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## Magnetism

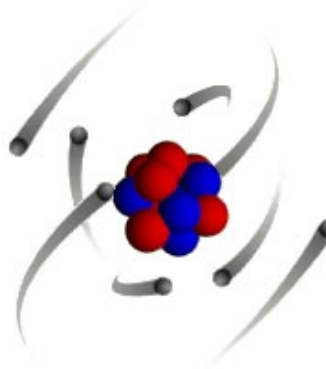
Magnets are very common items in the workplace and household. Uses of magnets range from holding pictures on the refrigerator to causing torque in electric motors. Most people are familiar with the general properties of magnets but are less familiar with the source of magnetism. The traditional concept of magnetism centers around the magnetic field and what is known as a dipole. The term "**magnetic field**" simply describes a volume of space where there is a change in energy within that volume. This change in energy can be detected and measured. The location where a magnetic field can be detected exiting or entering a material is called a magnetic pole. Magnetic poles have never been detected in isolation but always occur in pairs, hence the name dipole. Therefore, a **dipole** is an object that has a magnetic pole on one end and a second, equal but opposite, magnetic pole on the other.

A bar magnet can be considered a dipole with a north pole at one end and south pole at the other. A magnetic field can be measured leaving the dipole at the north pole and returning the magnet at the south pole. If a magnet is cut in two, two magnets or dipoles are created out of one. This sectioning and creation of dipoles can continue to the atomic level. Therefore, the source of magnetism lies in the basic building block of all matter...the atom.

### The Source of Magnetism

All matter is composed of atoms, and atoms are composed of protons, neutrons and electrons. The protons and neutrons are located in the atom's nucleus and the electrons are in constant motion around the nucleus. Electrons carry a negative electrical charge and produce a magnetic field as they move through space. A magnetic field is produced whenever an electrical charge is in motion. The strength of this field is called the **magnetic moment**.

This may be hard to visualize on a subatomic scale but consider electric current flowing through a conductor. When the electrons (electric current) are flowing through the conductor, a magnetic field



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forms around the conductor. The magnetic field can be detected using a compass. The magnetic field will place a force on the compass needle, which is another example of a dipole.

Since all matter is comprised of atoms, all materials are affected in some way by a magnetic field. However, not all materials react the same way. This will be explored more in the next section.

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