11 Mixtures

What you will learn

It's a mixed up world

Separating mixtures

Solids in liquids

Separating solutions

To get the water back

What's in mixtures...

11a It's a mixed up world

Not many of the materials that we come across in our daily lives are made up of just one type of element or compound. The food we eat, the air we breathe and the milk we drink are all mixtures.

Many advertisements use the word 'pure' a lot. Pure orange juice is made only from squeezed oranges.

What does "pure' mean?

What is pure and what is not

Scientists use the word 'pure' in a slightly different way. Orange juice may be made from only oranges, but it is a complex mixture of compounds dissolved in water. Orange juice contains natural sugars, vitamin C and many other substances.

In Science, pure substances contain only one compound or element. All its particles are the same.

Almost all natural substances are mixtures of chemicals.

What particles would a bottle of pure water contain?

The air you breathe

The air you breathe is a mixture. It consists of elements such as nitrogen, oxygen and inert gases (e.g. helium, neon) as well as compounds such as carbon dioxide and water vapour.

Do you know?

98% of the Earth's crust is made up of just eight elements – oxygen, silicon, aluminium, iron, calcium, sodium, magnesium and potassium.

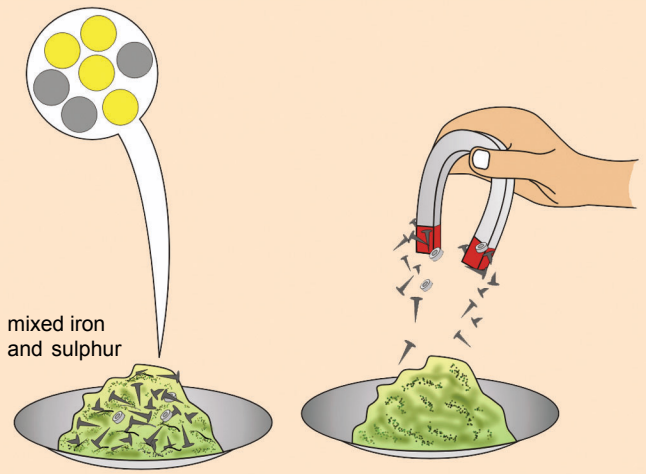
Mixing them up

Iron is an element. It is made from iron atoms only, and it has its own special properties.

Sulphur is an element. It is made from sulphur atoms only, and has its own special properties.

If you mix iron and sulphur, you mix up the iron and sulphur atoms. But the iron and sulphur still keep their special properties. You just have a **mixture** of iron and sulphur.

How could you separate the iron from a mixture of iron and sulphur?



Naturally pure

Is anything naturally pure? The answer is not much! Rainwater in pollution-free areas is almost pure water, but even this contains some dissolved carbon dioxide, oxygen and nitrogen.

White sugar and salt are almost pure substances. Sugar is found mixed up in the sap of sugarcane. Before you use them, they are separated out from their natural mixtures by physical processes such as dissolving, filtration and evaporation.

1 Fill in the blanks using the following words.

particles	**mixtures**	**different**
pure	**same**	

If a substance is ....., it contains only one chemical compound, so all its particles are the ..... Most natural substances are ..... They are made up of ..... chemical compounds, with their different .... all mixed together.

Explain why mineral water is not pure in the scientific sense.

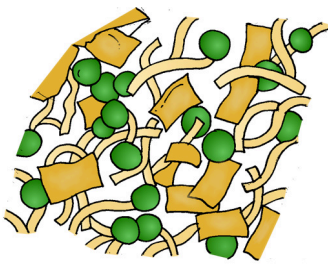
Ideas

- *In nature, most substances are mixtures.*
- *In Science, a pure substance contains just one chemical compound or element.*
- *In a pure substance, all the particles are the same.*
- *A mixture has the properties of the substances that make up the mixture.*

11b Separating mixtures

How do you separate a mixture?
Decide how you would separate:

- the green peas
- the pieces of noodles from the soup
- the different coins.



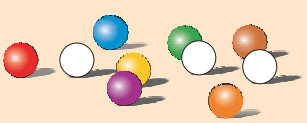
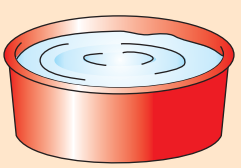
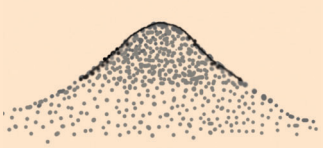
Sorting by size

If you had a mixture of rice and sand, you could pick the rice out, grain by grain but that would take ages. There is a faster way to separate them. Rice grains are larger than grains of sand, so you could put the mixture through a sieve.This lets the sand through but not the rice.

Other types of sorting

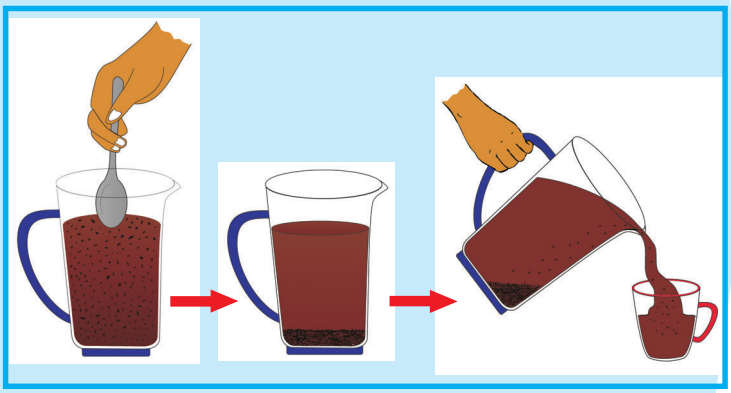
To separate mixtures, you need to find a difference between the mixed substances which you can use to separate them out.

Use the information to work out how to separate:

			What a mix - up!	Helpful hints
1	**snooker balls** size about 4cm sink in water various colours	**ping - pong balls** size about 4cm float in water white		
2	**iron filings** grey sink in water magnetic	**copper filings** brown sink in water non-magnetic		

Solids from liquids: decanting

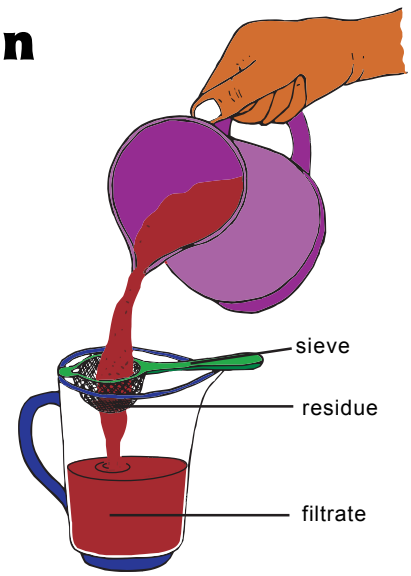
How do you make tea at your home? Some people use tea bags while others use tea packets where you need to put tea into the kettle. In this case if you left the kettle for sometime, most of the tea would settle at the bottom of the kettle. This is called **sediment**. If you are careful, you can pour the clear tea off, leaving the solid behind. This method of separation is called **decanting.**



Solids from liquids: filtration

After the tea has been decanted, it is often still not very clear. There are still some tea mixed up with the liquid. These are in **suspension.**

They can be separated out using a sieve with very tiny holes. The liquid can get through the holes, but any solids in suspension are trapped. This process is called **filtration.** The solid left behind in the sieve is the **residue**. The clear liquid in the cup or the mug is the **filtrate**.



1 Peas are green and sand grains are offwhite. Why can't you use this difference to separate peas and sand?

2 A car engine will not work properly if dust or dirt gets mixed up with the petrol. The petrol going to the engine passes through a container filled with matted fibres.

a. What is this for?

b. How does it work?

Ideas

- *Solids of different sizes can often be separated through a sieve.*
- *If a mixture of liquid and solid settles out, the liquid can be decanted off.*
- *Solids can be filtered out of liquids.*

11c Solids in liquids

Gardens are often sprayed with a special mixture to protect them from disease. Gardeners make this spray by mixing a substance with water.

Solid copper sulphate comes in beautiful blue crystals. Sometimes these crystals are mixed with water and lime and they are sprayed to the field to prevent from disease.

These crystals seem to disappear when you mix them with water, but water turns into a blue solution. So copper sulphate must be there. What do you think happend?

Dissolve it

Copper sulphate **dissolves** in water and makes a **solution**. This makes it easy to spray onto the leaves. Substances that dissolve in water to form a solution are described as soluble. The liquid is called the **solvent** and the solid is called the solute. Copper sulphate is soluble in water. Water is the solvent and copper sulphate is the solute.

How much copper sulphate could you dissolve in water? Could you go on adding more and more, making the solution stronger and stronger?

The answer is no. You would eventually find that no more copper sulphate would dissolve, no matter how long you stirred the mixture. When this happens, the solution is **saturated.**

What dissolves?

Everything does not dissolve in water. A lot of things, such as chalk and oil, will not dissolve. They are **insoluble.**

Think of solids that are soluble and insoluble.

Dissolve it..... slowly or faster

If you drop some cubes of sugar into water and leave them alone, you can watch them dissolve. The crystals will slowly dissolve. It would take a lot of time to dissolve it completely.

Fortunately, you can make things dissolve faster. You can speed up the process.

1 Heat it up. Heat makes solids dissolve faster.

2 Shake or stir the mixture. This mixes the solid with the liquid faster.

3 Crush it. Small peices of solid dissolve faster than large ones.

1 Copy the following and match the correct word to its description. One has been done for you.

the solid that dissolves	**insoluble**
the liquid that does the dissolving	**solution**
It will dissolve	**solute**
it's completely full with solid	**soluble**
It will not dissolve at all	**solvent**
a liquid with solid dissolved in it	**saturated**

Ideas

- *Some solids **dissolve** in water to form a **solution.***
- *The water is the **solvent,** and the solid is the **solute.***
- *The solution is called a saturated solution if no more solid will dissolve.*
- *There are ways you could speed up dissolving.*

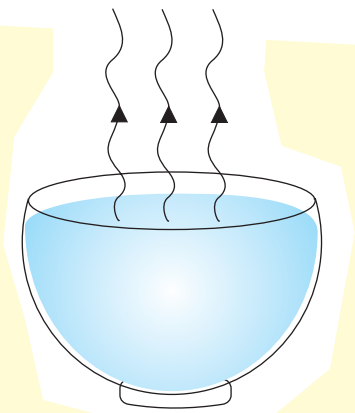
11d Separating solutions

When it rains, everything gets wet. But if it stops raining and the sun comes out, everything dries up again. Where does all the water go?



Evaporating out

Water can slowly turn into a gas at any temperature. If you leave water in an open bowl at home, some of the water turns to a gas called **water vapour** and mixes with the air. This process is called **evaporation.**



Evaporation dries up puddles, and dries out clothes on the line. The hotter it is, the faster evaporation happens.

Evaporation is useful

When salt dissolves in water, the salt particles are far too small to be filtered out by filter paper. The sea contains salt in solution. How can you get the salt out?

The simplest way is to let the water evaporate away. When water gets lost the salt particles would join back together and crystals start to grow. It's like dissolving in reverse.

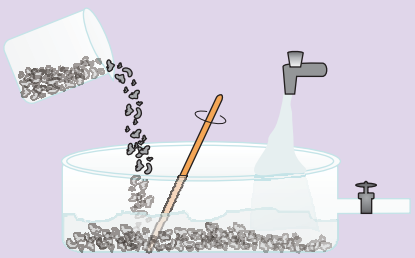
Pure salt by other methods

In some countries salt is dug from underground mines. The rock salt that is dug up is mixed up with sand and clay. How can it be separated?

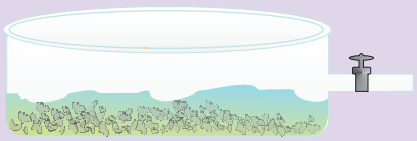
A useful difference between salt, sand and clay is that only the salt is soluble in water. This difference is used to purify the salt.

The purification stages

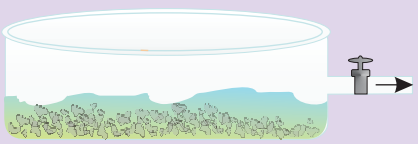
Here are the stages that are used to purify rock salt.



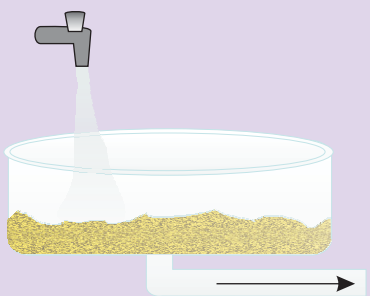
Stage 1 The rock salt is mixed with water.



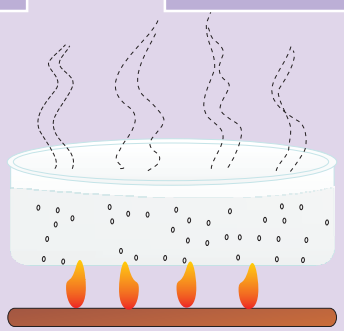
Stage 2 The mixture is allowed to stand.



Stage 3 The liquid is run off.



Stage 4 The liquid is filtered through fine sand.



Stage 5 The liquid is heated.

1. Have you ever used washing machines to spin-dry your clothes? What is being separated in this case? How is it done?
2. Think of a way how you could get fresh water from sea water.
3. Where does the water go when a rain puddle dries up in the sun?

Ideas

- *Water will slowly evaporate into the thin air.*
- *Evaporation happens faster if the water is heated.*
- *If a solution is allowed to evaporate, the solute is left behind.*

11e

To get the water back

Evaporation is a good way to get the salt back from a salt solution. But what if it is the water you want? How could you get that back?

There is a clue. You can see the answer in a glass of very cold water on a hot day .....

Condensation

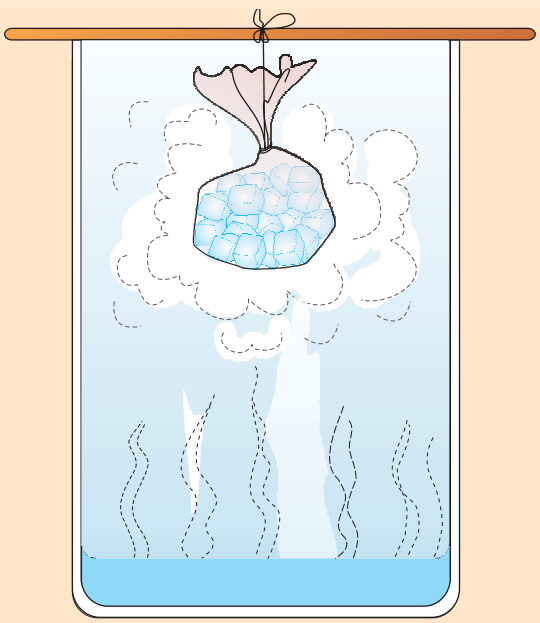
Evaporation is a good way to get the salt back from a salt solution. But what if it is the water you want? How could you get that back?

Water vapour in the air is invisible. On a hot day this vapour is hotter than the water that you put in the glass. Some of the water vapour that is nearer to the glass cools slightly and some of it turns back into tiny droplets of water. It **condenses.**

Make your own clouds

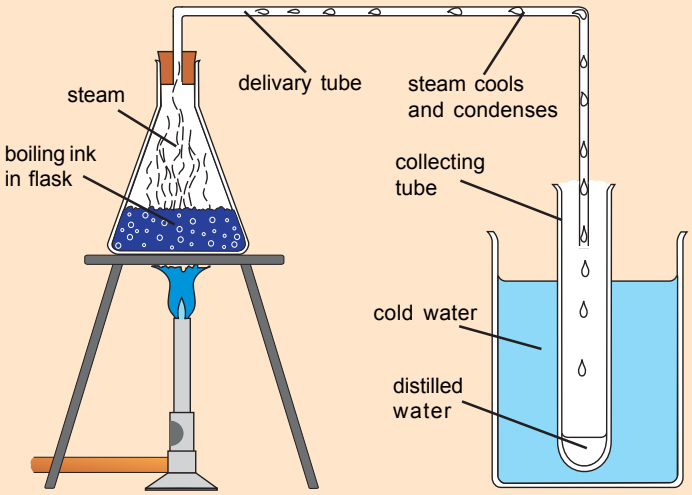
Water vapour in the air cools and condenses as it rises above the land or sea.

You can make your own clouds in a tall jar. Just hang a bag of ice over some very hot water.



Collecting water

The warmer water is, the faster it evaporates. You can turn all the water into a gas (water vapour) if you heat the water until it bubbles and boils.
To get the water back, you collect the gas and cools it, so that it condenses back to liquid water. This process of boiling and condensing water is called **distillation**.
The pure water that is collected is called **distilled water**.
What do you think is the purpose of the beaker of cold water?

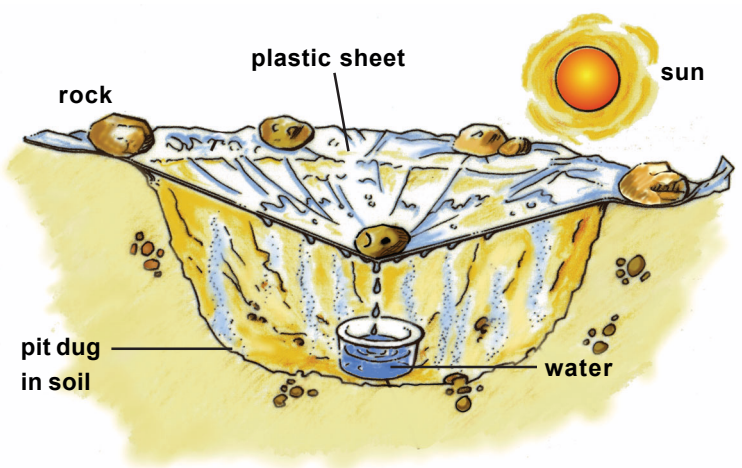


What happens if you get lost?

Imagine you are lost in a desert with no water and nothing but a clear plastic sheet and an empty jar.

No need to fear! The soil contains some moisture even in the desert. The heat from the sun can be used to collect this moisture.

See if you could explain what happens.



1 Fill in the blanks using the following words.

water vapour		**liquid**	**boil**
evaporation	**condenses**		

Water can slowly turn into a gas at low tempera ture by ..... If you keep heating, the water starts to ..... .
A lot of .... escapes into the air.
If it is cooled, it ..... and turns back to ..... water.

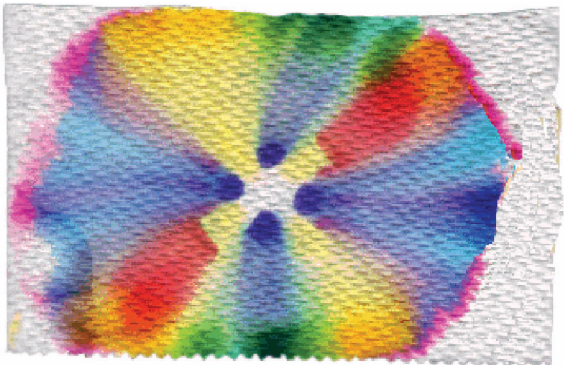
Ideas

*Water vapour in the air can **condense** back to form liquid water if it is cooled.*

*Pure water can be collected from a solution by **distillation**.*

11f

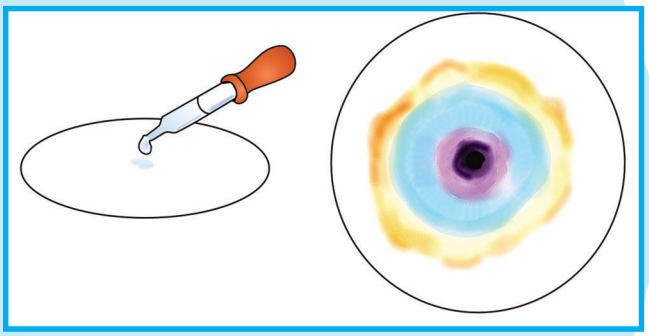
What's in mixtures..



Have you ever got wet in the rain on the way to school?
Have you ever spilt water onto your exercise book?
Sometimes the ink dissolves in the water and makes a mess.
Sometimes it also forms lots of different colours.
Why does this happen?

Chromatography

Chromatography is used to separate and identify the different coloured components in dyes or inks.



If you put a drop of mixed ink onto filter paper and add water drop by drop, the water spreads out into the filter paper, spreading the ink with it. But the dyes in the ink do not move at the same speed. Some move as faster as the water, while some stays behind or move much slowly. The result is the dyes separate into a series of coloured rings. This process is called **chromatography.**

Chromatography at everyday life

It is often used to test a substance for purity and is also widely used in the testing of dyes in food and other industries.

Chromatography is very useful in scientific research because it gives quick results. It is easy to handle and requires very small amounts of the mixture.

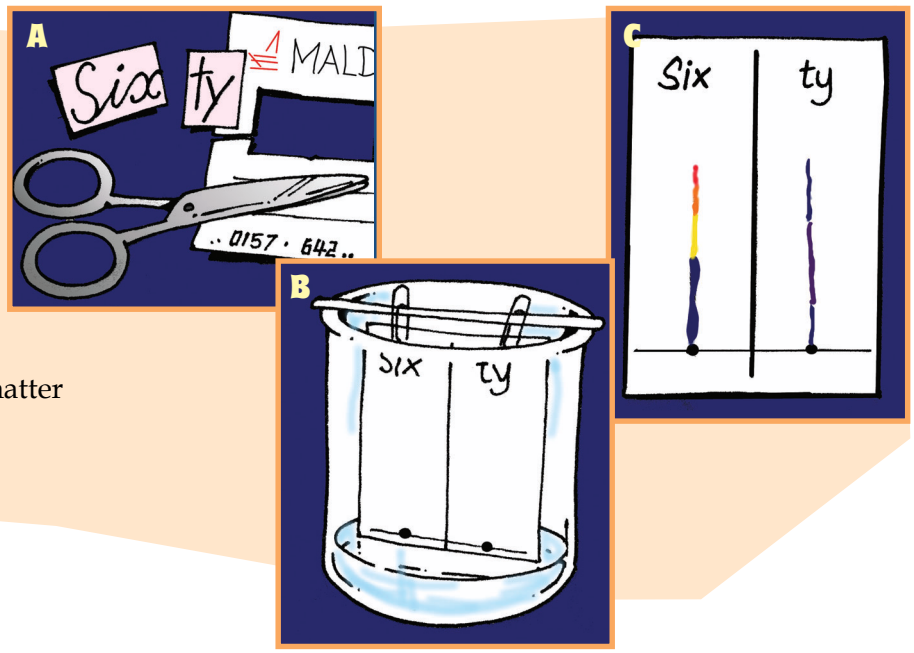
Do you know?

Smog is a mixture of fog and smoke particles. Smog used to be a big problem in British cities. Over 20,000 people died in one week during a bad smog in 1925. Now there are laws to control smoke emissions. Smog is no longer a problem in Britian.

Be a detective

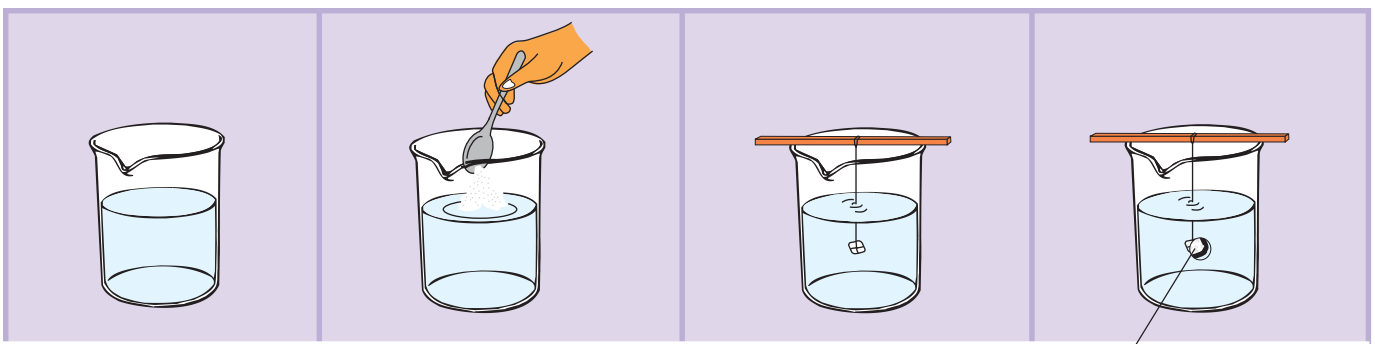
Inspector fauzee thinks that this cheque has been faked. Sombody has changed six to sixty. The black ink looks the same, but perhaps the ink is different.

How can you investigate the matter using the chromatography?



Crystallisation

Crystallisation is used to separate a soluble solid from its solution. Using this method, the solid is obtained in the form of crytals.



Sugar solution.	Add more sugar until it is saturated.	Suspend a sugar cube in the solution.	Sugar crystals grow around the cube when the solution cools.

1 Fill in the blanks using the following words.

speeds	**chroamtography**
separates	**dyes**

When water soaks up into paper, it carries any soluble ..... with it. The different dyes are carried along at different ..... This ..... out the diferent dyes. The pro cess is called ..... .

Ideas

- *You can separate out mixtures of dyes using chromatography.*
- *Chromatography can be used to identify the dyes in a mixture.*

Jabir ibn Haiyan

Died 803 C.E

Father of modern chemistry

Jabir Ibn Haiyan, the alchemist Geber of the Middle Ages, is generally known as the father of chemistry. Abu Musa Jabir Ibn Hayyan, sometimes called al-Harrani and al-Sufi, was the son of the druggist (*Attar*).

In his early days, he practised medicine and was under the patronage of the Barmaki Vizir during the Abbssid Caliphate of Haroon al-Rashid.

Jabir's major contribution was in the field of chemistry.

He introduced experimental investigation into alchemy, which rapidly changed its character into modern chemistry.

His contribution of fundamental importance to chemistry includes perfection of scientific techniques such as crystalization, distillation, calcination, sublimation and evaporation and development of several instruments for the same. The fact of early development of chemistry as a distinct branch of science by the Arabs, instead of the earlier vague ideas, is well-established and the very name chemistry is derived from the Arabic word *al-Kimya*, which was studied and developed extensively by the Muslim scientists.

Several technical terms devised by Jabir, such as alkali, are today found in various European languages and have become part of scientific vocabulary. Only a few of his books have been edited and published, while several others preserved in Arabic have yet to be annotated and published

His various breakthroughs e.g., preparation of acids for the first time, notably nitric, hydrochloric, citric and tartaric acids, and emphasis on systematic experimentation are outstanding and it is on the basis of such work that he can justly be regarded as the father of modern chemistry.

He made several astronomical observations, and devised a device similar to the vernier, to increase the precision of instrumental readings. In physics, his contribution comprised the study of different forms of energy, heat, light and mechanical, and such concepts as force, vacuum and infinity.