivity, or how easily it reacts with other substances.

1. What happens at the molecular level when a liquid freezes into a solid? (Freezing, p. 26-27)
   1. When a liquid freezes into a solid, it undergoes a physical change of state. As liquid is cooled toward its freezing point, the energy of its molecules decreases. These slow-moving molecules are eventually brought together through attractive forces, turning the substance from a liquid to a solid.
2. How do cooling temperatures cause condensation? (Condensation, p. 28-29)
   1. Condensation refers to the changing of a gas or a vapor into a liquid. This happens as gases or vapors are cooled. Cooling substances slows the movement of their molecules until they condense together to form liquids. For example, clouds form from water vapor cooling.
3. Sometimes people wake up to frost on very cold mornings. What physical change is at play and how does it work? (Deposition, p. 30-31)
   1. On cold mornings, people can sometimes see frost. This is because of deposition. During the day, the air and ground are warmed by the sun. Once the sun sets, air temperature drops significantly as warmer air rises from the ground and colder air sinks towards it. Water molecules in the cold air latch onto the solid ground and change into frost, a solid. Deposition occurs when gases change to solids, skipping the liquid phase.
4. What happens at the molecular level when substances are heated? (Melting and Boiling, p. 32-35)
   1. Cooling substances causes their molecules to lose energy and slow down. Heating substances, on the other hand, causes their molecules to gain energy and speed up. Heating solids can cause them to melt into liquids. Heating liquids can cause them to boil and evaporate into gases or vapors.

1. What is pressure and how can it create physical changes in matter? (Melting and Boiling, p. 32-35)
   1. Pressure is the continued action of a weight or a force. Pressure can create physical changes in matter by pushing molecules of gas closer together. This causes an increase in their energy, so they collide more often, which causes the gas to heat up and eventually change into a liquid state.