

Physical Science 100-Sections 6, 7, 8-Dearden

Chapter 11-MOLECULAR MODEL OF MATTER-7 Feb. 2001

- A. A **scientific model is an extended metaphor**. We use an idea that we are already familiar with to represent an idea or part of nature that we are still struggling to understand. We will now discuss a series of models that have been used to help explain and understand how nature behaves on the very smallest scale.
- B. The **molecular model** can be outlined as follows:
1. Matter is made up of tiny particles called molecules.
 2. Each kind of matter is made up of a different kind of molecule.
 3. The molecules are in constant motion. They jiggle, collide, and rebound due to electromagnetic forces.
 4. The motion and interaction of molecules can be analyzed and understood and future conditions can be predicted by using the laws of force and motion and the laws of conservation.
- C. The molecular model can accurately describe many things we observe:
1. **Brownian motion**. When you look through an optical microscope at dust in a pan of water, the dust jiggles about in what is called Brownian motion. The molecular model explains this motion by saying that the erratic motion of the dust particles you see is caused by forces produced when the particles collide with molecules you do not see.
 2. **States of matter and changes of state**. In solids, the molecules are rigidly attached to each other due to electrical forces. In liquids, the molecules are not held rigidly in place. They are still in contact, but slide past each other. In gases and plasmas the molecules act as free particles in space. Most of the volume is empty. The particles collide with each other and rebound due to electromagnetic forces. Changes in state occur when energy is either provided or taken away. For example, to change from a solid to a liquid, energy must be provided to break the molecules apart from each other. Different materials melt at different temperatures depending on how much energy must be provided to separate the molecules from each other. Evaporation occurs when a liquid loses high energy molecules that escape and form a gas. In this way, energy is lost from the liquid.
 3. **Internal energy**. There are two ways energy is stored inside matter. The kinetic energy of individual molecules is determined by their motion and their mass. It is called **thermal energy**. The **electrical potential energy** of molecules depends on the relative positions of their charged parts to each other and to the charged parts of nearby molecules.
 4. **Temperature**. Temperature is a measure of the *average kinetic energy* of a large number of molecules. The temperature depends on the mass and the speed of molecules.
 5. **Heat flow**. Internal energy is transferred from one object to another with a different temperature through collisions between molecules. The “hot” molecules give some of their energy to “cold” molecules.
 6. **Pressure**. Molecules bouncing off the walls of a container or colliding with the molecules of another substance are responsible for the pressure exerted by the gas.