

Magnetism • Section Summary

Inside a Magnet

Key Concepts

- How can an atom behave like a magnet?
- How are magnetic domains arranged in a magnetic material?
- How can magnets be changed?

The magnetic properties of a material depend on the structure of its atoms. All matter is made up of atoms. An **atom** is the smallest particle of an element. An **element** is one of about 100 basic substances that make up all matter. Every atom has a center region and an outer region. The center region of an atom is called a **nucleus**. Two kinds of particles are found inside the nucleus: protons and neutrons. A **proton** is a particle that carries a positive charge. A **neutron** is a particle that does not carry an electric charge. Particles called electrons usually exist in the outer region. An **electron** is a particle that carries a negative charge. **A spinning electron produces a magnetic field that makes the electron behave like a tiny magnet in an atom.** In most atoms, electrons form pairs that spin in opposite directions. The magnetic fields of the electrons in these pairs cancel. Therefore, the pairs have weak magnetic properties. Some atoms contain electrons that are not paired. These atoms tend to have strong magnetic properties.

A grouping of atoms that have their magnetic fields lined up in the same direction is called a **magnetic domain**. The entire magnetic domain acts like a bar magnet with a north and a south pole. In a material that is not magnetized, the magnetic domains point in random directions. **In a magnetized material, all or most of the magnetic domains are arranged in the same direction.** The magnetic fields of the domains are aligned. A material can be a strong magnet if its magnetic domains align. A material that shows strong magnetic properties is said to be a **ferromagnetic material**. In nature, iron, nickel, cobalt, and gadolinium are common ferromagnetic materials. Today, the most commonly used magnets are made from a material called ferrite.

Magnets can be made, destroyed, or broken apart. A magnet can be made by placing an unmagnetized ferromagnetic material in a strong magnetic field or by rubbing the material with one pole of a magnet. A magnet made from a material that easily loses its magnetism is called a **temporary magnet**. A magnet made from a material that keeps its magnetism for a long time is called a **permanent magnet**. A permanent magnet can lose some or all of its magnetism. If a magnet is hit hard, its domains can be knocked out of alignment. Heating a magnet will also destroy its magnetism. Above a certain temperature, every ferromagnetic material loses its magnetic properties. If a magnet is broken in two, the result is two smaller magnets. Each smaller magnet has its own north pole and south pole.