Electromagnetism
Electromagnetism

- Magnetism and electric current
- Solenoids and electromagnets
- Summary activities
Current and magnetism

When a **current** flows through a **conductor**, it generates a magnetic field.

For a straight wire, the **strength** of the magnetic field depends on:

- the **size** of the current through the wire
- the **distance** from the wire.

The magnetic field is generated **at right angles** to the direction of the current.
Demonstrating the effect of current

One way to demonstrate the magnetic effect of a current-carrying wire is to use a **compass**.

Compasses are designed to align with the magnetic field of the Earth. The needle points to the magnetic north pole.

If a compass is placed next to a wire, what will happen when the current is switched on?

The compass needle will be **deflected** by the magnetic field that the current generates.
Field around a wire

The direction of the magnetic field around a straight wire can be worked out by using the right hand grip rule.

Grip a wire so that your thumb points in the direction of the conventional current (from the positive to the negative terminal of a battery).

Your fingers will curl around the wire in the direction of the magnetic field (from north to south pole).
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What is a solenoid?

To **increase** the strength of the magnetic field, the wire can be curled into a **solenoid** shape.

To understand why, consider the way that magnetic field lines interact in a single loop of wire.
Understanding solenoids part one

The current flows around the loop.

The flow of charge generates a magnetic field around the wire.

Notice that the magnetic field generated here…

… is acting in the opposite direction to the magnetic field generated here.
Inside the loop, the magnetic field lines are pointing in the **same** direction. Field lines pointing in the same direction **add** together.

Therefore, the magnetic field will be **stronger** inside the loop.
Electromagnets

When many loops are combined in a coil, the same concentrating effect is amplified many times.

The magnetic field of a solenoid is similar to the magnetic field of a bar magnet. Inside the coil, the magnetic field is straight and uniform.

To make the magnetic field even stronger, the solenoid can be wrapped around an iron core.

An electromagnet is made from a solenoid with an iron core.
Electromagnetic devices

Unlike fixed magnets, the magnetic field of an electromagnet can be easily switched on or off in an electric circuit.

Magnetic fields can be used to make things **move**. Motors that use electromagnets can therefore be used to transfer **electrical energy** into **kinetic energy**.

Lots of electronic devices make use of electromagnets. For example:

- loudspeakers
- hairdryers
- fans
- and many more!
An electromagnetic circuit

Electromagnets are often used in a circuit called a relay.

What will happen when the switch is closed?

Current will flow in the top circuit, turning the iron core into an electromagnet.

One end of the iron arm will be attracted to the end of the electromagnet, so the other end will push the contacts together.

The bottom circuit will be complete and the motor will operate.
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Multiple-choice quiz