

MAKING MAGNETS WORK – MAKE A COMPASS AND AN ELECTROMAGNET and find out how a motor works!

Equipment

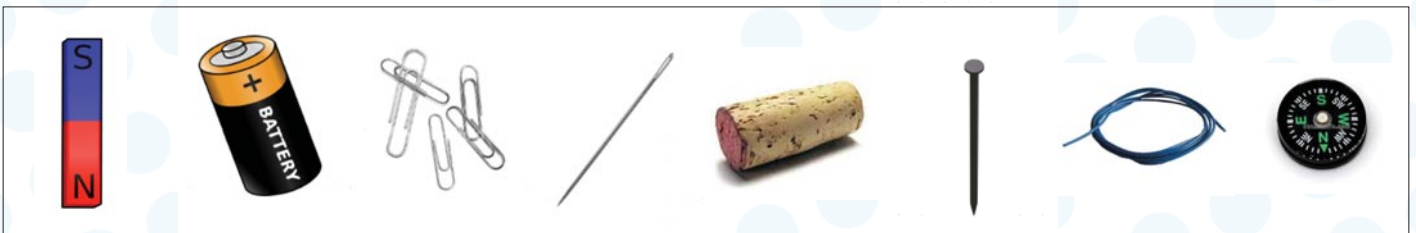
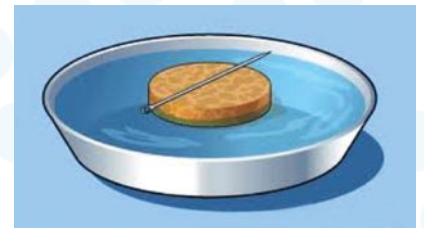
Activity 1: Sewing needles (or small iron bars), bar magnets, paper clips, compass, small bowl or butter carton of water, slice of cork (or similar) on which to place needle.

Activity 2: 1.5 volt battery, large nail (minimum 5 cms.), insulated wire stripped at both ends (60 – 90 cm. lengths depending on length of nail), sellotape or blu-tack, paper clips.

Activity 3: Small compass, insulated wire, battery

Suggested class level

Senior



Preparation

It is recommended that children have previously carried out the following activities relating to magnets and electricity:

1. Find out what sort of things 'stick' to a magnet (i.e. iron and steel mainly);
2. Show that unlike poles of magnets attract each other and like poles repel each other;
3. Make an electric circuit.

Background information

Magnets can only attract things made from certain kinds of metal, mainly iron and steel. (They also attract cobalt and nickel, but children will rarely come across these). These are called **magnetic materials**. A magnet can be made from a magnetic material by stroking the latter in the same direction many times with a magnet.

A compass is a magnet which is free to rotate about a vertical axis – it will line up in a North-South direction, with its North pole pointing to Earth's North.

As well as producing heat and light, electricity also produces magnetism. This is called **ELECTROMAGNETISM**.

This is a temporary effect – the magnetism disappears when the current is switched off.

Electricity produces movement if coils of wire carrying current are placed near a magnet. When like poles of the magnet and the current-carrying coils of wire (which act like a magnet) face each other, they repel each other and cause movement. This is the basis of an electric **motor**.

TRIGGER QUESTIONS

Activity 1.

What do magnets do?

(They 'stick to' or attract things).

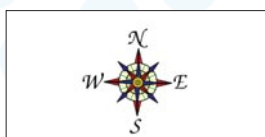
Do they only attract things? (They can push away other magnets if a North Pole of one faces the North Pole of another magnet; and similarly with two South Poles).



What kind of things do they 'stick' to? (*Metals*)

Do they 'stick to' (attract) all metals?

(No. Mainly just iron and steel; and a few other less common metals – cobalt and nickel. These are called magnetic materials).



Do you think you can make a magnet out of all metals?

(No, only out of magnetic materials).

How would you find your way if you were lost?

(Discuss various ways: Map, compass, GPS, lighthouse, stars at night - the Plough points to North Star; also with a 'hands' watch point the hour hand to the sun, and half-way between the hour hand and the number 12 on your watch is the South,.....)



What is a compass made of? (*A magnet, which is free to rotate about a vertical axis*).

In what direction does it point? (*In a North-South direction*).

Where do you think North is from here? (*Discussion on directions from classroom*).

Activities 2 and 3:

What does electricity give us? (Ask children to think of the classroom or kitchen – light, heat – e.g. kettle, oven, movement – e.g. electric motor in washing machine, hairdryer.....).

We will investigate how the movement comes about.

Content

SCIENCE:	Energy and Forces – Magnetism and Electricity Materials – magnetic and non-magnetic
MATHS:	Data: Representing and Interpreting Data

Skills

Predicting, experimenting, observing, recording, analysing

Cross-curricular Links

HISTORY:	Early explorers from Europe (e.g. Christopher Columbus) used compasses to guide them on their travels.
GEOGRAPHY:	Compass points – North, South, East, West.

ACTIVITIES

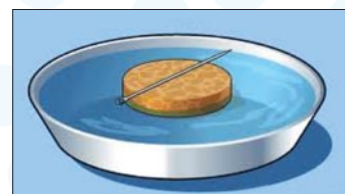
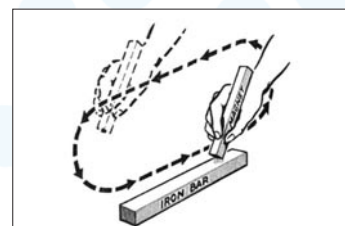
Activity 1. Make a compass

Rub a bar magnet along a needle (or iron bar) a number of times in the same direction and with the same end of the magnet. (The needle gradually becomes magnetised). Try to lift some paper clips with the needle to see if it is magnetised. Now rub it some more times.

Does the number of rubs make a stronger magnet?

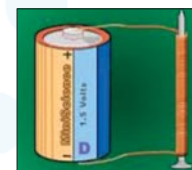
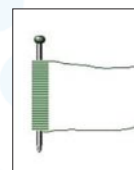
The more times you rub the magnet across the needle the more paper clips it will hold, up to a certain maximum.

- Cut off a small circle from one end of the cork.
- Float the cork in the bowl or carton of water.
- Carefully place the magnetised needle on top of the cork.
- Does the needle point in any particular direction?
North-south, because it is now a compass!
- Compare the direction of the needle of a compass with the one you have made.
Keep away from any iron or steel on your desk as this may affect the compass needles.



Activity 2: Make an Electromagnet

- Leaving an inch or two free at each end, wind the wire tightly around the nail as many times as you can.
- Place a paper clip near the nail.
- Touch the free ends of the wire **BRIEFLY** against the terminals of the battery.
N.B. Briefly - See Safety Note



What happens?

The paper clip is attracted to the magnet, because the nail has become an electromagnet.

What happens when you disconnect the circuit?

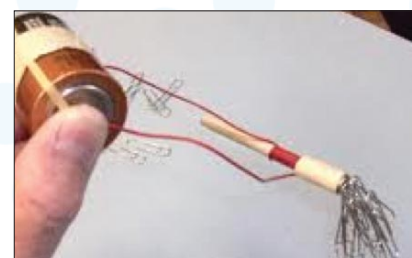
The paper clip falls off.

What do you think is an advantage of an electromagnet over an ordinary (permanent) magnet?

You can switch an electromagnet on and off, so that it works only when you want it to.

Children can investigate how the number of coils (e.g. 10, 15, 20...) affects the number of paper clips the electromagnet can pick up. They should record their results:

ELECTROMAGNET	
Number of coils	Number of paper clips picked up



They can then draw a graph, with number of coils on the horizontal axis, and number of paper clips on the vertical axis.

What shape is the graph?

Is there a direct connection between the number of coils and the strength of the electromagnet?

Activity 3: Discover how an electric motor works!

- Put a compass on a desk or table with the needle lining up with the North-South markings.
- Place the wire across the top of the compass so that it lies in the same direction as the compass needle.
- Touch each end of the wire to the opposite ends of the battery briefly. Look very closely at the compass needle.
- What happens to the compass needle? (It moves slightly.)
- What happens to the compass needle when you take away the wire from the battery? (It moves back to its original position).
- Have you any idea why the compass needle moves? (An electric current produces magnetism – a temporary one, which disappears when the current is switched off. This is called **ELECTROMAGNETISM**. All magnets have a North and South pole. The North produced by the current repels the North of the compass needle, so the needle moves!
- What do you think would happen if you had a big strong magnet, a strong current and lots of coils of wire? (A big movement! i.e. AN ELECTRIC MOTOR).



Safety

- Magnets can damage cards with a magnetic stripe, e.g. credit cards, school IDs, etc. Keep magnets away from these.
- Be careful with point of needle in Activity 2.
- In Activities 2 and 3, the wires may get fairly hot (and also the battery will run down quickly) if the circuit is connected up too long. Because there is no 'load' in the circuit, (i.e. nothing like a bulb or motor or buzzer to use up the energy from the battery), most of the energy goes into producing heat. **Therefore it is recommended that the circuit is only connected up very briefly.**

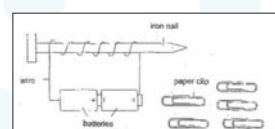
Follow-up activities

Children can introduce a switch into the circuit to switch their electromagnet on and off.

Can the children think of any other way that they could make a stronger electromagnet?

(Hint: this time keep the number of coils the same, but use a stronger current by using a higher voltage battery, say 3 volts or 4.5 volts).

How many paper clips can they pick up this time?



Did You Know?

Magnets have been known since the year 600 B.C. by the ancient Greeks, and perhaps earlier by the Chinese. They noticed that iron was attracted to a rock called lodestone. It was quite a mystery then as nothing was known about magnets.

Motors, electric bells and loudspeakers work using electromagnetism.

Electromagnets are used to lift scrap iron and steel out of rubbish collections. After they are lifted out the crane swings around and the current is switched off. The metals now fall off onto where you want (*because the electromagnet is only a temporary magnet – i.e. it is only a magnet while the current is flowing*).



Electromagnets are used on some trains instead of wheels! They are called MAGLEV trains.

Repelling magnetic forces from two electromagnets hold the trains a few centimetres above the track, and push them along. They can move very fast because there is no friction between the train and the rails to slow them down.

