Unit 2

Everyday Chemistry

Metals

Some metals, including Gold, Silver and Copper, are found uncombined in the Earth's crust.

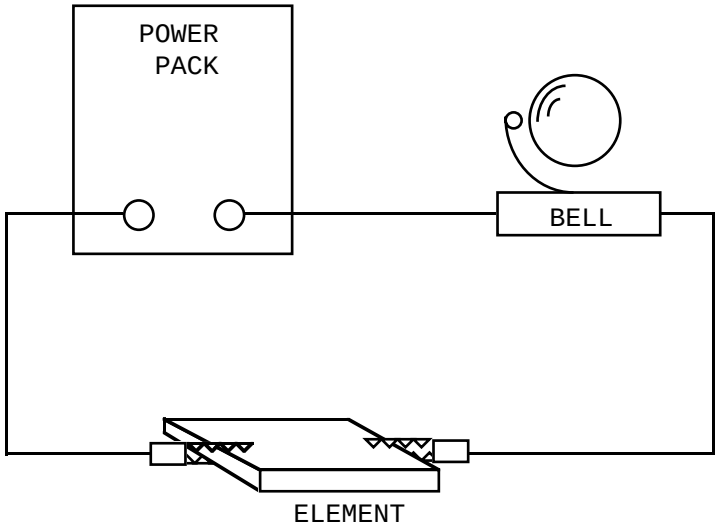
Most metals are found combined with other elements in compounds which we call 'ores'. We can get metals from their ores in many ways.

Heat a mixture of Lead oxide and Carbon in a test-tube.
Blobs of molten Lead are formed.

All metals conduct electricity.

Most non-metals (e.g. Sulphur, Oxygen and Bromine) do not conduct electricity. The exception is Graphite (a form of Carbon) which is a non-metal which is a good conductor of electricity!

Your teacher will show you how to find out whether an element conducts electricity or not with the following apparatus:



If the bell rings, the element conducts!

Uses of Metals

The uses of metals depend on what kind of properties they have. For example, Copper is used to make electrical wires because it conducts electricity. Here are some other uses of metals related to their properties:

Metal	**Use**	**Related Property**
Aluminium	Aircraft	low density (light)
Copper	Copper-based saucepans	good heat conductor
Gold	Jewellery	malleable (soft)
Lead	Ship keels	high density (heavy)

Alloys

Alloys consist of two or more different metals, melted down and mixed together.

e.g. **Brass** contains Zinc and Copper and is used to make the pins for electric plugs etc.

Some alloys contain metals and non-metals

e.g. **Mild steel** contains Iron and Carbon and is used to make girders and beams because it is very strong.

Other alloys and their uses are listed below:

Alloy	**Elements present**	**Uses**
Solder	Tin Lead	Joining metals
Stainless steel	Iron Carbon Chromium Nickel	Knifes and forks

Reactions of Metals

With Oxygen:

Metal oxides are produced when metals react with Oxygen.

Your teacher will burn some Iron wool in air. The Iron combines with the Oxygen in the air forming Iron oxide.

Iron + Oxygen -> Iron oxide

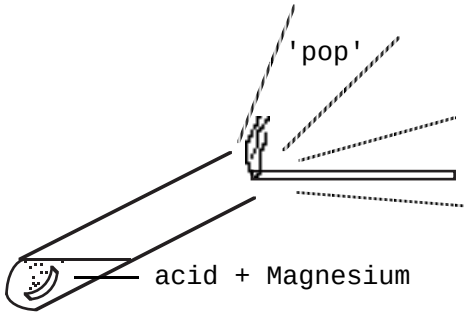
Your teacher will burn some Magnesium powder in air.
The Magnesium combines with the Oxygen in the air forming Magnesium oxide.

Magnesium + Oxygen -> Magnesium oxide

With Acid:

Hydrogen is produced when metals react with acids.

Add Magnesium ribbon to some dilute acid in a test tuble. Hydrogen gas is given off. Hydrogen burns with a 'pop'.



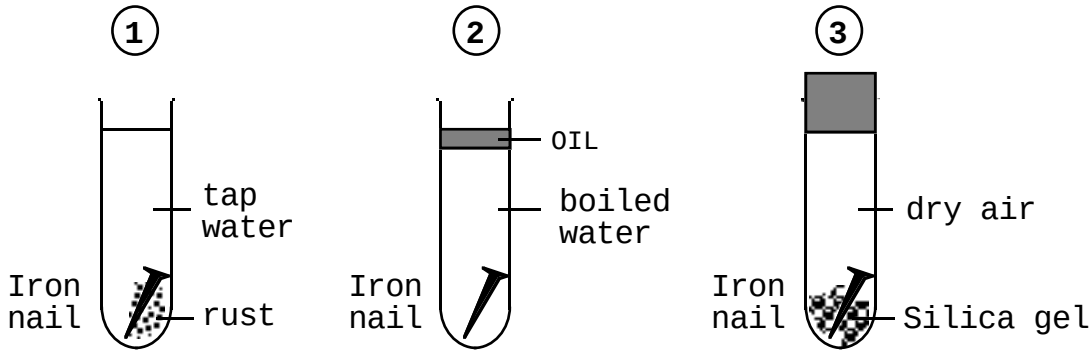
Corrosion

Corrosion is a chemical reaction taking place on the surface of a metal. The surface of the metal changes into a compound.

The rusting of Iron is the most common form of corrosion. The Iron goes brown and flakey and loses its strength.

What does Iron react with when it rusts?

Your teacher will show you three test tubes set up a few days ago:



RUSTING **NO RUSTING** **NO RUSTING**

Test tube 1 contains tap water. Tap water contains **Water** and **Oxygen** which has dissolved in the water from the air.
The Iron nail in test tube 1 rusts.

Test tube 2 contains tap water which has been boiled for 10 minutes.
The boiling removes the dissolved Oxygen. The layer of oil prevents Oxygen from getting back in.
Test tube 2 therefore contains **Water** but no Oxygen.
The Iron nail in test tube 2 does not rust.

Test tube 3 contains air which has been dried with Silica gel.
The Silica gel absorbs Water from the air.
Test tube 3 therefore contains **Oxygen** but no Water.
The Iron nail in test tube 3 does not rust.

What can we conclude from this experiment?

Iron only rusts when <u>BOTH</u> Oxygen and Water are present.

We can use a yellow liquid called 'Rust Indicator' to watch corrosion actually happening. Rusting Iron turns this indicator blue.

Place an Iron nail in a test tube containing Rust Indicator. After a few minutes a blue colour appears around the Iron nail.

Set up the following two test tubes and compare the rate of corrosion in each:

Iron nail +
Rust indicator

Iron nail +
ACID +
Rust indicator

The blue colour appears faster when ACID is present.
Iron rusts faster when acid is present.
Acid rain increases the rate of corrosion.

Set up the following two test tubes and compare the rate of corrosion in each:

Iron nail +
Rust indicator

Iron nail +
SALT +
Rust indicator

The blue colour appears faster when SALT is present.
Iron rusts faster when SALT is present.
SALT is spread on the roads to stop ice from forming in cold weather. This SALT, unfortunately, increases the rate of corrosion of car bodywork.

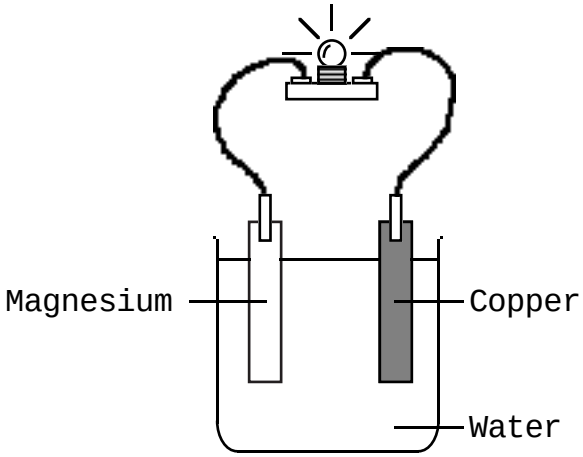
So, how can we stop rusting?

We can cover the Iron by painting, greasing, tin-plating and coating with plastic. These materials form a barrier over the Iron keeping the Water and Oxygen out.

Batteries

A battery makes electricity from a chemical reaction taking place inside it. When the chemicals run out the battery goes 'flat' and needs to be replaced.

Make a simple battery as follows:



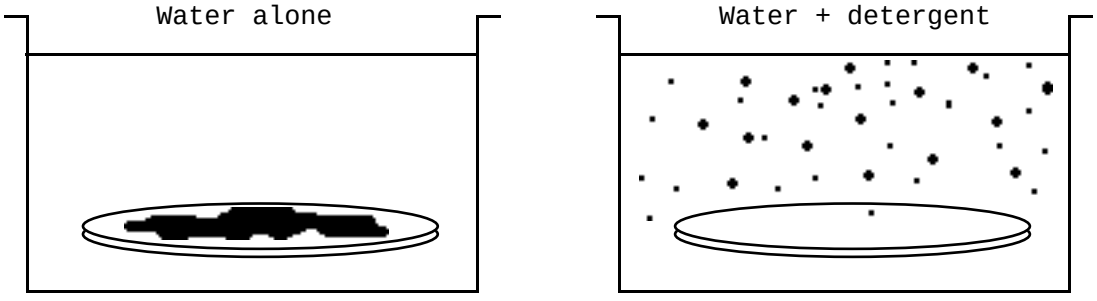
Enough electricity is generated to light up a bulb!

Some batteries can be recharged e.g. the Lead-Acid battery used in a car and the Nickel-Cadmium battery used in camcorders, laptops etc.

Keeping Clean

Our hair and skin get covered in natural body oils which attract dirt. Greasy marks on our clothes also contain dirt. Unfortunately this dirt/oil mixture is not soluble in water.

We cannot wash with water alone. We have to use cleaning chemicals like soap and detergent - shampoo, washing-up liquid and washing powders are all detergents. Soap and detergents are soluble in both water and grease. They break up the oil and grease into tiny droplets which can then mix with water.



Grease on plate

Grease cleaned off plate

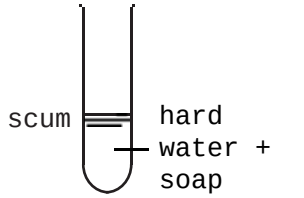
Your teacher will show you how to make some soap from Castor oil !

In some parts of the world the tap water contains impurities which stop soap from working properly - it forms a 'scummy' deposit on clothes instead of cleaning them. This kind of tap water is called 'Hard Water'. Detergents do not form these scums in hard water so detergents, not soap, must be used in hard water areas.

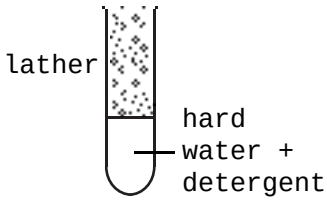
In Ardrossan we are lucky - our tap water is not 'hard'. We live in a 'Soft Water' area where soap works fine!

Take two test tubes of hard water.

Add a few drops of soap solution to the first test tube and shake it. A grey scum floats on top of the test tube.



Add a few drops of detergent to the second test tube and shake it. No scum forms - just a nice lather.



Clothing

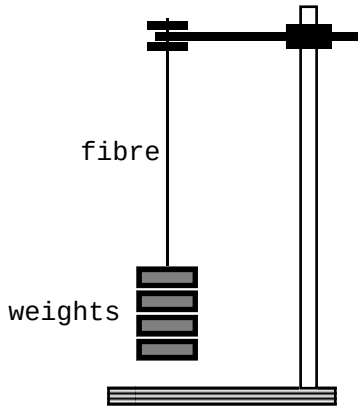
Clothes are made from thin strands called fibres.

Natural fibres come from plants and animals.
Silk is a natural fibre obtained from the silk worm.
Wool is a natural fibre obtained from sheep.
Cotton is a natural fibre obtained from the cotton plant.

Synthetic fibres are made by the chemical industry.
Nylon and Polyesters (e.g. Terylene) are synthetic fibres.
Compared to natural fibres, synthetic fibres are stronger and less likely to get damaged in the washing machine.

Your teacher will show you how to make Nylon fibre.

Investigate the breaking strength of natural and synthetic fibres by hanging weights on these fibres until they break.



The bright colours of our clothes are obtained using coloured chemicals called dyes.

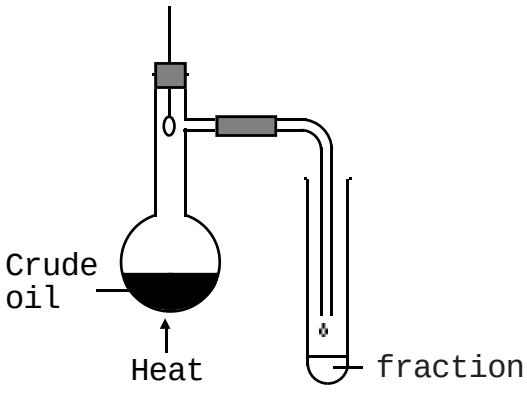
Fuels

A fuel is a chemical which is burned to produce energy.

Most of the fuels we use in our homes are fossil fuels like coal, crude oil, natural gas and peat.

Crude oil is a thick, black liquid which contains gases, petrol, paraffin and diesel all mixed up with other substances.

Your teacher will show you how the crude oil mixture can be separated by distillation



As the crude oil is heated, the compounds with the lowest boiling points begin to boil out of the mixture and condense in the test tube. Fractions can be obtained which contain groups of compounds with boiling points within a given range.

Six fractions are separated :

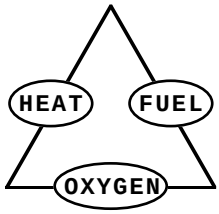
Fraction	**Boiling range/^{0}C**	**Uses**
Gases	below 20	Calor gas
Petrol	20 - 170	Cars
Paraffin	170 - 300	Stoves, planes
Diesel	270 - 370	Trains, lorries
Lubricating oil	above 370	Machinery
Bitumen	solid residue	Roads

Burning Fuels

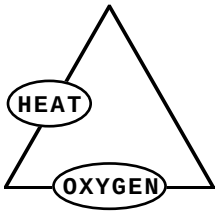
For a fire we need:

* something to burn (the **fuel**)
* **Oxygen**, usually from the air
* a source of **heat** to start the fire and keep it going

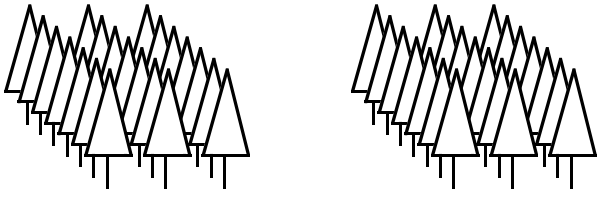
This can be summarised in the Fire Triangle:

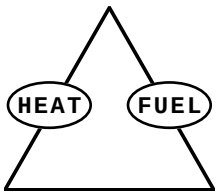


If we take away any one of these three, the fire goes out.



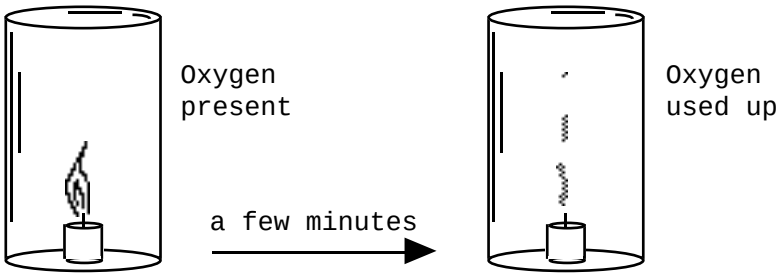
Remove the fuel and the fire cannot spread e.g. gaps are left between blocks of trees to prevent a forest fire from spreading.





When a substance burns it reacts with Oxygen. Remove the Oxygen and the fuel cannot burn.

Your teacher will show you what happens when a candle burns inside a closed jar:



The burning candle reacts with the Oxygen inside the jar. When all the Oxygen is used up the flame goes out.

Water is commonly used to 'smother' the flames and keep out Oxygen but we must never use Water to put out:

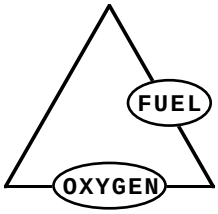
* **Electrical fires**

  Water conducts electricity!

* **Burning petrol or fat**

  Water, heavier than petrol or fat, sinks under the burning liquid, turns into lots of steam and explodes the burning petrol or fat everywhere.

  Alternative extinguishers are: fire blanket, sand, Carbon dioxide and foam.



Remove the heat and the fire cannot keep going. Most house fires are put out with water which cools the fire and removes the heat.

We must take care when using fossil fuels:

* Fossil fuels will not last forever. Since they were formed from the remains of plants and animals over hundreds of millions of years, they cannot be replaced very easily! We say that they are a 'finite' energy source. Over-use of fossil fuels may lead to a shortage of fuels in the future.

* Oil spillages can cause great damage to marine life and the environment.

* Carbon monoxide (poisonous gas) can be produced when fuels burn in a low supply of Oxygen.

* Lead compounds added to petrol cause pollution

* Carbon (soot) is produced by diesel engines. This produces a lot of smoke in the exhaust and is harmful.

Harmful exhaust gases can be reduced using a catalytic convertor. This converts the harmful exhaust gases into harmless gases.

Plastics

Plastics are synthetic materials i.e. they are made by the chemical industry. Most plastics are made from chemicals obtained from crude oil.

The uses of plastics depend on their properties.

e.g. **Silicones** repel water and are therefore used to water-proof materials.

PVC, like most plastics, is an electrical insulator and is therefore used to cover electrical wires.

Some plastics are **thermosetting** - they do not melt on heating. They are therefore used to make things which might get very hot in use.

e.g. **Bakelite** is used to make pot handles.

Formica is used to cover kitchen table tops.

Other plastics are **thermoplastic** - they melt on heating. They can therefore be used to make things which need to be made by melting and shaping.

e.g. **Polythene** is used to make plastic bags.

Expanded Polystyrene is light and therefore used as a packing material.

Perspex is transparent and is therefore used as a substitute for glass.

Kevlar is very strong and is used to make bullet-proof vests and military helmets.

Plastics have many advantages over natural materials:

- They do not corrode like metals.
  Plastics can be used to make drain-pipes instead of Iron.

- Their fibres are stronger than natural fibres.
  Nylon jumpers do not wear as quickly as those made from cotton or wool.

Plastics, however, have one major disadvantage compared to natural materials: **getting rid of plastics is difficult!**

- When dumped and buried, most natural materials are biodegradable (broken down by bacteria) and rot away. Plastics are **NOT BIODEGRADABLE** They last forever and pollute the environment.

- Burning is not a good solution either.
  Though the heat produced can be used as a source of energy, most plastics give off poisonous gases like Carbon monoxide when burned.

It would therefore be sensible to recycle plastics as much as possible. The thermoplastic ones can be melted down, reshaped and used again. This is particularly important since crude oil, the raw material from which plastics are made, will not last forever.

Recycling, however, can be difficult. There are so many different types of plastics in common use. They must all be separated by hand before recycling.

Chemists are now trying to make plastics from renewable sources e.g. Rayon can be made from cotton.