The Nature of Electromagnetic Waves

Key Concepts

- What does an electromagnetic wave consist of?
- What models explain the behavior of electromagnetic waves?

An **electromagnetic wave** is a transverse wave that transfers electrical and magnetic energy. It does not need a medium through which to travel. **An electromagnetic wave consists of vibrating electrical and magnetic fields that move through space at the speed of light.** Light and all other electromagnetic waves are produced by charged particles. Every charged particle has an electric field surrounding it. When a charged particle moves, it produces a magnetic field. The energy that is transferred through space by electromagnetic waves is called **electromagnetic radiation.** All electromagnetic waves travel at the same speed in a vacuum–about 300,000 kilometers per second. When electromagnetic waves travel through a medium such as air, they travel more slowly.

Many properties of electromagnetic waves can be explained by a wave model. However, some properties are best explained by a particle model. To understand the wave model of light, for example, think of light waves as being like transverse waves on a rope. If you shake a rope through a fence with vertical slats, only waves that vibrate up and down will pass through. If you shake the rope from side to side, the waves will be blocked by the slats. A polarizing light filter acts like a fence. When light waves strike a polarizing filter, only the waves vibrating in one direction pass through. The light that passes through is called **polarized light.**

Sometimes light behaves like a stream of particles of energy. When a beam of light shines on some substances, it causes tiny particles called electrons to move and produce an electric current. Sometimes a beam of light can even cause electrons to be knocked out of substances. This is called the **photoelectric effect**. It can be explained only by thinking of light as a stream of tiny packets of energy. Each packet of light energy is called a **photon.**