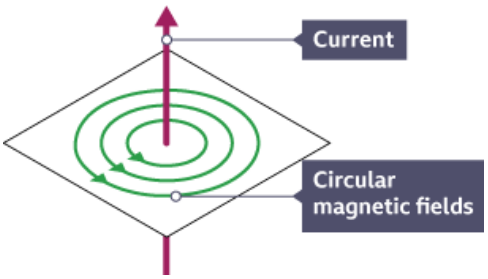
Introduction to electromagnetism

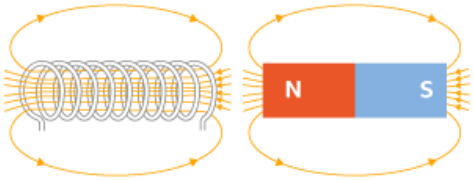
Video : https://www.bbc.co.uk/bitesize/articles/z7922v4#zrjcdnb

Any wire with current flowing through it has a *magnetic field*. Most of the time the magnetic field is too small to be important or have any noticeable effect.



The magnetic field lines around a current-carrying wire are circular. The field lines are closer together near the wire. This shows that the magnetic field is stronger when close to the wire.

Any wire with current flowing through it has a magnetic field



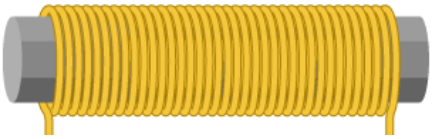
A coil of wire with many turns is called a *solenoid*.

The shape of the magnetic field around a current-carrying solenoid is like the magnetic field pattern of a bar magnet.

A current-carrying solenoid and a bar magnet have identical magnetic fields. If the magnetic field becomes strong enough to be useful, it is called an electromagnet. A typical electromagnet consists of a wire coiled around an iron core.

The iron core is often called a soft iron core. This is because iron is magnetically soft. This means the iron core is easy to magnetise and easy to demagnetise.

A typical electromagnet consists of a wire coiled around an iron core.



This Maglev train is held up and controlled by electromagnets.

Electromagnets are used in automatic door locks, headphones, scrap yard cranes and even to make magnetic, levitating trains.

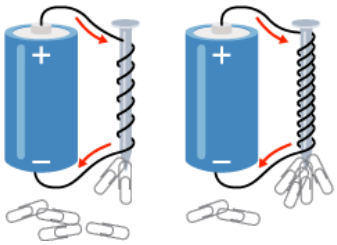
The driver of this crane is able to switch the electromagnet on and off to pick up and drop magnetic materials.

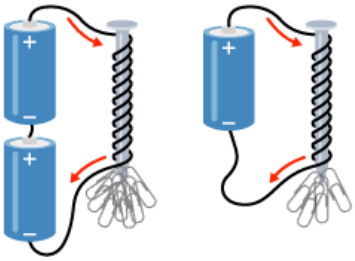
Electromagnets can be switched on and off. They are only magnets while current is flowing though the coil. Electromagnets can be made stronger or weaker.

Increasing the strength of the electromagnet

There are three main ways to increase the strength of an *electromagnet*

1. Using more turns on the coil of wire will produce a stronger magnetic field. Coiling up a longer piece of wire adds up the magnetic field of each turn.



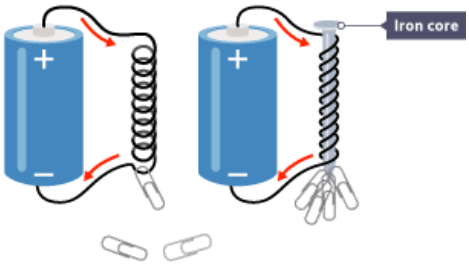


2. Increasing the current through the wire creates a greater current which will produce a stronger magnetic field. A greater current will produce a stronger magnetic field.

The current in the wire produces a magnetic field and a greater current will produce a greater field

3. Adding a soft *iron core* increases the strength of an electromagnet.

Iron is a magnetic material. A coil of wire is wrapped around an iron core. The iron core becomes magnetised when the electromagnet is switched on. This increases the overall strength of the electromagnet.



Summary

- An electromagnet uses an electrical current to generate a magnetic field.
- There are three ways to strengthen an electromagnet:
    - increasing current
    - increasing the number of turns of the coil
    - adding an iron core

An electromagnet with a permanent magnet can be used to make motors and loudspeakers.

Investigation on electromagnetism

You are to plan an experiment to investigate the effect of coils of wire on electromagnetic force. You should use a familiar method to measure the magnetic field strength.

1. Write out a suitable research question for your experiment and explain it.

2. What is the dependent variable in your experiment?

3. How will the dependent variable be measured?

4. What is the independent variable in your experiment?

5. How will the independent variable be measured?

6. List the control variables in your experiment and explain how they are to be controlled.

7. Suggest a hypothesis for your experiment with scientific reasoning.

8. Write a brief set of instructions for someone to carry out your experiment.