

Kept in suspension

There are many ways of separating mixtures in a laboratory. Some methods are simple and quick and others need expensive equipment and take some time.

No matter how hard you try, you can't dissolve sand in water; sand is insoluble. If you shake up the sand and water in a sealed jar, the sand spreads through the water, forming a cloudy **suspension**. When you stop shaking the jar, the particles of sand are suspended in the water briefly, but they soon settle to the bottom, forming a **sediment**. Muddy water is also a suspension, but most of the particles in mud are smaller than sand particles so it takes much longer for them to settle to the bottom. Some insoluble substances don't form suspensions but float on top of the liquid.

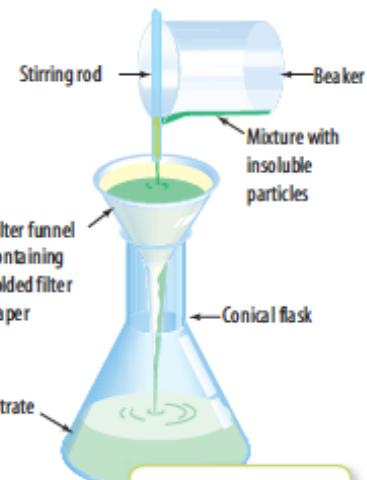
What do a vacuum cleaner, tea strainer and protective face mask have in common? They are all devices for separating particles from suspensions by **filtration**. In the laboratory, filtration is carried out using filter paper, but there are many other useful methods of filtration that are used in the home and in industry. In filtration, solutions, solvents or gases pass through the filter but particles that cannot fit through the filter are trapped by it. Insoluble particles can be separated from a mixture using filter paper in a funnel as shown on the right.



- (a) A face mask filters dust from the air.
- (b) A car air filter removes dust particles from the air.
- (c) A vacuum cleaner contains a filter bag which traps the dust as air is sucked through it.
- (d) A food strainer separates the chips from the oil.

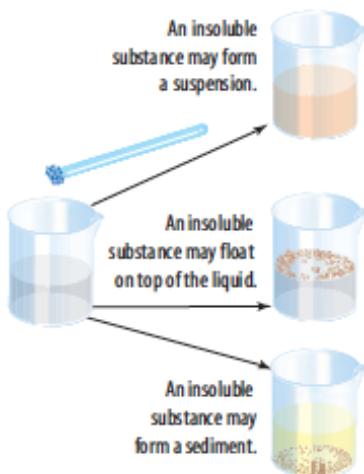
Sift and separate

The particles of solutes dissolved in a solution are so small that they can't be seen, and they can't be separated from a solution by filtration.



Equipment used to filter a mixture that contains insoluble particles

Adding an insoluble substance to a liquid



Sink or float: mixing solids with liquids

WHAT DOES IT MEAN?

The word **residue** comes from the Latin word **residuum**, meaning 'left over'.

The word **aqueous** comes from the Latin word **aqua**, meaning 'water'.

INQUIRY: INVESTIGATION 5.4

Filtration in the laboratory

KEY INQUIRY SKILL:

- processing and analysing data and information

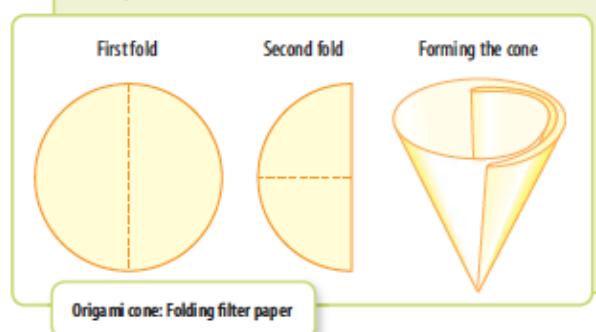
Equipment:

100 mL beaker funnel filter paper
glass stirring rod conical flask
insoluble substance, such as soil, chalk dust or charcoal

- Half fill your 100 mL beaker with water.
- Add your insoluble substance to the water and stir with the stirring rod.
- Set up the equipment for filtering as shown in the top diagram on the previous page.
- Fold the filter paper as shown in the diagram below.
- Place the filter paper in the funnel and moisten with clean water to hold the filter paper in place.
- Pour your mixture into the filter paper.

DISCUSS AND EXPLAIN

- Describe the appearance of your mixture in the beaker before filtration. Did it form a suspension or sediment, or float on top?
- The liquid passing through the filter into the conical flask is called the **filtrate**. Describe your filtrate.
- Examine your filter paper. The material trapped by the filter paper is called the **residue**. Describe your residue.
- Filter paper is like a sieve with small holes in it. Explain how the filter paper worked like a sieve in this experiment.



More mixtures

Some mixtures are neither solutions nor suspensions. A mixture that contains suspended particles too small to settle or be removed by filtering is called a **colloid**. Unlike solutions, which are clear, colloids are cloudy. Colloids can be formed by solids, liquids or gases. Examples of colloids include mist,

cappuccino froth, whipped cream and paint. An **emulsion** is a colloid in which one liquid is spread evenly through another and the liquids don't settle out into layers. Homogenised milk and mayonnaise are examples of emulsions.

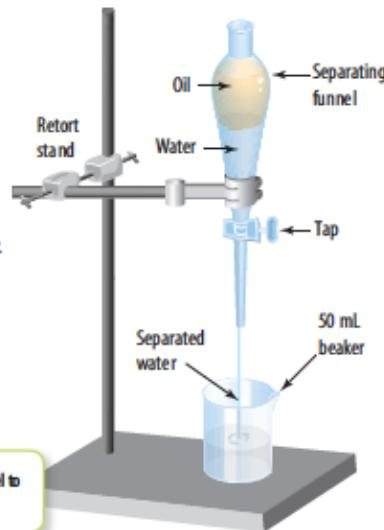
Settling down

There are a number of ways of separating mixtures that are not solutions. The simplest method of separating a mixture of a liquid and an undissolved solid is **decanting**. The solid is allowed to settle to the bottom of the container, forming a sediment. The liquid is then carefully poured off the top. Decanting can be used to separate most of the mud from muddy water. After the mud has settled, the water can be poured off. If the water is still cloudy, it can be filtered to remove the remaining undissolved particles.

Aboriginal Australians combine **sieving** (a type of filtration) and decanting to prepare native yams, which contain a poison. The yams are boiled and placed into a dilly bag. The bag is squashed and the softer parts of the yam are strained through the bag into a can of water. The bag acts as a sieve, allowing some substances to pass through but not others. The skins and harder parts of the yam that are left in the bag are thrown away. The water is decanted from the can, and repeated washing with water removes more poison. The yam is then placed into another dilly bag and hung up overnight before being ready to eat.

The separating funnel

When one liquid does not mix with another but floats on top of it, a **separating funnel** can be used to separate the two liquids. Oil floats on water. This mixture can be separated using a separating funnel as shown on the right.



Using a separating funnel to separate oil from water

Centrifuging

A mixture can be separated by spinning it very quickly. This method is called **centrifuging**. The spin-dry cycle of a washing machine acts as a centrifuge and a filter. As it spins at high speed, the clothes are forced to the sides of the tub and the water passes out through the holes in the tub. The clothes cannot fit through

the holes and so much of the water is removed from them.

In the laboratory, centrifuging is used to separate solid or liquid substances from liquids. The mixture is placed in special test tubes that are spun in a circle at high speeds. The heavier substances are forced to the bottom of the tube and the lighter substances are left near the top.

WHAT DOES IT MEAN?

The word *centrifuge* comes from the Latin words *centrum*, meaning 'centre', and *fugere*, meaning 'flee from'.



eLesson



Centrifuging

Learn how to separate a solid from a liquid using a centrifuge in a step-by-step process as a scientist demonstrates how to separate lead oxide from water.

eles-0061

UNDERSTANDING AND INQUIRING

REMEMBER

- 1 Replace each of the following expressions with a single word.
 - (a) Liquid in which a substance dissolves
 - (b) Insoluble particles dispersed in a liquid
 - (c) Liquid passing through filter paper
 - (d) Substance that dissolves in a liquid
 - (e) What is formed when a solute dissolves in a solvent
 - (f) Material deposited on a filter
 - (g) An insoluble substance that sinks to the bottom
- 2 Describe what happens to a suspension if it is left to stand.
- 3 How can you distinguish a colloid from:
 - (a) a suspension
 - (b) a solution?
- 4 Which types of substances mix with each other to form emulsions?

THINK

- 5 The drawing on the left of page 185 shows a variety of commonly used filters. Think of some other filters used in the home. Construct a four-column table like the one below to describe the filters.

Filter	Mixture	Residue	Filtrate
Vacuum cleaner	Air and dust	Dust	Air
Food strainer	Chips and hot oil	Chips	Oil

- 6 The air filter and oil filter in a car engine have to be replaced occasionally. Why do you think this is done?

- 7 List some examples of separating mixtures in the kitchen using:
 - (a) filtration
 - (b) decanting.

IMAGINE

- 8 You are out in the bush and the only water available to drink is in a muddy waterhole. You have an empty bottle and a cup. How would you remove the dirt from the muddy water so that you could drink the water?

INVESTIGATE

- 9 The kidneys act as filters to remove wastes from our blood. Find out more about how the kidneys filter wastes from the blood.
- 10 What types of paper can be used to filter a suspension? Carry out an investigation that tests a variety of different papers (such as newsprint, tissue paper, brown paper, kitchen towel and so on) for their suitability as filter paper. Write a report on your findings.
- 11 An oil spill at sea can ruin the local environment and kill wildlife. Find out when and where the worst oil spill disasters have occurred and how the oil was separated from the water.

eBook plus

- 12 Classify a series of liquid mixtures as suspensions, solutions or emulsions by completing the **Time Out: 'Mixtures'** interactivity in your eBookPLUS. int-0224
- 13 Identify which commonly used mixtures can be separated by the process of filtration by completing the **Filtration** interactivity in your eBookPLUS. int-0223



→5.3 The pool shop