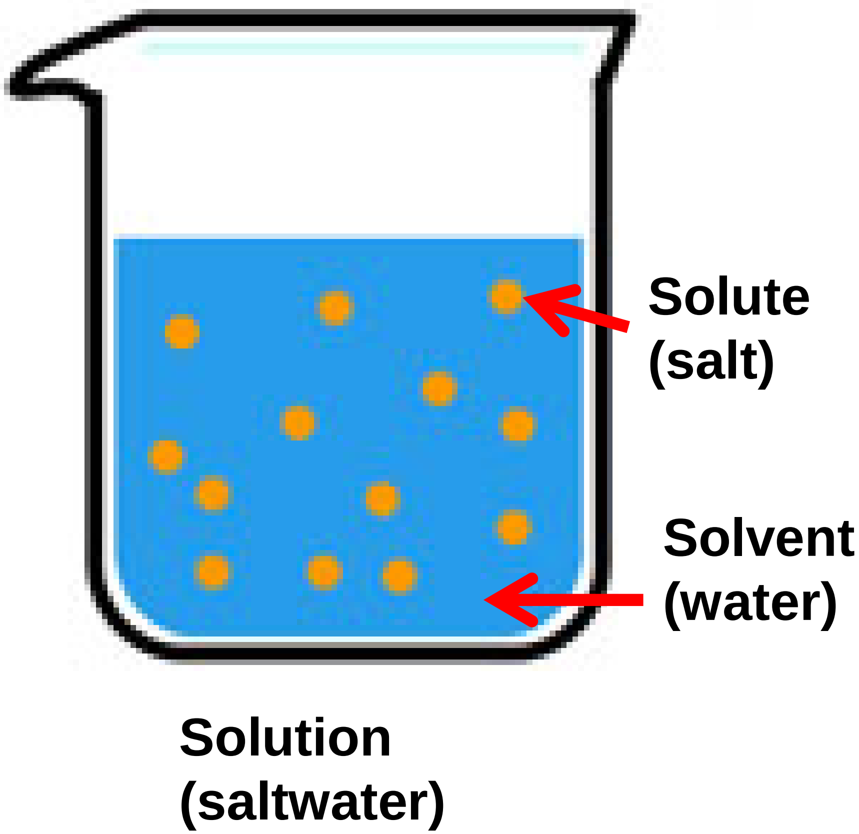
Separating Mixtures

Junior Science

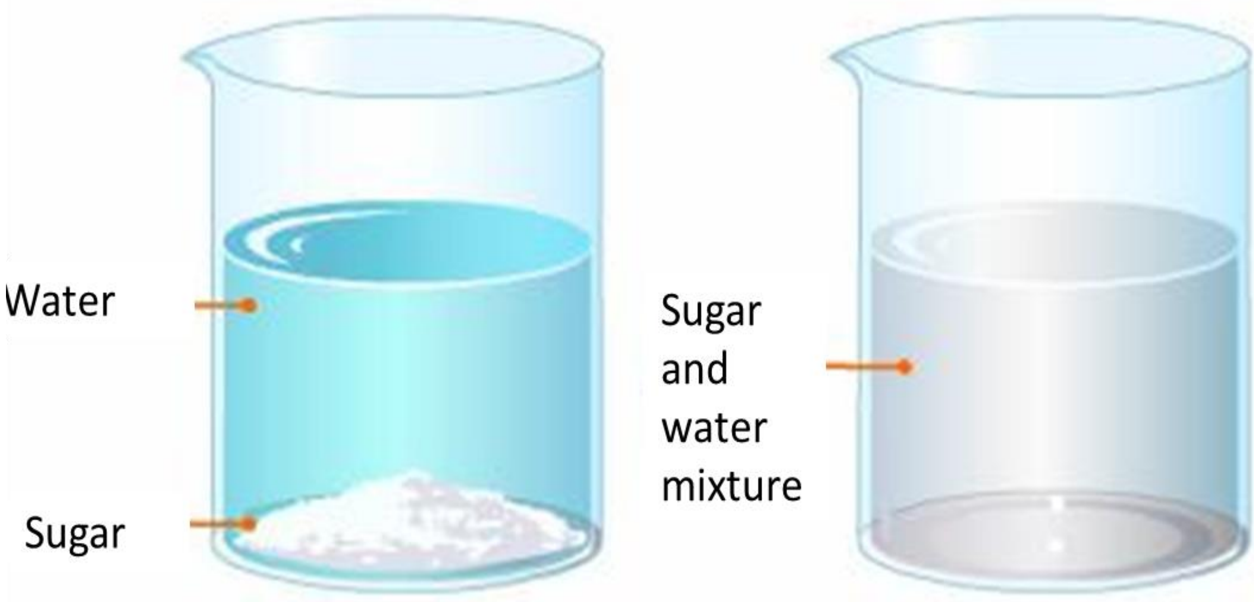
Solutions are made from a solute dissolved in a solvent



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 of Sugar in Water

As a solvent water forms solutions with many different solutes.

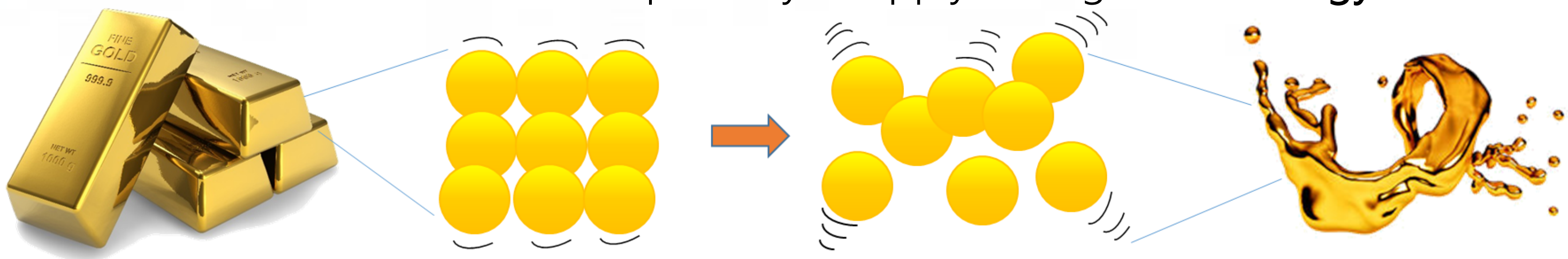
extra info

Solutions are simply **mixtures** of materials, one of which is a liquid or a gas. The liquid or gas, also called a fluid because it is able to flow.
One of the most common solvents is water. All water found in natural sources on Earth, except in rain water or ice, is in the form of a solution – such as **salt water** in the oceans and **mineral water** in rivers, springs, water and lakes. Minerals from the surrounding rocks are eroded and dissolved into the water.

Dissolving and melting.

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

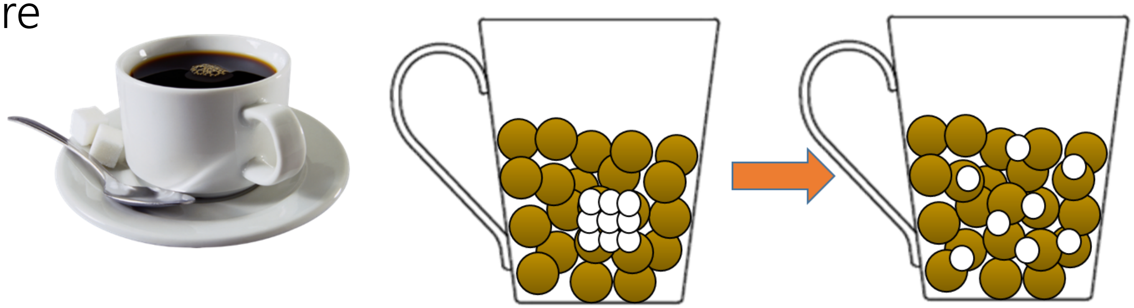
All Solids will **melt** into liquids if you apply enough **heat energy**



Heating adds more kinetic energy to particles

Particles will break free from each other to form a liquid

Some solids will **dissolve** into solvents to form a **solution**, which is a mixture



The solid sugar cubes are added to a cup of coffee (a mixture of water and coffee granules)

The coffee dissolves the sugar and the particles are spread throughout the solution

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 to 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.

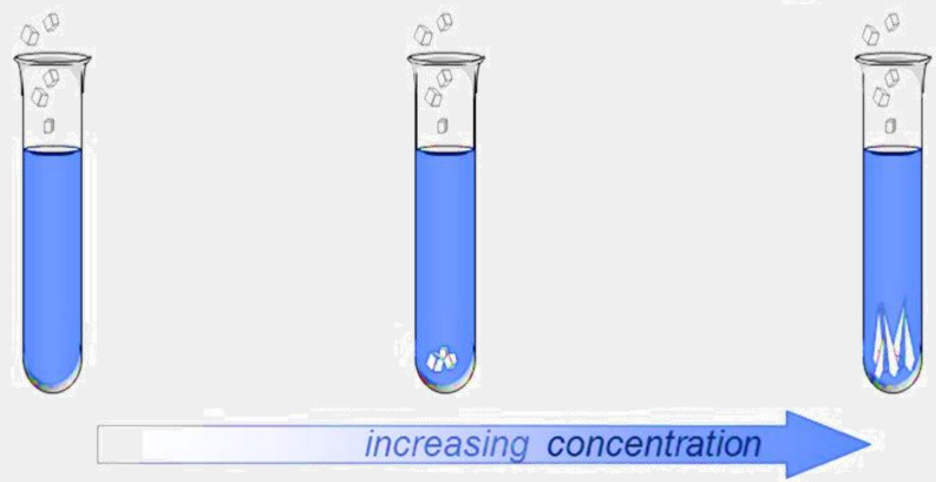
Background Knowledge

Saturated solutions

extra info

The amount of a solid (solute) that can be dissolved into a solvent to form a solution depends on the **solubility** of the substance. When a solvent can dissolve no more solute then the solution is known as **saturated**. If any more solute is added after this point then solids crystals begin to form.

Unsaturated solution	**Saturated solution**	**Supersaturated solution**
more solute dissolves	No more solute dissolves	Becomes unstable, crystals form



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Background Knowledge

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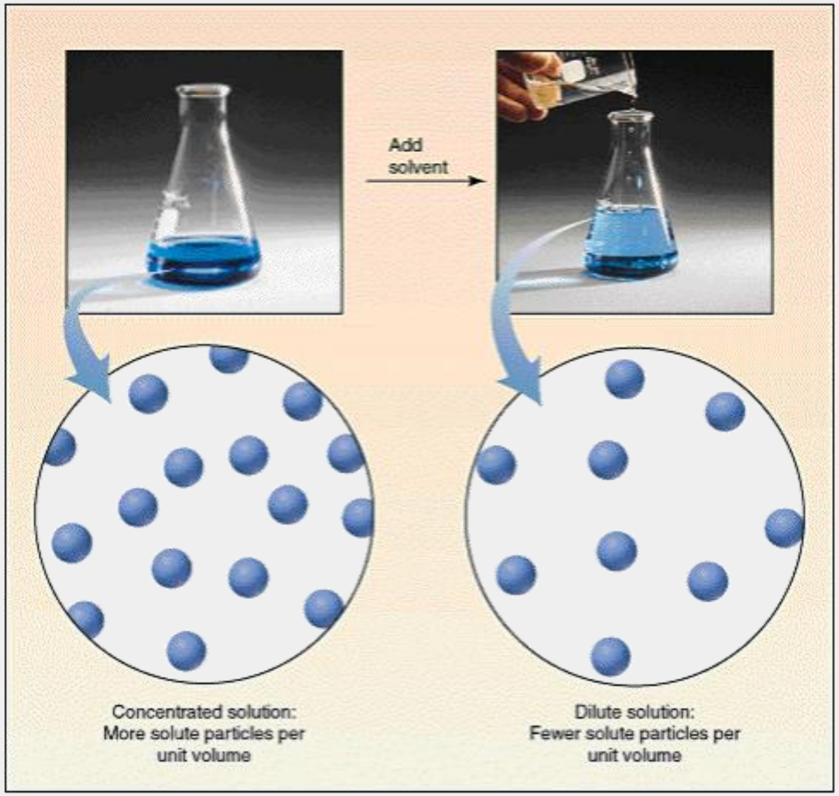
Concentration, dilution and saturation.

extra info

A solution becomes more **concentrated** as more solute is dissolved into the solvent. When a solvent can dissolve no more solute – and extra solute added remains as a solid – the solution is said to be **saturated.**

To **dilute** a solution more solvent is added – so there becomes fewer particles of solute dissolved into the solvent as a solution becomes more **diluted**.



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.

Background Knowledge

Mixtures are made up of different components

extra info

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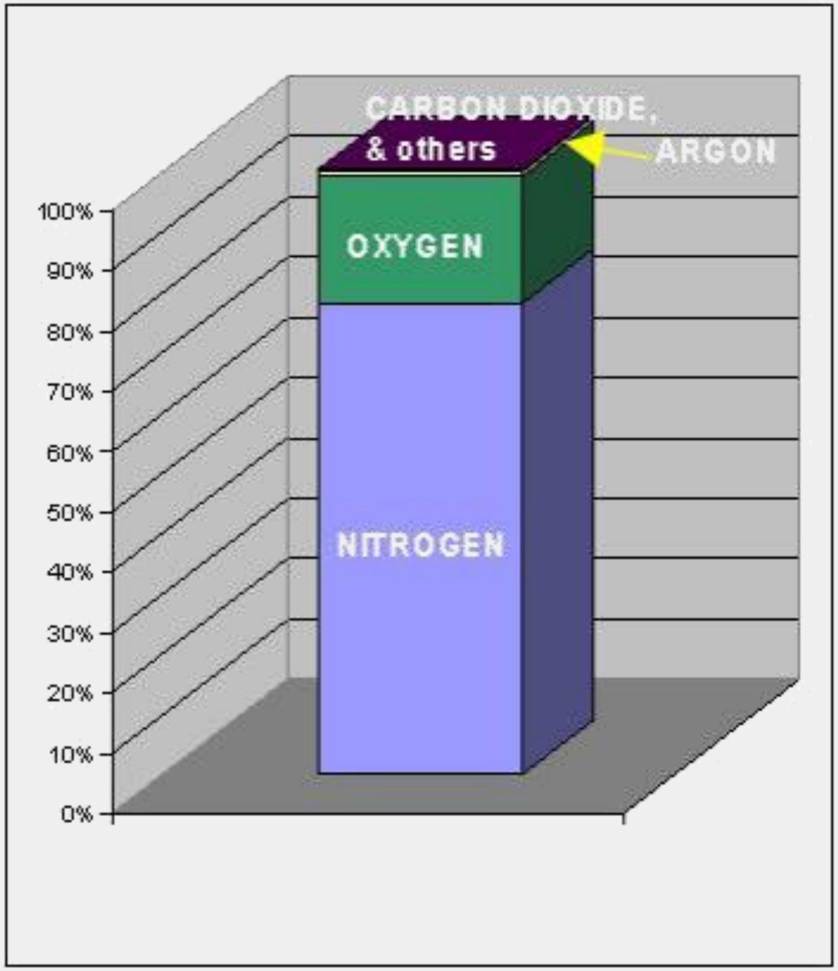
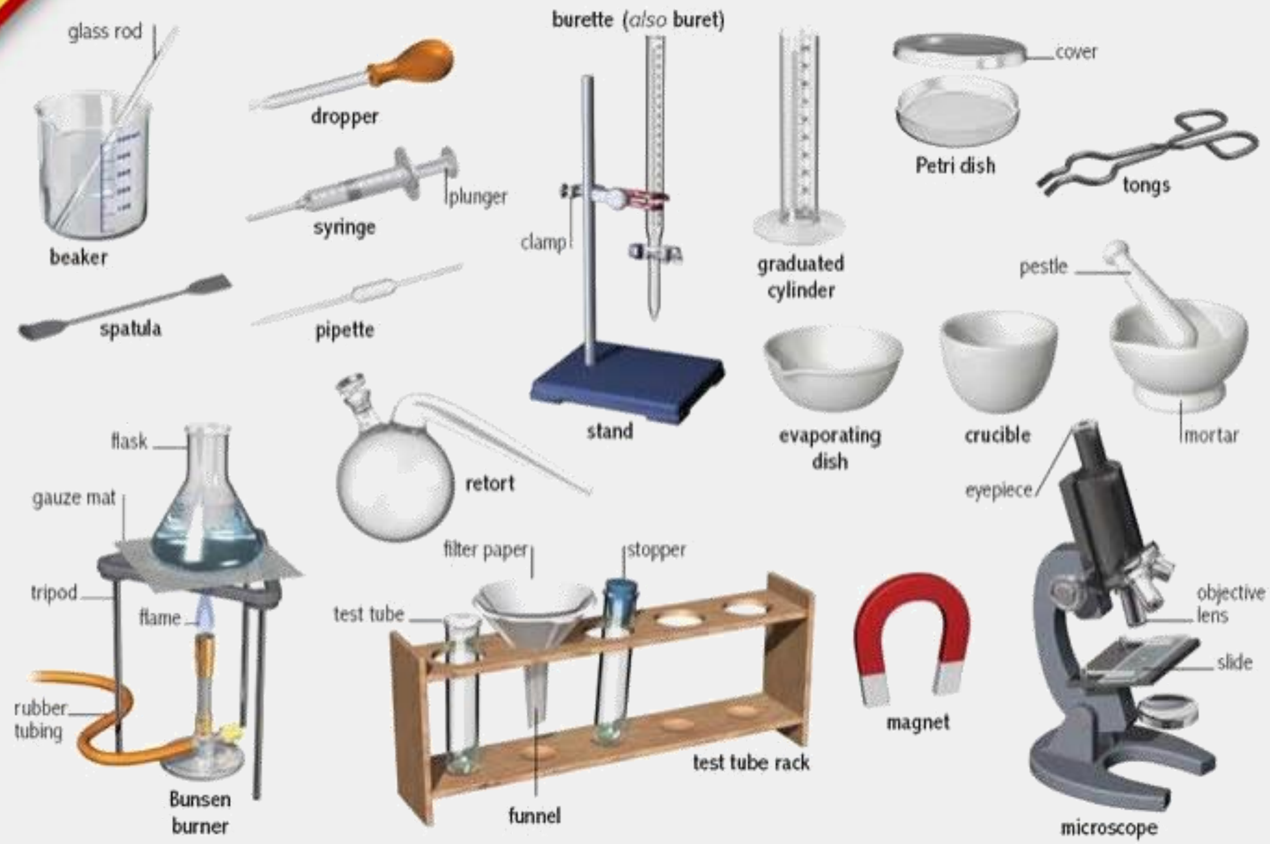
Mixtures can be **physically separated** into different components.
A common household example of a mixture could be a cup of white coffee. This mixture is made up of three major components: Milk, coffee and water. Milk itself is a mixture that can be further broken down into other components such as fat, protein, sugar and water

Components of air mixture



Background Knowledge

Common Laboratory equipment



Science labs contain equipment that are used to carry out separation of mixtures. You will need to remember the name and how to draw this equipment, using common equipment diagrams.

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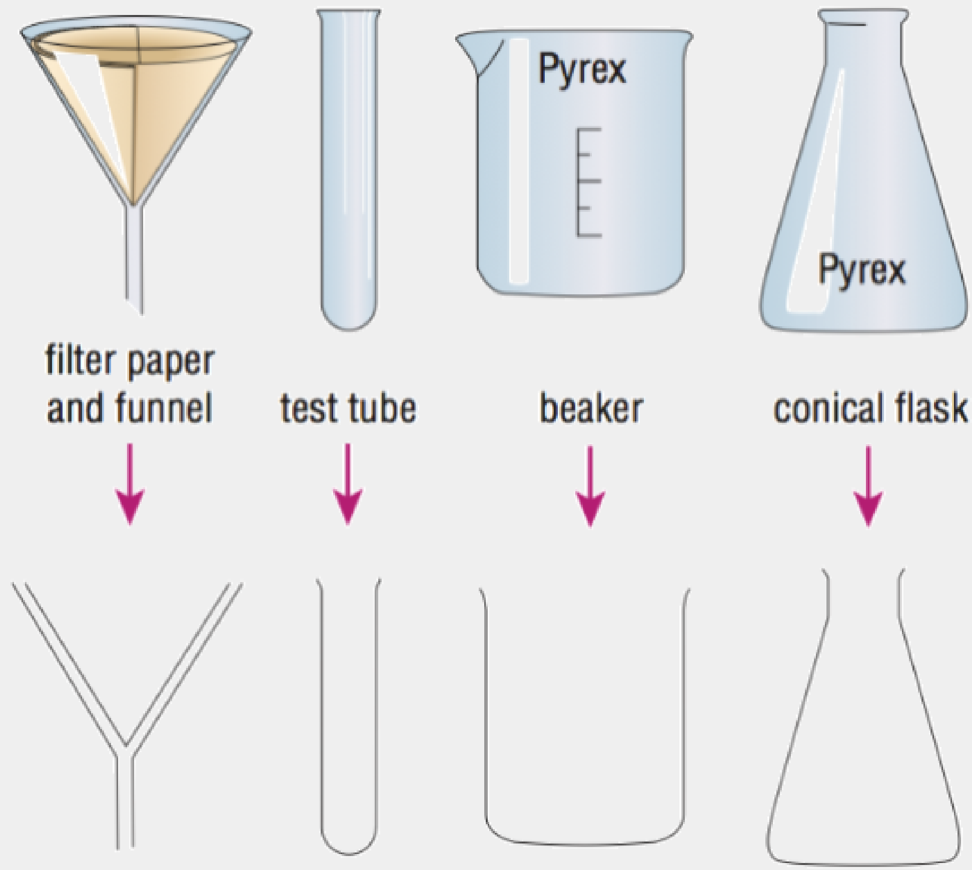
Background Knowledge

Drawing equipment in Science

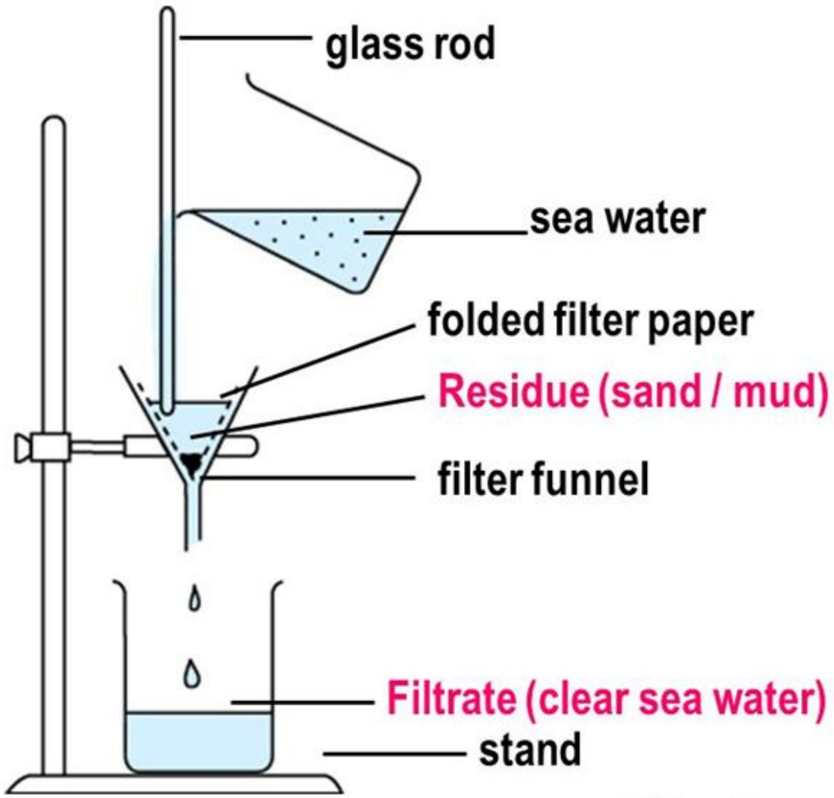


In the science lab we often we have to draw the equipment. We use diagrams to show the equipment, which saves us time drawing. The scientific diagrams are recognised world wide.

Mixtures can be easily separated physically using methods such as: 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 to 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



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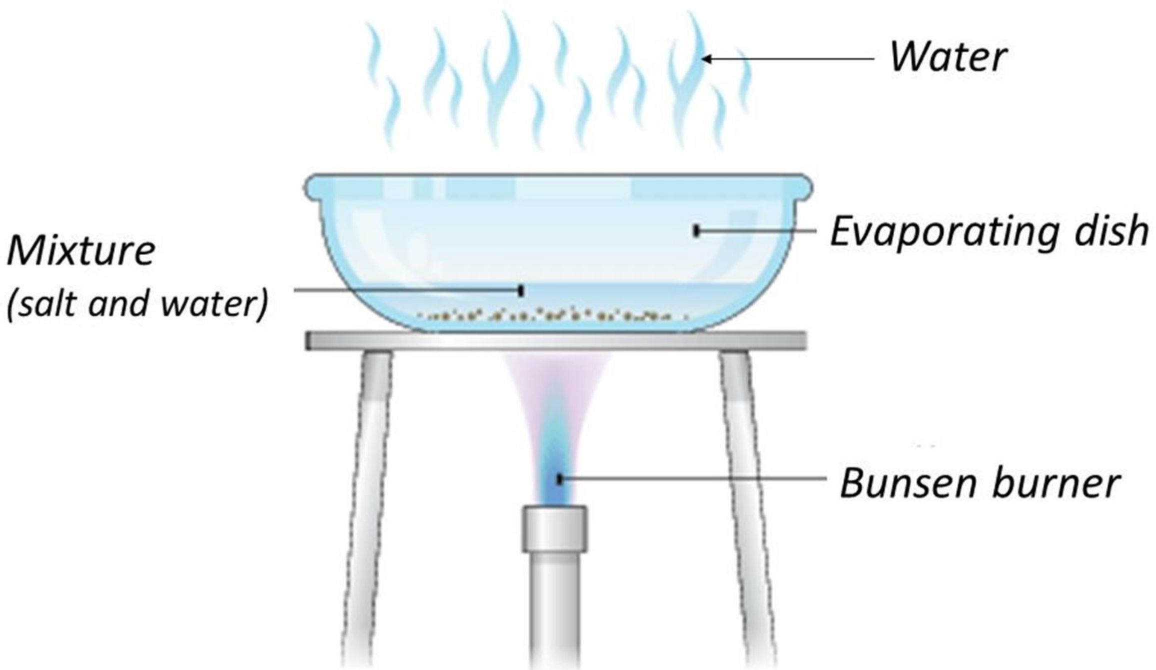
Mixtures can be easily separated physically using methods such as: dissolving

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.

Mixtures can be easily separated physically using methods such as: 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.

Mixtures can be easily separated physically using methods such as: Decanting

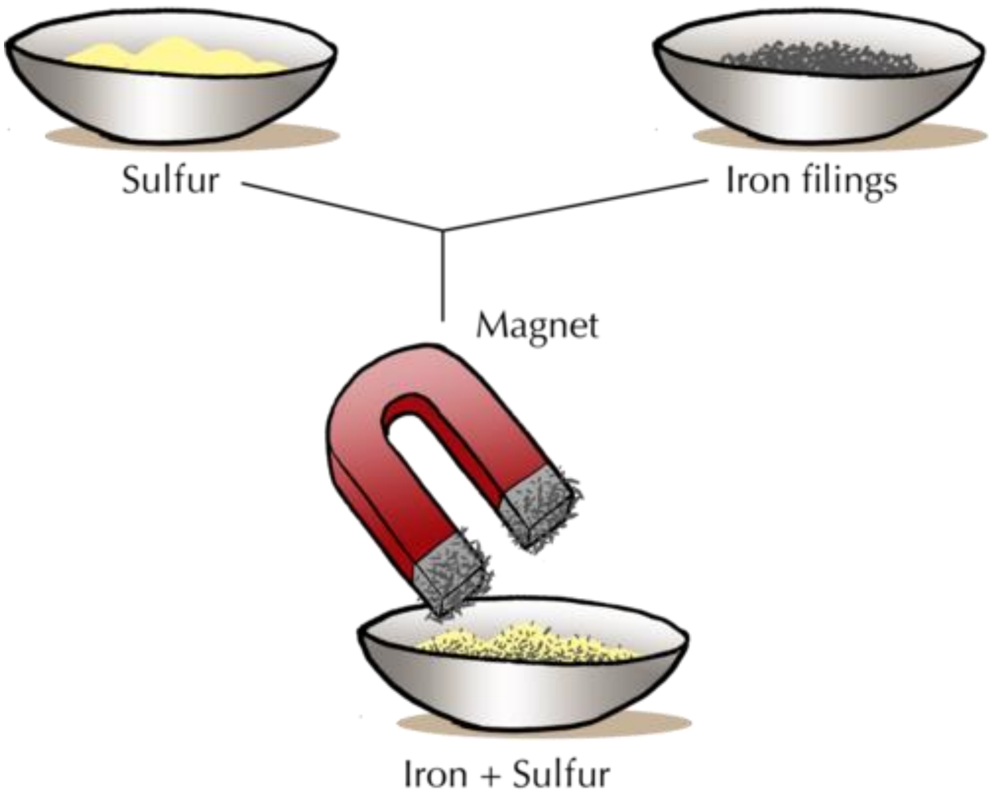
Decanting is simply pouring off a liquid without losing any of the more dense substance (usually an **insoluble solid**) in the bottom of the container. Decanting separates a **heavier substance from a lighter one**. Chemists are most often after the substance at the BOTTOM of the container.

Original mixture of a solid and liquid

Heavier solid is allowed to settle to the bottom

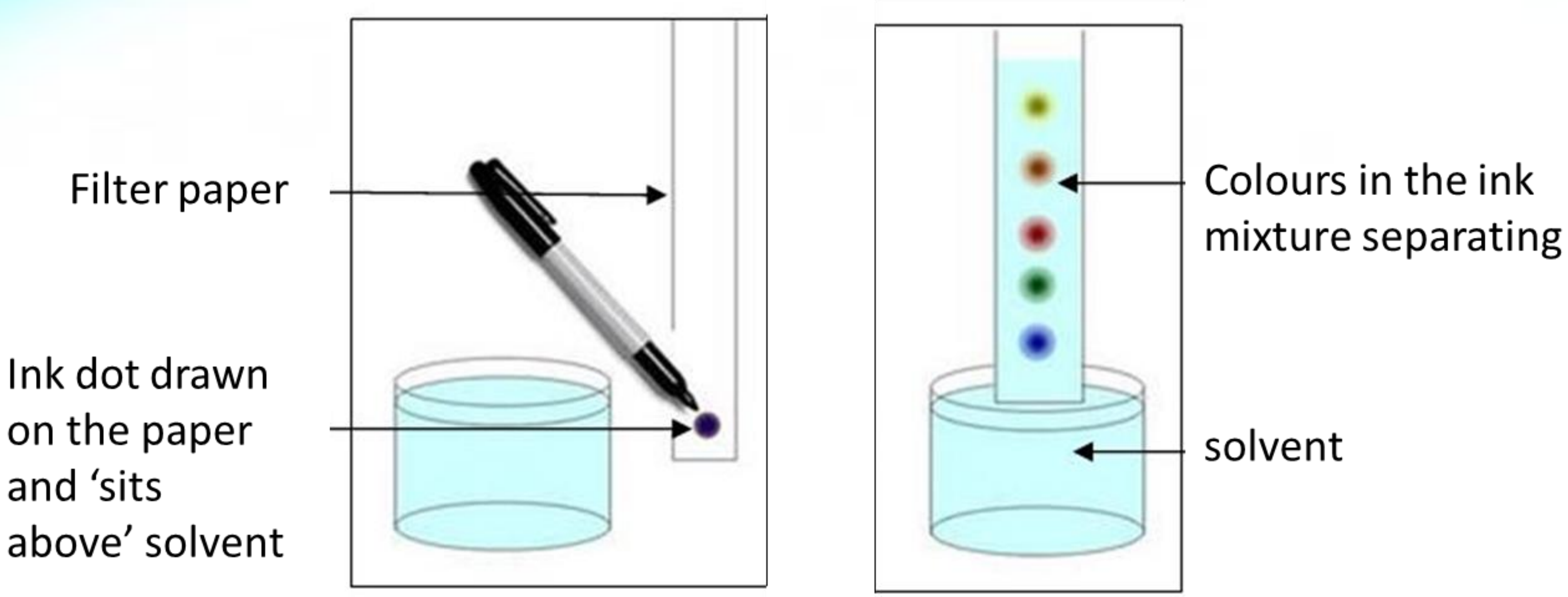
The liquid is poured off the top while the solid remains

Mixtures can be easily separated physically using methods such as: Magnetism



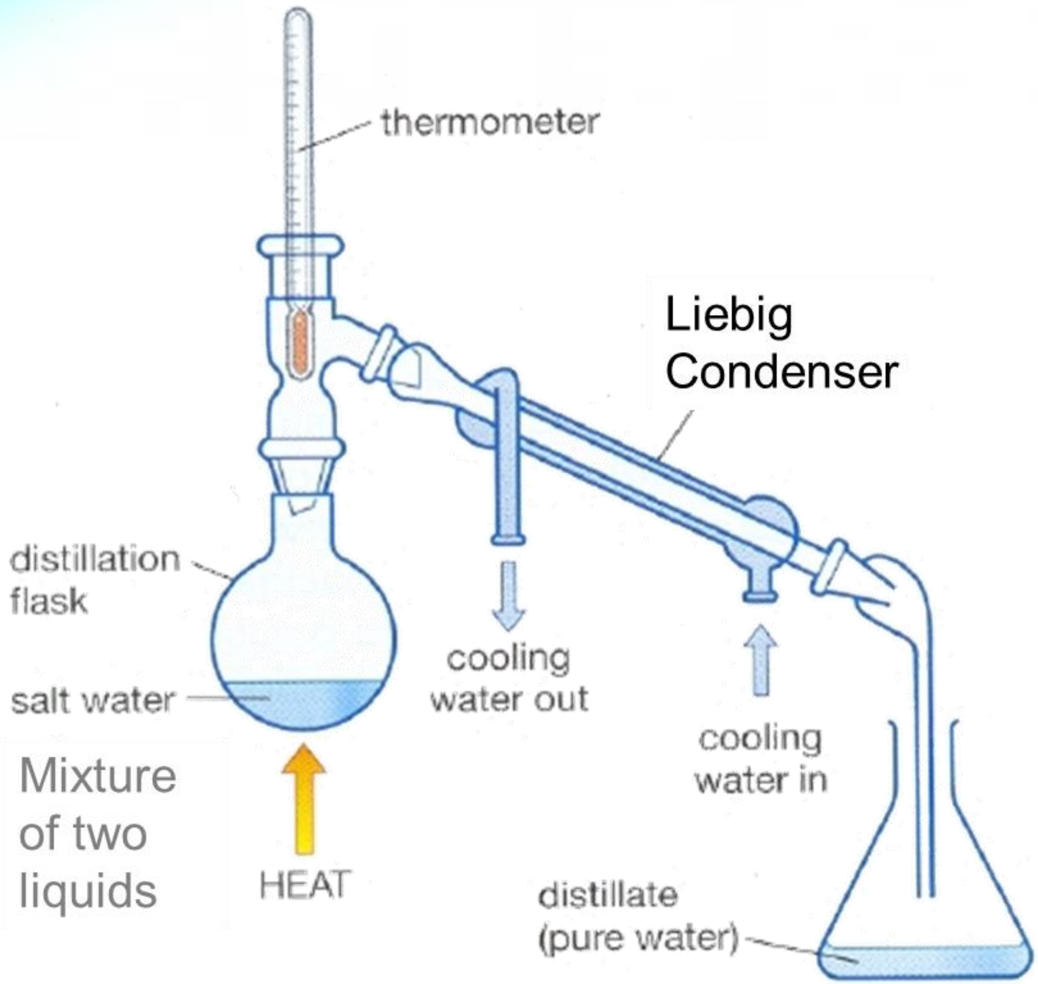
Magnetism can be used to separate a **magnetic substance** (such as iron) from a mixture containing **non-magnetic** substances (such as sulfur or sand).
The magnetic substance of the mixture is separated with the help of the magnetic attraction.
A magnet is moved over the mixture containing the magnetic 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.

Mixtures can be easily separated physically using methods such as: 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.

Mixtures can be easily separated physically using methods such as: 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 <u>Liebig Condenser</u> 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.

http://lookgoodandstudyhard.blogspot.co.nz/2015/12/chemistry-unit-2-experimental-techniques.html

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Mixtures can be easily separated physically

Separation technique	Property used for separation	example
Magnetic Attraction	magnestism	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

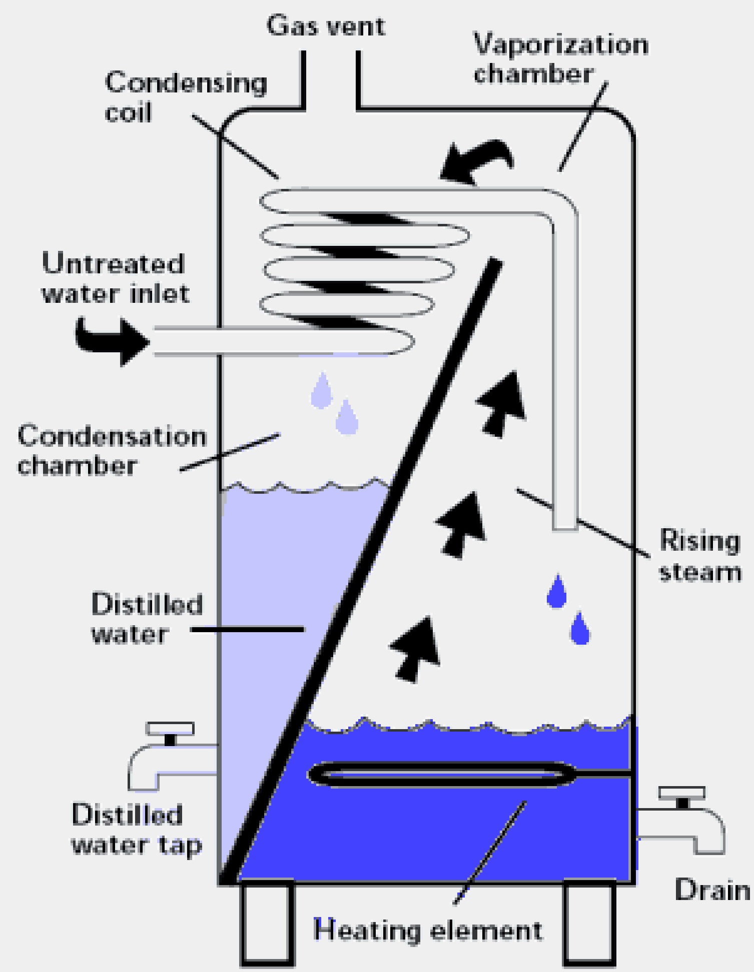
Background Knowledge

Separation processes can create substances that are useful for us

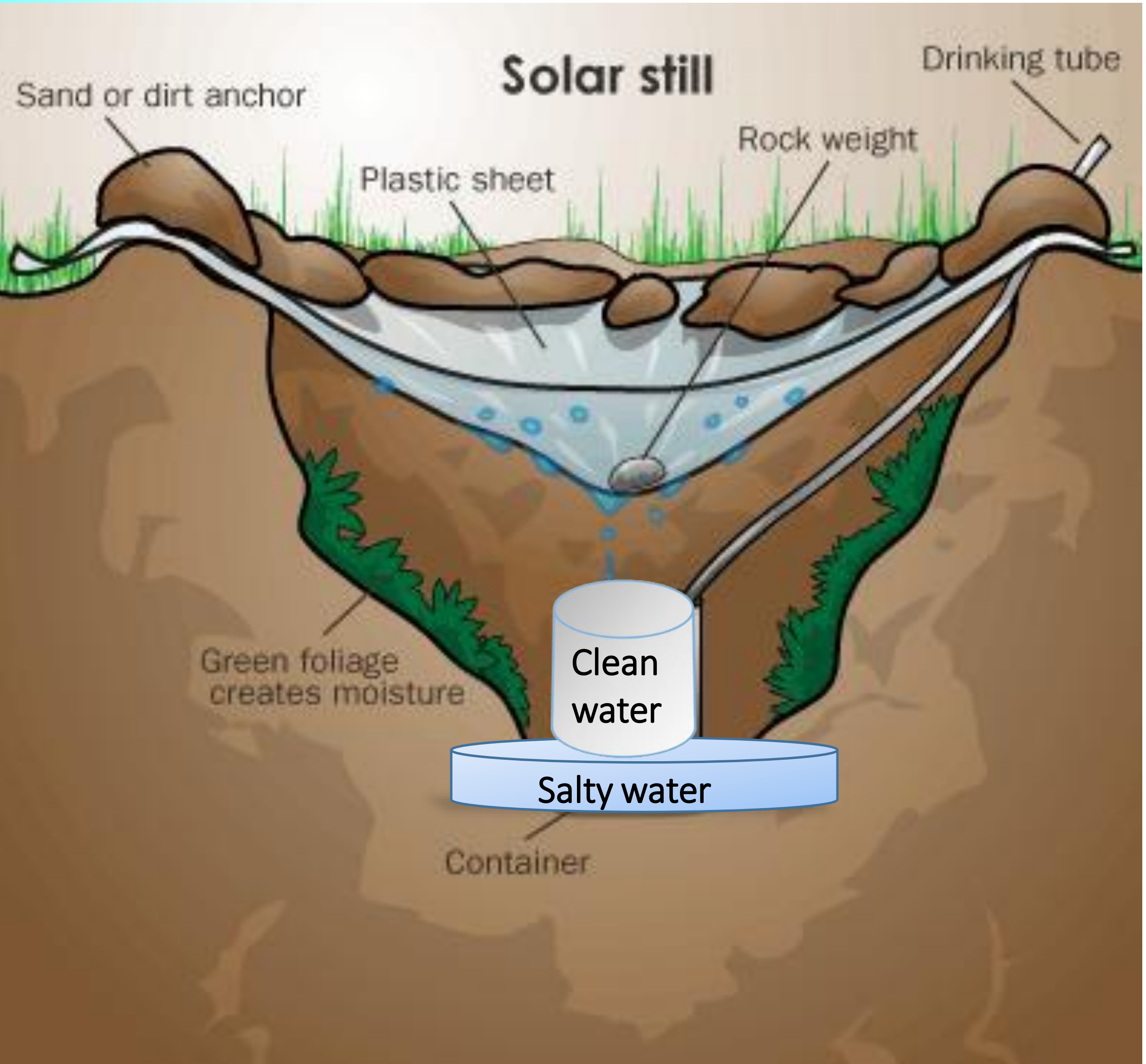
extra info

In areas that have a limited amount of fresh water but access to salty sea water a purification machine (as shown to the right) can be used to separate out the salt and other substances from the pure water that can then be drunk.

If we require the salt instead of the water we use the same starting solution of salt water. This time we evaporate off the water in large holding ponds and collect the salt deposits that remain.



Survival with a solar sill – making pure water from salty water



With a few pieces of equipment a **solar sill** can be made to produce clean drinking water.
A **hole** must be dug with a container of the salty water placed at the bottom.
Another **collecting container** sits on top with a straw leading out of it for drinking.
A **plastic sheet** covers the hole and is secured with rocks. A rock weight is placed on the sheet.
Water is **evapourated** from the salty water, **condenses** on the plastic sheet and drips into the collecting container.