Amgen | Teach
Engaging Science Educators

PDST
Professional Development Service for Teachers | An tSeirbhís um Fhorbairt Ghairmiúil do Mhúinteoirí

Electricity-

Practical activities

Magnetism

Electrostatics

Electricity basics

Heating, Magnetic, Chemical effects of electricity

Electronics

Gonzaga College, 7th November 2015

Magnetism

Syllabus

OP45 Carry out simple experiments to show attraction and repulsion between magnets, and test a variety of materials for magnetism

OP46 Plot the magnetic field of a bar magnet

OP47 Demonstrate that the Earth has a magnetic field, and locate North and South.

Overview

There are three kinds of magnet;

Naturally occurring (called Lodestone)

Man-made magnets

Electromagnets

Magnets have two distinctive properties;

1. **they attract certain metals**
2. **when suspended freely they come to rest pointing in a north-south direction**

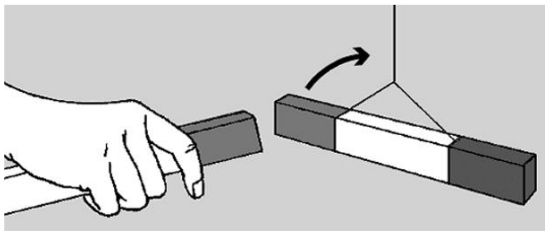
Uses of magnets

- Fridge magnets
- In motors
- In speakers

Task 1

OP45: Carry out simple experiments to show attraction and repulsion between magnets,

Where is the attraction strongest?



Summarize your observations about attraction and repulsion

What lessons for storing magnets?

Task 2

Test a variety of materials for magnetism

To test a material for magnetism bring a magnet up to the material and see if the material becomes attracted to the magnet.

Record findings in the table

Magnetic materials	Non magnetic materials

Task 3

Investigate making and destroying magnets

Can magnetism be induced?

What is meant by magnetic susceptibility?

What is meant by magnetic retentivity?

How long is magnetism retained?

Investigate how many pins (“end to end”) can you hang from either pole of a bar magnet?

Task 4

Investigate the idea of molecular magnets as a concept for how magnetism may be induced in a metal that is initially non-magnetic.

Use test-tube containing iron filings and a rubber bung.

Stroke it repeatedly in one direction with a permanent magnet.

Test for magnetism by placing test tube near a compass.

Task 5

To visualise the magnetic field around a bar magnet

OP46: Plot the magnetic field of a bar magnet

This may be done using;

small magnetic compasses, called plotting compasses

or

by sprinkling iron filings

.

Note that students should know that the lines joining the North and South poles are called **magnetic field lines**; they are most concentrated at the poles.

Activity: visualising the magnetic field lines

For each group use a salt cellar containing iron filings.

Cover the magnet with a transparent plastic dish.

Then sprinkle on the filings.

Record the patterns of fields

(a) around an isolated bar magnet

(b) in the region between like poles

(c) in the region between unlike poles.

Task 6

Syllabus: Demonstrate that the Earth has a magnetic field, and locate North and South.

What is a compass?

How do navigational compasses work?

Is the magnetic field of the earth strong or weak?

The Earth's Magnetic Field

The origin of the Earth's magnetic field is still unknown, although the consensus appears to be that it is probably caused by electric currents circulating in the molten outer part of the iron-rich core of the planet, which is at a temperature of at least 2200 °C. Either way, the situation today is that it acts as though there is a bar magnet in the centre of the Earth, with its *South end* up beside our *Geographic North Pole*.

This is why the north pole of our magnets point there (a little confusing, isn't it?).

However the magnetic North Pole is not directly in line with the geographic North Pole, and the difference gets bigger as you travel further north (or south) of the equator (see diagram).

This difference is known as *magnetic variation,* and once the angle is known, the Earth's magnetic field can be used for accurate navigation.

But this arrangement is not immutable over geologic timescales.

Every 500,000 years or so the system "flips", and the magnetic field undergoes complete reversal; the north magnetic pole becomes the south and vice versa.

What would happen if the molten iron inside the Earth were to cease to slosh around completely?

For starters there would be no magnetic field. And the consequences of this?

Without the protection of the magnetic field life on Earth, including life for all human beings, would be greatly subject to greatly enhanced and very harmful cosmic radiation; satellites would be nudged from orbit; the climatic consequences could well be dramatic.

The Earth's magnetic field can be used for accurate navigation, both by man and animal.

Bird Migration

Many migratory birds such as swallows have a mineral in their brains known as *magnetite*, which helps them navigate as they travel across the oceans.

It has also been shown recently that sharks are sensitive to magnetic fields. Scientists put a number of hammerhead sharks into a pool which they surrounded with copper wire. When they turned on the current through the wire there was a noticeable change in behaviour of the sharks.

A study recently found that even cows in a field tend to align themselves along the magnetic North-South axis. This was first noticed when sharp-eyed observers were looking at images of the countryside using GoogleEarth.

Task 7

Establish the link between electricity and Magnetism

by performing Oersted's experiment

How can electricity be used to make or destroy magnets?

Task 8

Make an electromagnet and test it

Task 9

Magnetise a 6-inch nail by an electrical method

Then

De-magnetize the nail electrically

Test each time by bringing the nail near a compass

Electrostatics

Task 1

Explore charging by friction

and

How like charges repel and unlike charges attract

Task 2

Examine an Electroscope

And investigate how to charge it by induction

Question: What's happening when you charge an electroscope?

Task 3

Experience a mild Electric shock (Rory)

Task 4

Discuss Lightning

Demonstration of Van de Graff generator

Extension activity:

Capacitors

Current Electricity

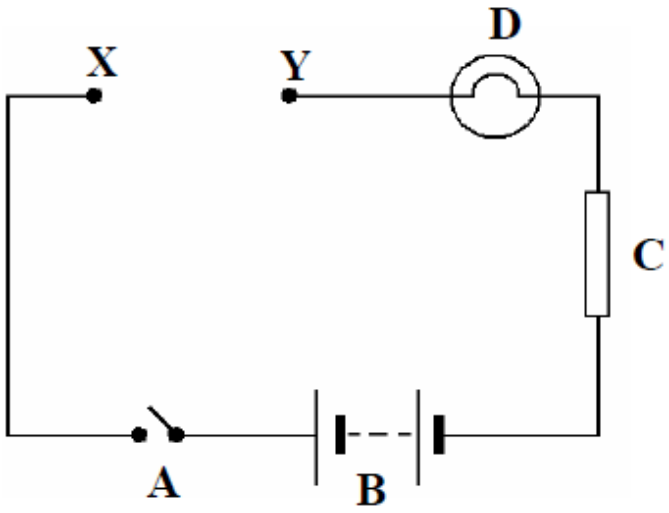
Task 1

Draw the symbol for each of the following underneath the word

Resistor **Switch** **Voltmeter** **Light Bulb** **Battery** **Rheostat**

Task 2

Experiment: Identify materials as conductors or insulators



1. Place various different materials between points X and Y in the circuit and turn on the switch.

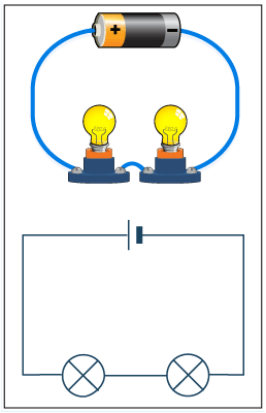
2. If the bulb lights then the material is a conductor and if it doesn't then the material is an insulator.

Task 3

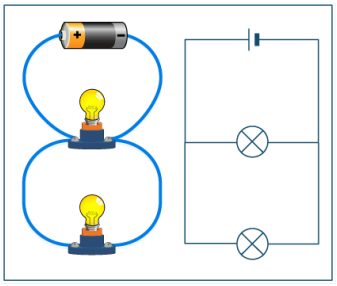
Investigate series and parallel circuits

A series circuit

- This is where the two bulbs are connected one after the other.
- All the current coming from the battery goes through both bulbs.
- Advantage: Uses less electricity than if the bulbs are connected in parallel.
- Disadvantage: If one bulb blows the circuit is broken and so no current flows, e.g. lights in a Christmas tree.



A parallel circuit



The current coming from the battery splits up and some goes through each bulb.

Advantage: If one bulb blows there will still be a complete circuit through the other bulb so it will remain lit.

Light bulbs in a house are generally connected in parallel for this reason.

Disadvantage: It uses more electricity than if connected in series.

Extension activity:

Examine two bulbs in series but with different spec. 6 V, 60 mA and 6 V, 150 mA

Task 4

Explore voltage values at different places in a circuit

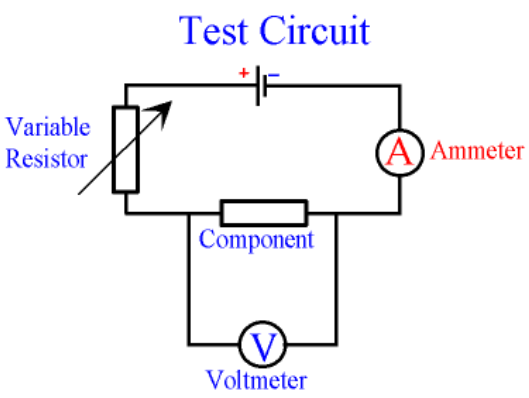
- what happens the voltage if two equal resistors are in series?

- what happens the voltage if two unequal resistors are in series?

Task 5

Experiment: To establish the relationship between potential difference and current

1. A **coil of wire** may be used as the component.



2. Set up the circuit as shown and note the current (I) and potential difference (V)

3. Adjust the variable resistor (rheostat) to get a new values.

4. Repeat about 6 times

5. Record values in the table below.

Voltage								
Current								

6. Plot a graph of potential difference against current.

7. Work out the slope of the graph

8. Remove the component from the circuit.

9. Measure the resistance of the component using a multimeter set to the Ohm range.

10. Compare the results from 6 and 8

11. Draw a conclusion

Extension activity

Repeat the above procedure with a **filament bulb** as the component

Voltage								
Current								

Generating electricity

Task 5

Show how a.c. may be generated by a coil and magnet

Refer to the work of Faraday

Task 6

Show how d.c. may be obtained using acid and two different metals

Use a lemon and various combinations of a copper nail and a zinc nail and an iron nail.

Record the voltage obtained in each case.

How may bigger voltages be obtained?

Get a light bulb to glow using lemon batteries.

3 effects of electricity

Heating effect

Kettle etc

Task 1

Heat 150 ml of water using a coil with 2A of current for ten minutes, etc

Chemical effect

Electrolysis etc

Electroplating and

production of gases

Task 1

Electroplate a key with copper

Magnetic effect

Electromagnetism

Task 1

Make and test an electromagnet

Demo Electromagnetic induction

Extension activities

Induction motor

Induction cooker

Speaker

Electronics

Syllabus

OP57 Describe a diode as a device that allows current to flow in one direction only and recall that a light emitting diode (LED) requires less current than a bulb

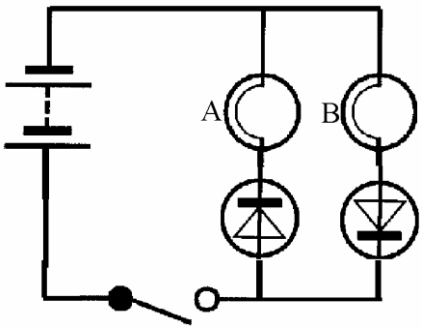
OP58 Set up simple series circuits using switches, buzzers, LEDs and resistors

OP59 Measure the resistance of a light-dependent resistor (LDR) under varying degrees of brightness of light

OP60 Identify everyday applications of the diode, including the LED, and of the LDR

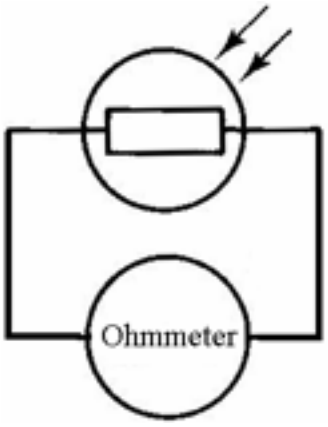
Task 1

Set up and examine the circuit



Task 2

Set up and examine the circuit



Task 2

Set up and examine the circuit