Introduction to Science Junior Science

GZ Science Resources

What is Science?

Science is both a collection of knowledge and the process for building that knowledge.

Science asks questions about the natural world and looks for natural explanations.

Science works only with testable ideas and uses observations to make conclusions.

Theories are developed based on the evidence scientists collect.

Observation in Science

To observe means to record or make note of something we have experienced. We also think of observations as watching something, but in Science, observations may be made with any of our senses (by seeing, feeling, hearing, tasting, or smelling) or even using tools to make observations that are then changed into something our senses detect.

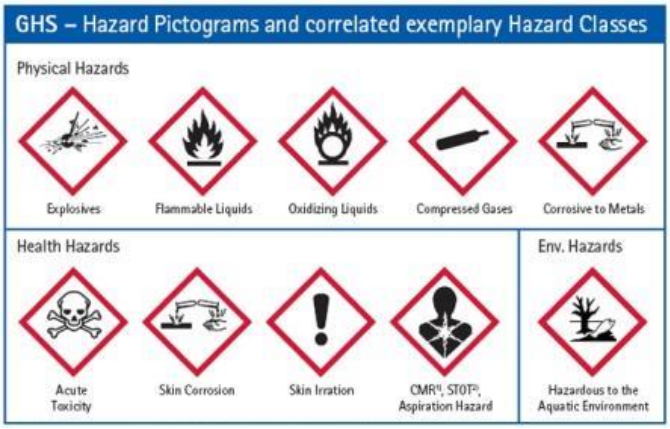
Laboratory Rules

A School Science Laboratory can be a fun place that allows you to investigate and observe Science taking place. It can also be a dangerous place if rules are not followed. To protect yourself and the classroom from harm we need to follow School Lab Rules carefully each time we are in the class or taking part in a practical.

1. Do not smell or taste chemicals.
2. Place bags under your desks.
3. Wear safety equipment if asked.
4. Tie long hair back during practicals.
5. No running in class.
6. Tell the teacher if you break equipment.
7. Clean up your work area after practicals.
8. No eating in the class.
9. .....
10. .....

Laboratory safety symbols

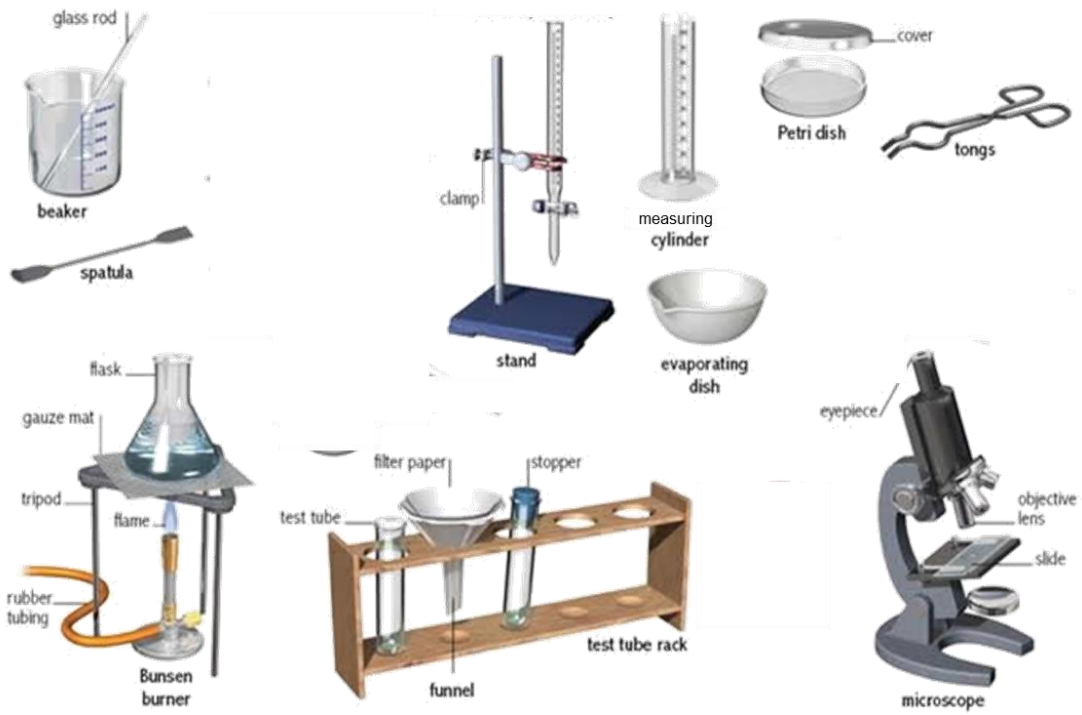
Easy to recognise safety Hazchem symbols are often used in Labs and on labels of chemicals when special care is required. A chemical may be poisonous or be explosive or burn when it touches skin. Safety symbols and Lab rules are designed to warn and protect you from dangerous situations.



Common Laboratory equipment

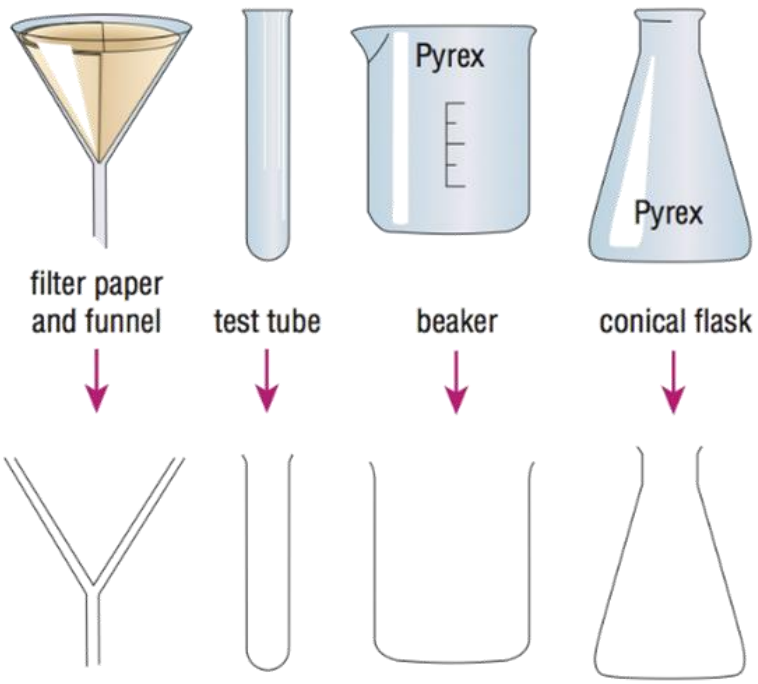
Science labs contain equipment that are used to carry out investigations and experiments. This equipment may be quite different from what we have in our homes but it is often designed for specific uses.

The names and uses of the equipment will need to be learnt along with how to use it.

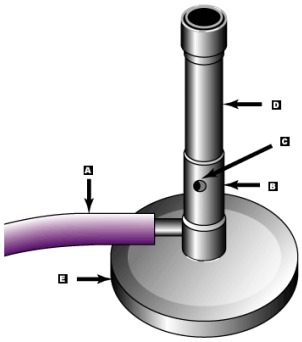


Drawing equipment in Science

In the science laboratory, we use special equipment. Often we have to draw the equipment. We use diagrams to show the equipment, which saves us time drawing. The scientific diagrams are recognised worldwide.



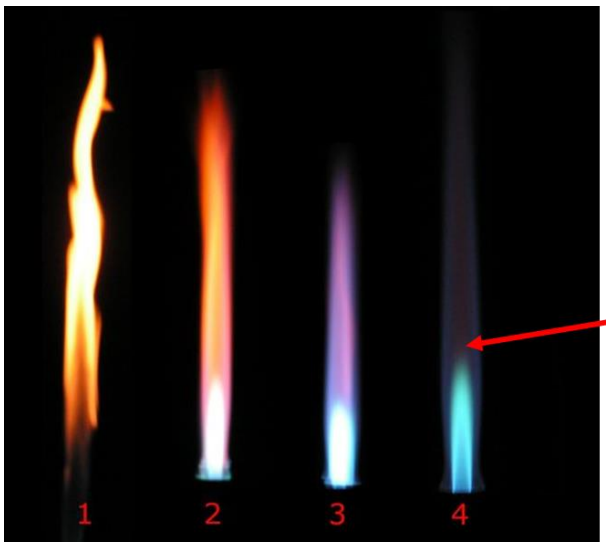
Draw and label the Bunsen Burner



Part of the Bunsen Burner	Function
A. Gas hose	To allow gas to enter the burner
B. Collar	To control the amount of air entering the burner
c. Air Hole	To allow air to enter the burner
D. Barrel	To raise the flame to a suitable height for heating and burning
E. Base	To support the burner and make it more stable

The Bunsen Burner Flame

The Bunsen Burner burns gas with oxygen in the air to make a hot flame used in the laboratory. When the air hole is closed (1) the flame is large and orange. This flame only partly allows oxygen to burn with the gas so is cooler and creates soot. As the air hole is opened, more (2-4) the flame becomes bluer and hotter. The best flame to use is (4) with the air hole mostly open.



When using the Bunsen Burner to heat boiling tubes etc place it at the hottest place at the top of the bright blue flame.

Measurements in Science

The process of science involves observation, investigation and testing. Scientific observations can be made directly with our own senses or may be made indirectly with equipment to collect data. Being able to take accurate measurements is important.

The units and type of equipment used depends on whether you are measuring length, volume, temperature or mass.

Measuring in Science

Quantity	Unit	Symbol	Equipment used
Volume	litre	L	flask
	millilitre	mL	measuring cylinder
Temperature	Celsius	°C	thermometer
Mass	kilograms	Kg	Scales
	grams	g	Scales
Length	Metres	m	Metre ruler
	millimetres	mm	Hand ruler

Collecting Data

Data that is collected from an investigation can be analysed (in order to explain and interpret it) easier if placed into a clearly labelled and laid out data table. The left column is the data of the variable (factor) that you are changing. The right hand side columns are for the data of the variables you are measuring.

The table must have:

- ❑ A heading linked to the aim
- ❑ Labelled quantities, units and symbols
- ❑ Values (often numerical) of data collected

Data tables can also contain processed data such as results from multiple trials that have been averaged to give a more reliable value.

Data Collected

This is chart of the numerical data collected in my experiment…

Independent Variable (This is the *one thing I changed in my experiment.*)	**Trial 1**	**Trial 2**	**Trial 3**	**Average** (Add the three trials together and divide by three.)

Processing Data - Averaging

When collecting and measuring data in investigations, such as that for calculating speed, errors can occur. This may be due to the measuring instrument and the way it is used. Data can also be recorded incorrectly.

Repeating the investigation a number of times and averaging out the measurements can help reduce random errors and increase reliability. This value is called the mean.

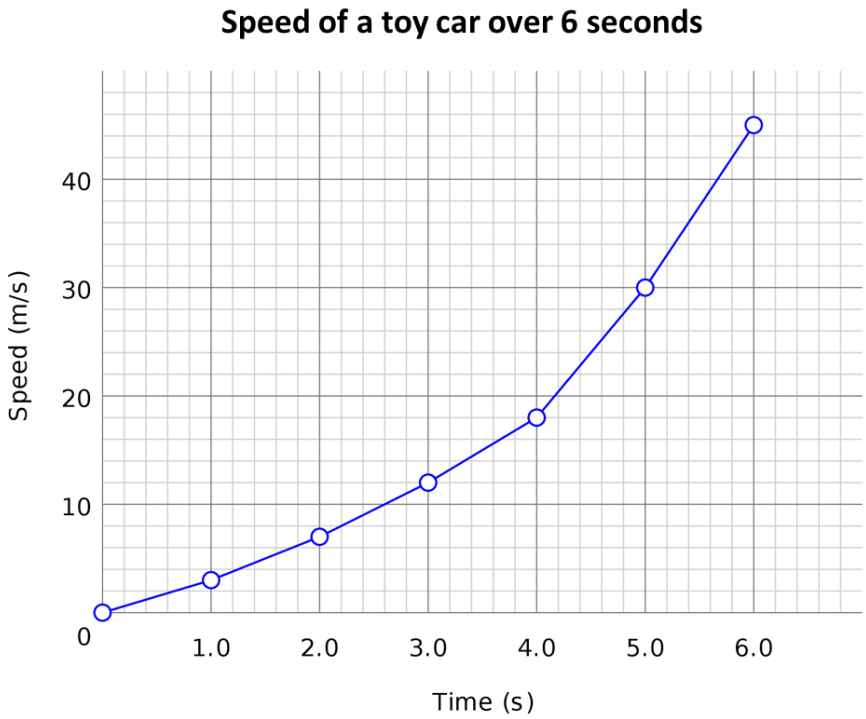
Distance walked in 1 minute

	Trial 1	Trial 2	Trial 3
Distance (m)	113	121	119

Mean = (113 + 121 + 119) ÷ **3**
= **117.7** m

Drawing a line Graph

Graphs are used to show patterns in data more easily than a data table. Often processed (averaged) data is used.



A well-drawn line graph must have the following features:

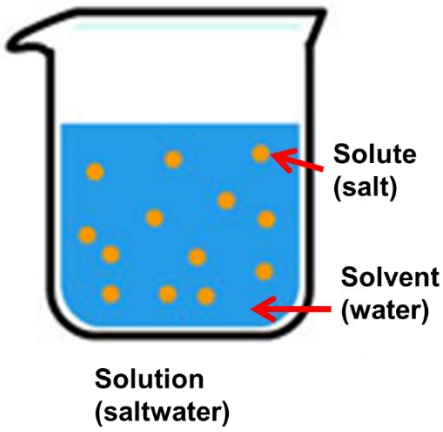
- ❑ A suitable heading
- ❑ Evenly spaced numbered axes
- ❑ Labels with units
- ❑ Correctly plotted line.

Use the acronym SALT when plotting graphs:

Scales Axes Labelling Title

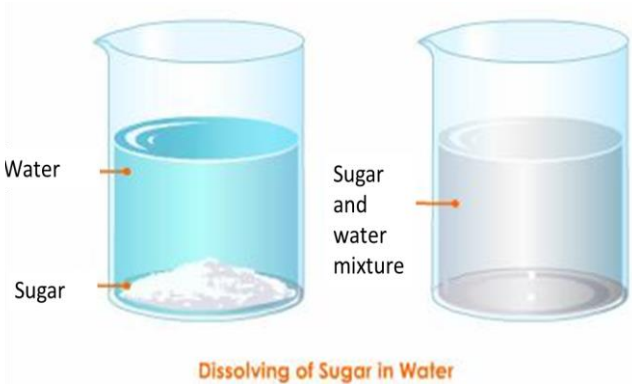
Solutions are made from a solute dissolved in a solvent

A solution is made up of a solvent and a solute. A solvent is a substance such as water that is able to dissolve a solute. The solvent 'pulls apart' the bonds that hold the solute particles together and the solute particles diffuse (spread randomly by hitting into each other) throughout the solvent to create a solution. The solution is a mixture with evenly spread solvent and solute particles. These particles can be physically separated by evaporation.



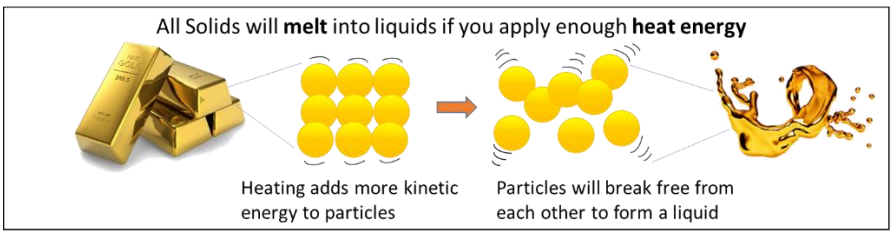
Where has the sugar gone?

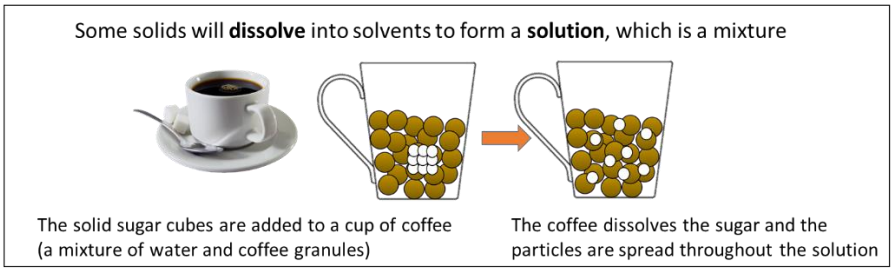
When a solid mixes into a liquid and can no longer be seen, it has dissolved. Often the particles of the solute seemed to have disappeared but they are all still present. They are now just in very small particles, too small to be seen by eye.



Dissolving and melting.

Both dissolving and melting are physical changes but they involve different processes





Everyday solutions

Many drinks we purchase are solutions. Most of them are solutions of mainly sugar (solute) and water (solvent) with a small amount of flavouring, colouring and some minerals mixed in. We do not "see" the sugar because it is dissolved into the water and becomes too small to see. This means a lot of sugar can be hidden in the liquid and we are unaware of the amount of sugar we take in, even in so-called healthy sports drinks.

Mixtures can be separated by physical processes

Mixtures of substances are not chemically bonded (joined) to each other so they can be separated by physical techniques.

The state of the various substances in the mixture, such as a liquid and solid or the physical properties of the substances, such as different boiling points will determine which method of separation will be used.

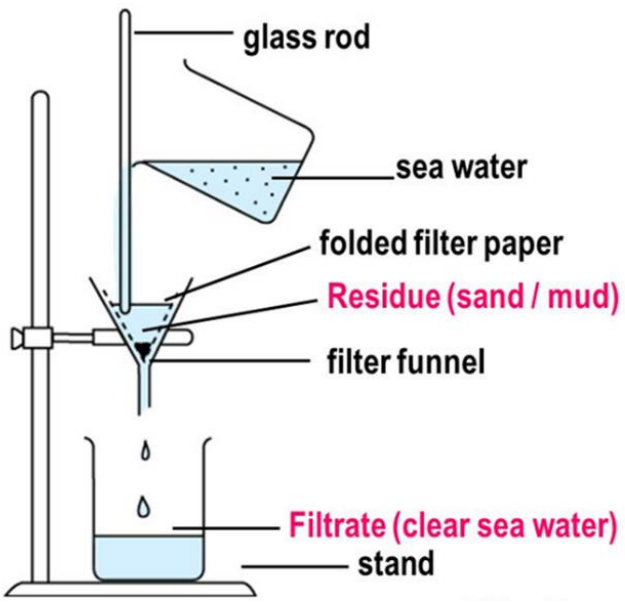
Filtering

Filtering separates an insoluble solid in a mixture from the liquid completely.

The solvent molecules (liquid) and any dissolved molecules present in the solution can pass through the filter paper, which has small holes, while the solid particles cannot because they are too large and stay in the filter paper.

The solvent or solution containing dissolved substances passes through the filter paper is called filtrate. The solid particles that remain on the filter paper are called the residue.

Filtering mud, sand and seawater

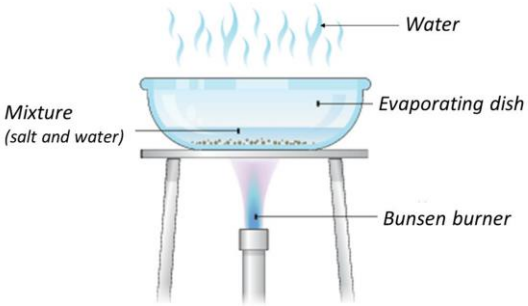


Evaporating (by boiling)

Evaporating separates a dissolved solid from a liquid. The solvent (liquid) is lost into the surroundings.

The liquid will evaporate but evaporation becomes faster at higher temperatures.

The solid remains because it has a higher (often very much higher) boiling point than the liquid.

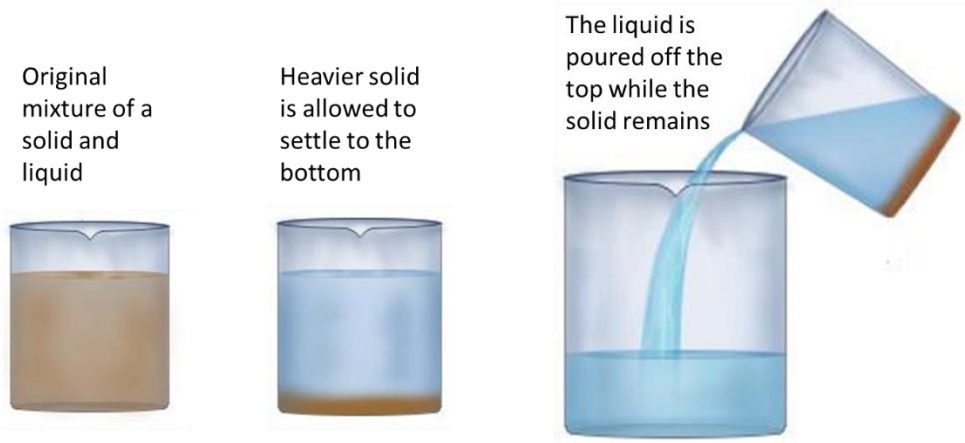


Dissolving

When two solid substances are mixed together, they can be separated by dissolving. A solvent such as water can be added if only one of the substances is soluble. For example; if salt is mixed with dirt then adding water will dissolve the salt (which can later be separated by evaporation) and the remaining dirt can be removed from the solution by filtering. The salt becomes the solute and will go through the filter as it is in solution.

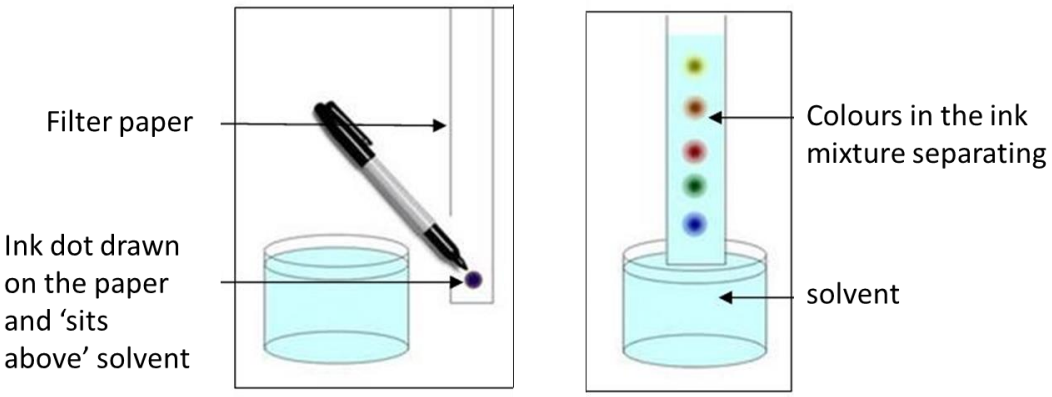
Decanting

Decanting is simply pouring off a liquid without losing any of the more dense substance (usually an insoluble solid) in the bottom of the container. Decanting separates a heavier substance from a lighter one. Chemists are most often after the substance at the BOTTOM of the container.



Chromatography

Chromatography is a method used to separate the various substances in a mixture of dye or ink. Substances of the mixture will differ in how much they "stick" to things: to each other, and to other substances. Some of the substances of the ink will stick more tightly to the paper fibres. They will spend less time in the water as it moves along the paper fibres, and they will not travel very far. Other components of the ink will stick less tightly to the paper fibres. They will spend more time in the water as it moves along the paper fibres, and they will travel further through the paper.

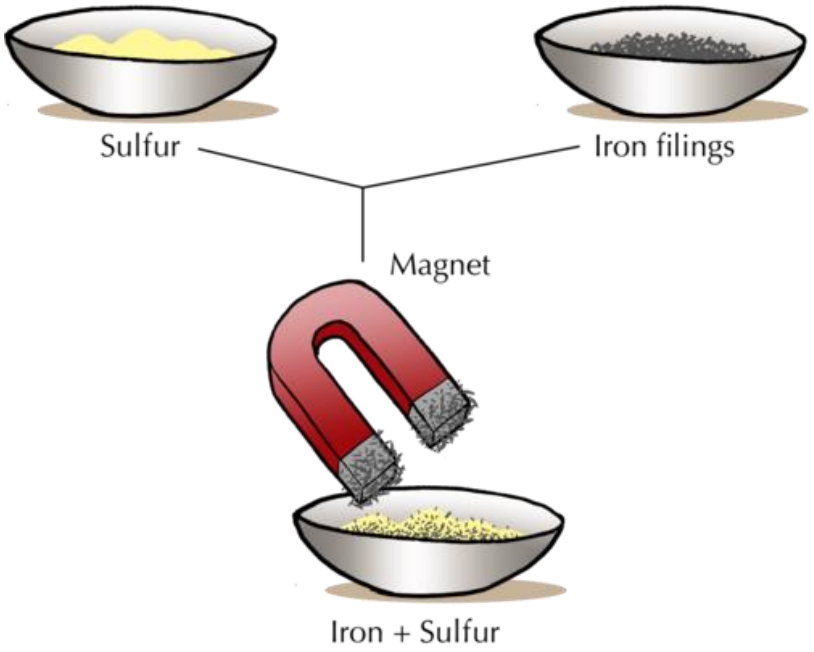


Magnetism

Magnetism can be used to separate a magnetic substance (such as iron) from a mixture containing non-magnetic substances (such as sulfur or sand).

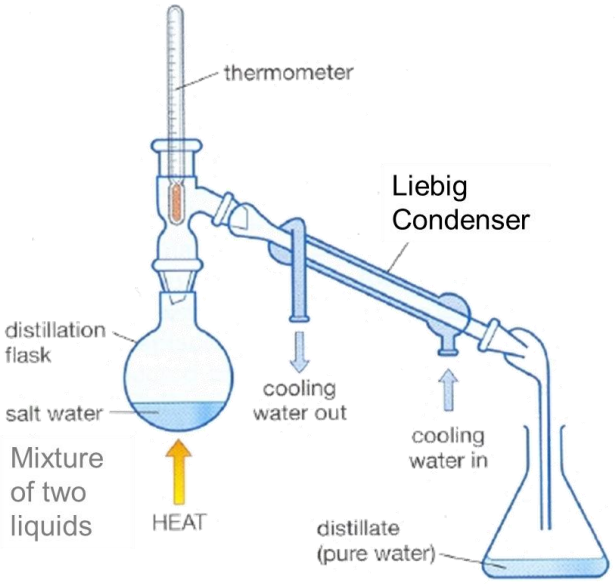
The magnetic substance of the mixture is separated with the help of the magnetic attraction.

A magnet is moved over the mixture containing the magnetic substance e.g., iron filings. These get attracted to the magnet. The process is repeated until the magnetic material is completely separated from the mixture. The non-magnetic substance is left behind.



Distillation

Distillation is a process of boiling a liquid until it forms a vapour and condensing, then collecting the liquid. The liquid collected is the distillate. The Liebig Condenser cools the vapour back into liquid. The purpose of distillation is separation of a mixture of two liquids. This is possible if the two substances have different boiling points. The substance with the lower boiling point turns to gas and is collected while the other substance with a higher boiling point remains as a liquid in the flask.



Mixtures can be easily separated physically - Summary

Separation technique	Property used for separation	example
Magnetic Attraction	magnetism	magnetic iron can be separated from non-magnetic sulfur using a magnet
Decanting	density or solubility	liquid water can be poured off (decanted) insoluble sand sediment less dense oil can be poured off (decanted) more dense water
Filtration	solubility, size of particles	sand can be separated from a solution of sodium chloride in water by filtration
Evaporation	solubility and boiling point	soluble sodium chloride can be separated from water by evaporation
dissolving	solubility	soluble salt can be separated from sand by dissolving into a solvent
Distillation	boiling point	ethanol can be separated from water by distillation because ethanol has a lower boiling point than water