INTRODUCTION TO MAGNETISM & ELECTRICITY

MAGNETISM

Magnetism is a natural phenomenon with many useful applications.

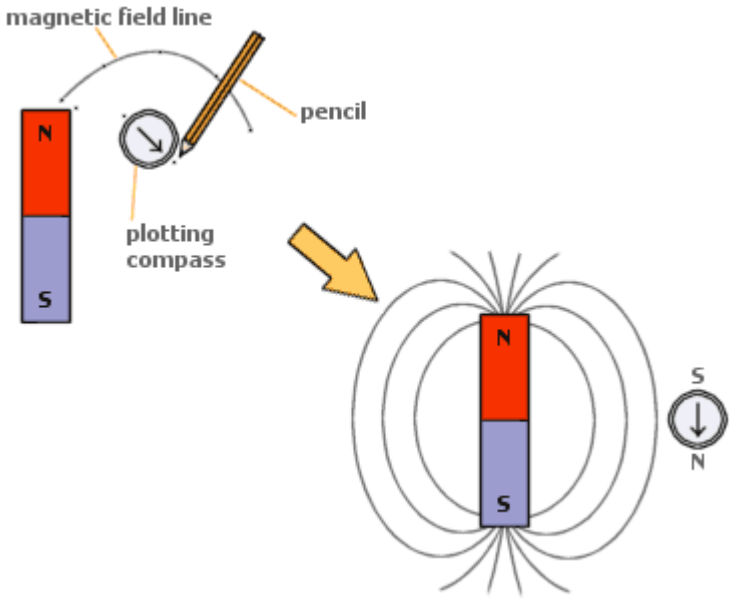
The two ends of a bar magnet are called the poles. One end is the north pole and one end is the south pole. The north poles of two bar magnets will repel one another as will the south poles of two bar magnets put close to each other. However, the north pole of a magnet will attract the south pole of another magnet.

Very few elements are magnetic. Those that are include iron, cobalt and nickel.

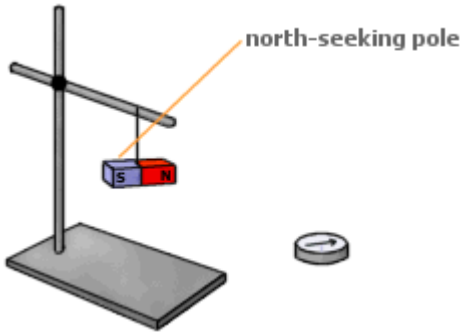
Only magnetic materials can be attracted to a magnet or made into a magnet. Most magnets are made from iron and steel.

Around a magnet there is an invisible field where the magnet exerts a force. This is called the *magnetic field*. The strength of the magnetic field gets weaker as the distance from the magnet increases. Pigeons use the magnetic field around the earth as a directional tool when flying. It helps them find their way home.

The direction of the magnetic field around a magnetic object can be seen using a plotting compass. If you place a compass in various places around a magnetic object, the needle will always point away from the north pole of the magnetic object. If you were to mark these N compass points on a piece of paper and do this many times around the magnetic object, you will produce a picture of the magnetic field.



If a magnet is suspended from a string, the poles of the magnet will point in the same direction as the compass needle. The end that points north is the north-seeking pole and the end that points south is the south-seeking pole.



ELECTROMAGNETISM

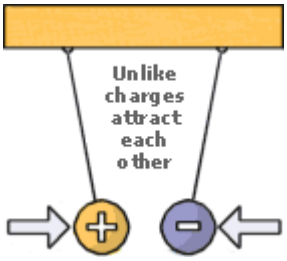
The relationship between magnetism and electricity is one of the most important concepts in physics. When electric current flows through a wire, a magnetic field is produced around the wire. This magnetic field will cause a compass needle to move.

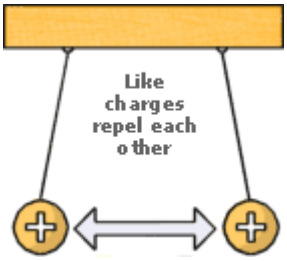
Any piece of iron can be made magnetic by wrapping a current-carrying wire around it. The iron then becomes an electromagnet. Unlike a 'normal' or permanent magnet, an electromagnet is only magnetic when there is an electric current flowing through the wire.

Most of the world's electricity is generated electromagnetically. Doorbells, televisions, loudspeakers and numerous other devices work electromagnetically.

STATIC ELECTRICITY

Static electricity is a build-up of electric charge. It occurs when non-conductors of electricity gain or lose electrons.





Usually, atoms have the same number of electrons and protons. In such instances, the atoms have no charge, they are 'neutral'. But if you rub things together, electrons can move from one atom to another. Some atoms get extra electrons and when this happens, they become negatively charged. Other atoms lose electrons and they become positively charged.

If two things have different charges, they are attracted (or pulled) towards each other. If two things have the same charge, they repel (or push away) from each other.

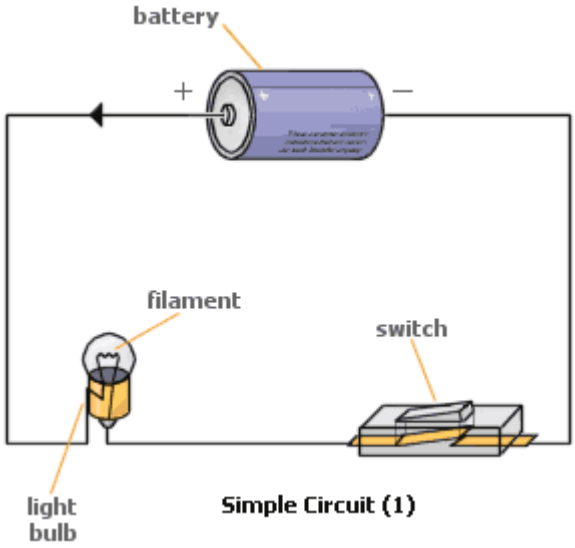
When you pull your hat off, it rubs against your hair. Electrons move from your hair to the hat. Now each of the hairs has the same positive charge. The hairs try to move away from each other. The farthest they can get is to stand up and away from all the other hairs.

Static electricity: hair raising stuff!

Static electricity: the sticky balloon!

CURRENT ELECTRICITY

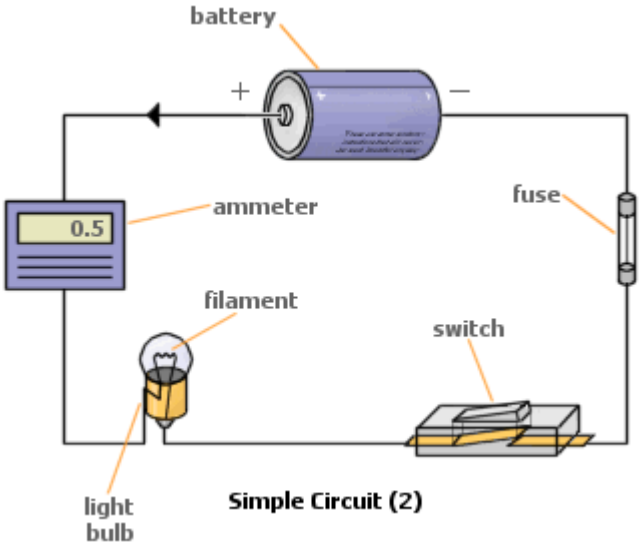
Current electricity is electric charge in motion. Within a piece of wire there are atoms. Electrons circulate around the nucleus of these atoms. When an electric current is flowing along a wire, the electrons of the metal atoms will jump from one nucleus to the next along the path of the wire. The amount of electrons moving through the wire is called the *current*. For current electricity to occur there must be a pathway for the electrons to flow through. This is an *electric circuit*.



Simple Circuit (1)

A circuit is basically a circle that allows electricity to travel in a large loop. It starts at an electrical source (such as a battery), travels along a conductor (such as a wire), goes through an electrical device (such as a light bulb) and ends up back at the battery where it started. It must end up back where it started.

A battery is a storage device for power. It has a positive terminal side and a negative terminal side. When a wire is connected from the positive to the negative side the electrons in the wire are repelled from the negative side and attracted to the positive side. This causes them to move along the wire. This movement of electrons along the wire is the current.



Simple Circuit (2)

The potential difference between two places in an electric circuit is what drives the current between them. Potential difference is measured in volts. If you increase the potential difference between two places in a circuit by using a battery with a higher voltage, then the current will increase. It is the current that moves and the potential difference that drives the movement.

RESISTANCE

Resistance is anything that causes an opposition to the flow of electricity in a circuit. It is used to control the amount of voltage and/or current in a circuit.

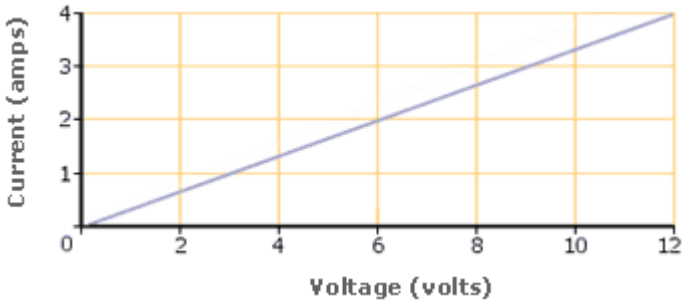
Everything in the circuit causes a resistance, even the wire. Resistance is measured in ohms and is denoted by the Greek symbol omega, Ω.

Ohm's law is a very important basic law of electricity. It defines the relationship between current, voltage and resistance. It states that if the temperature remains constant, the current flowing through a conductor is proportional to the potential difference (voltage) across it.

$$\underset{(V)}{\text{Voltage}} = \underset{(I)}{\text{Current}} \times \underset{(R)}{\text{Resistance}}$$

'Proportional' here means that if the voltage is doubled, then the current will double. Or, if the voltage is dropped by half, then the current will also decrease by a half.

If you were to draw a graph of this, it would look something like the one below.



Another way to express Ohm's law would be **V ÷ I = Constant**. As the graph shows, plotting voltage on the x-axis against current on the y-axis gives a line graph with a constant slope.