

Physical Properties of Matter

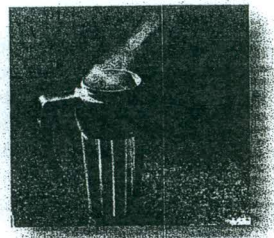
Chapter 2.3 - Changes in State

Section 1 Prior Knowledge

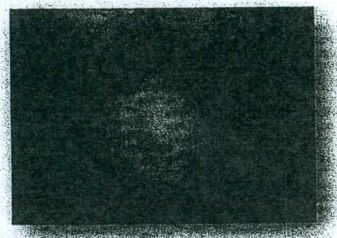
In Chapter 1, we learned about physical properties. A physical property is something that we can change without changing the chemical makeup of matter. This includes color, size, and shape. When a physical property changes, we call it a physical change. Chapter 2 taught about physical changes. Physical changes include ripping, breaking, and painting. These are changes that are reversible, because the chemical makeup of the matter did not change.

This chapter will focus on physical changes that alter the state of matter. Change in state (also called changes in phase) is physical changes in matter. They cause the matter to switch back and forth from solid, liquid, gas.

Energy is always involved in changes of state. Matter either loses or gains energy when it changes from one state to another. For example, when matter changes from a liquid to a solid, it loses energy. The opposite happens when matter changes from a solid to a liquid. For a solid to change to a liquid, matter must absorb energy.



Section 2 Phase Changes



Look at the snowball that is in the girl's hands. Was the snow in her hand ever in a different phase? What might cause the snow to change phases again?

This section will introduce the seven phase changes that can occur in matter. These phase changes are freezing, melting, evaporation, vaporization, condensation, sublimation, and deposition. The changes will be presented in pairs because of the

similar characteristics of the two phases. For example, freezing and melting will be presented together because they both occur at the same temperature for any element.

Section 2.1 Freezing and Melting

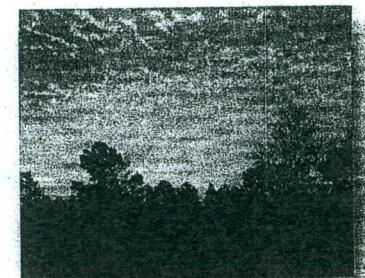
The process in which a liquid changes to a solid is called freezing. The process in which a solid changes to a liquid is called melting. Both freezing and melting occur at the same temperature for a specific molecule. When a liquid is changing to a solid, we refer to the temperature as the freezing point. When a solid is changing to a liquid, we refer to the temperature as the melting point. The freezing point and melting point of water is 0°C . At this temperature, water freezes to ice, or ice melts to water. Other types

of matter have higher or lower freezing and melting points. For example, the freezing and melting point of iron is 1535°C . The freezing and melting point of oxygen is -219°C .

If you held the snowball above in a warm room, the snow would absorb energy from the warmer air. The energy would allow the particles of frozen water to overcome some of the forces of attraction holding them together. They would be able to slip out of the fixed positions they held as snow. In this way, the solid snow would turn to liquid water.

Section 2.2 Condensation, Vaporization, and Evaporation

The picture to the right shows a thick fog. Where did the water particles in the fog come from? What will happen to the water when the Sun rises?



The process in which a gas changes to a liquid is called condensation. A gas condenses when it is cooled. Sometimes the gas condenses into small water droplets in the air. This causes dew, fog, rain, and other forms of precipitation.

When you get in your parent's car in the morning, the windshield may be covered in dew. Why does this happen? The air always has water vapor. When the water vapor contacts cooler surfaces, such as the windshield, it cools and loses energy. The cooler water particles no longer have enough energy to overcome the forces of attraction between them. They come together and form droplets of liquid water.

If a liquid gets heated enough, it starts to form bubbles of vapor. We often refer to this physical change as boiling, but the scientific term for this physical change is vaporization. Vaporization happens when particles of a liquid gain enough energy to completely overcome the force of attraction between them and change to the gaseous state. The temperature at which liquids turn to gas (vaporization) is often called the boiling point. The temperature at which gasses turn to liquid is called the condensation point. The boiling and condensation point are the same for each molecule. This temperature is 100°C for water. At this temperature, water turns to vapor, and vapor turns to water. A similar physical change occurs at 1413°C for table salt, and -196°C for nitrogen.

Liquids do not have to be heated to the vaporization point in order to change to a gas. The molecules on the surface of a liquid will absorb energy from the air around it. Once a molecule has enough energy to overcome the forces that are holding it, it will escape into the air as a gas. This process is called evaporation. Evaporation can happen at any temperature in which the substance is in the liquid phase, but it happens faster at warmer temperatures.

Section 2.3 Sublimation and Deposition

Have you every dropped a piece of ice onto a hot pan. Did you notice how the ice turned into a gas, without melting first? Solids that change to gases generally first pass through the liquid state. However, sometimes solids change directly to gases and skip the liquid state. The reverse can also occur. Sometimes gases change directly to solids.