Physical Science—Chapter 14 Study Guide: Magnetism

1. Introduction to Magnetism
   1. Lodestones—rocks with magnetic properties used in ancient times
   2. Magnets—an object capable of attracting materials such as iron and steel by magnetic force
   3. Magnetic behavior
      1. Law of magnetic poles—all magnets have both North and South poles and opposite pole attract each other
      2. Magnetic field—the region surrounding a magnet in which other objects are affected by magnetism
      3. Law of magnetic force—the force between two magnetic poles is directly related to the product of the poles’ strength and inversely related to the square of the distance between them
      4. Permeability—the extent to which a material can absorb or channel flux lines
2. Basics of Magnetic Force
   1. Electron spin—at the most basic level, magnetic force is produced by the spinning of electrons
   2. An electron’s magnetic field is often cancelled out by another electron spinning the opposite direction, but whenever an atom has electrons that are unpaired they end up with an overall magnetic field creating a North pole and a South pole on the atom
   3. Millions of magnetic atoms can line up to create a domain with a North and South pole
   4. Thousands or millions of domains join together to create a magnet
   5. This understanding of magnets is known as the **domain theory**.
3. Types of magnetic materials
   1. Diamagnetic—materials that are always *slightly* repelled by magnetic force
   2. Paramagnetic—materials that are always *slightly* attracted by magnetic force
   3. Ferromagnetic—materials that are always *strongly* attracted by magnetic force
      1. Magnetically soft substances—can be magnetized but do not hold the force for very long
      2. Magnetically hard substances—tend to hold their magnetic charge for a long time—permanent magnets
4. Methods of magnetizing
   1. Direct contact
   2. Induction—having the magnet close to an object can magnetize it
   3. Electric current—running a current around or near a ferromagnetic substance can make an electromagnet
5. Methods of demagnetizing
   1. Striking a magnet repeatedly
   2. Heating a magnet
   3. Storing a magnet improperly—forcing two poles of the same charge together over a long time
6. The earth as a magnet
   1. William Gilbert discovered much about the magnetic field around the earth
   2. The magnetic poles of the earth do not line up exactly with its geographic poles and they also move around over time
   3. Magnetosphere-- The magnetic field that extends around the earth out into space
      1. This magnetic field helps to protect the earth from solar wind, highly-charged particles that come from the sun
      2. Some of these particles penetrate the outer part of the magnetosphere and are trapped in regions of the magnetic field called the Van Allen radiation belts
      3. When these particles interact with the molecules in the air, amazing displays of differently-colored lights are produced
         1. Aurora borealis (north)
         2. Aurora australis (south)