Mrs Lawrence's 7/8X Science

MIXTURES

Theory & Theory Booklet

Name: _____

HOW TO USE THIS BOOKLET:

- Read the information provided within this booklet
- Answer the guided activities
- Where you have the required equipment, try to complete the prescribed activities.

  This will make the lesson content much more interesting, and will help you to understand the concepts being covered.

- Complete the matching questions within this Theory & Assignment Booklet

  If you are having trouble answering them, you can:

  - ✓ *Call Mrs Lawrence at school on 6785 1184*
  - ✓ *Email Mrs Lawrence at Ariana.lawrence@det.nsw.edu.au*
  - ✓ *FB Messenger Mrs Lawrence as Ariana Lawrence*
  - ✓ *Arrange for a tutorial session with Mrs Lawrence at the school library*

- Submit this Theory & Assignment Booklet to Mrs Lawrence for Marking

DUE: 5th June 2020

Science Equipment required for: Mixture Separation 1-4

	Student supplies:	**School supplies:**
Mixture Separation Set 1	• 2 glasses • Teaspoon • Salt • Sugar • Pepper • Soil • Flour • Clock/stopwatch	
Mixture Separation Set 2	• Newspaper • Cling wrap • Old glass jar • Wooden skewer • Peg • Sugar • Saucepan • Stove • Food dye • Wooden spoon	• Paperclips • Magnet Iron and sand mixture
Mixture Separation Set 3	• Glass • Tablespoon • Teaspoon • Oil • Stopwatch • Pepper • Salt • Saucer	• Filter paper • Filter funnel
Mixture Separation Set 4	• Scissors • Pencil • Sticky tape • Ruler • Plate • Saucepan • Glass • Spoon	• Mixture – beads, sand, salt and paperclips • Filter paper • Filter funnel • Magnet

Middle School Science Stage 4 Course

Mixture Separation Set 1

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Contents

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Outcomes

By completing this unit, students are working towards achieving the following outcomes:

- SC4-16CW: describes the observed properties and behaviour of matter, using scientific models and theories about the motion and arrangement of particles
- SC4-17CW: explains how scientific understanding of, and discoveries about, the properties of elements, compounds and mixtures relate to their uses in everyday life
- SC4-6WS: follows a sequence of instructions to safely undertake a range of investigation types, collaboratively and individually
- SC4-9WS: uses a variety of strategies to communicate information about an investigation
- SC4-1VA: appreciates the importance of science in their lives and the role of scientific inquiry in increasing understanding of the world around them

You have the opportunity to learn:

- that mixtures, including solutions, contain a combination of pure substances that can be separated using a range of techniques (CW3)
- to assemble and use appropriate equipment and resources to perform an investigation
- to record observations and measurements accurately, using appropriate units for physical quantities
- to use a range of representations to present data and information

Glossary

Use the word bank and a dictionary (or go online to www.dictionary.com) to complete the glossary table below.

solution	mixture	particles

Term	Meaning
Insoluble	Cannot dissolve.
	A composition of two or more substances that are not chemically combined and can be separated from one another.
	A small part of matter.
Pure substance	Made up of only one type of matter or substance.
Soluble	Able to dissolve.
Solute	A substance that dissolves in a liquid to form a solution.
	A liquid mixture of two of more substances.
Solvent	A liquid that dissolves another substance to form a solution.

Classifying Substances

Substances can be **classified** (or grouped) together in lots of different ways. We can look at ways substances are similar or ways that they are different.

If we investigate the different types of matter (parts) in a substance we can group substances as either:

- **Pure substances** or
- **Mixtures**

Pure substances are made up of only **one type of matter**.

A **mixture** is a **combination of two or more different substances**.
Each substance (or part of the mixture) remains unchanged when mixed.

Let's take a look at the picture below of jelly beans separated into coloured groups.

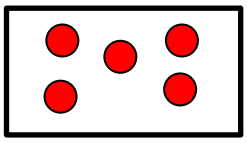
Each one of these groups represents a **pure substance** as each group is made up of only one type of jelly bean.

Now look at the picture below. It is a picture of lots of different coloured jelly beans.

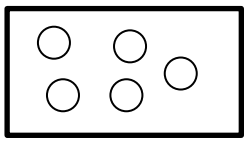
The lollies have not been separated out into pure substances. This picture represents a **mixture**.

Identifying Pure Substances

Let's look at the pictures below. The first box has red dots and the second box has white dots. Imagine each of these dots represents a bead. Notice how all the beads in each box look the same as each other. All the red beads together represent a **pure substance** and all the white beads together are a different **pure substance**.

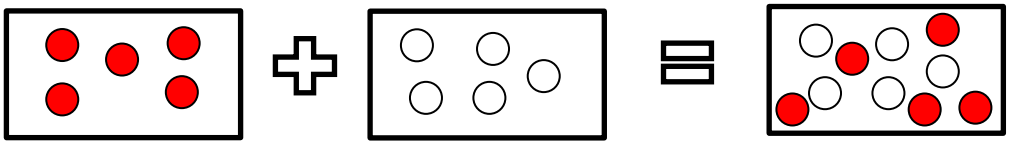


Pure substance 1



Pure substance 2

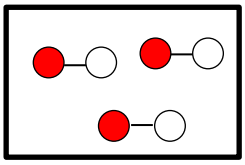
If we add these two pure substances together not all the beads look the same as each other anymore. We now have a **mixture**. A mixture is **not** a pure substance.



Pure substance 1 **Pure substance 2** **Mixture**

But if we join each red bead to a white bead each particle becomes the same - one **red** bead **joined** to one **white** bead.

 = one particle

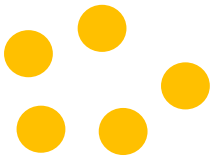


Pure substance

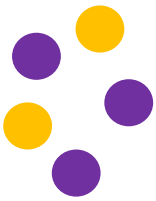
This is also a **pure substance**. It is not a mixture because **all the particles are the same**.

Activity 1

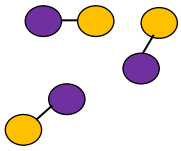
Identify whether each picture represents a pure substance or a mixture. Circle the correct word. The first one has been done for you.

1. 

Pure substance / Mixture

2. 

Pure substance / Mixture

3. 

Pure substance / Mixture

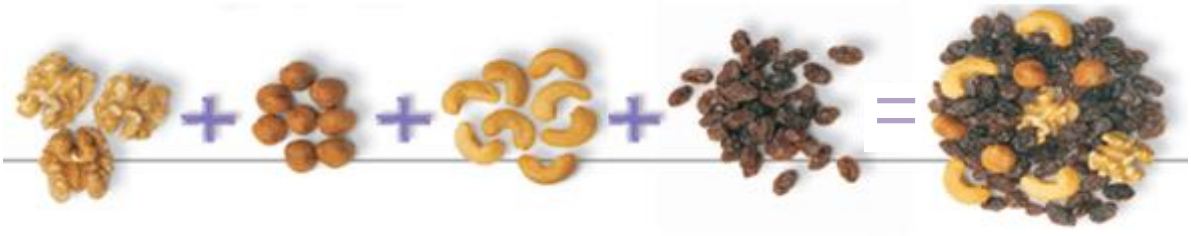
4. 

Pure substance / Mixture

Identifying Mixtures

If we buy a mixture of fruit and nuts at the supermarket we can separate the fruit and nuts into separate piles. The fruit and nuts all look and taste the same whether they are separated or mixed together. All substances in a mixture when separated out have the same properties as before they were mixed.

Mixtures are not chemically combined and can be easily separated.



mixture

Mixtures can be made up of solids, liquids or gases or a combination of these different states of matter.

Types of Mixtures

When we look around we find that lots of things are mixtures.

Mixtures can be made up of:

- **Different solids**

  For example: a mixture of fruit and nuts or a mixture of lollies.

- **Different liquids**

  For example: salad dressing can be a mixture of olive oil and lemon juice.

- **Different gases**

  For example: the air we breathe is a mixture of gases. Air is mainly a mixture of the gases oxygen and nitrogen. Oxygen is the one we need to stay alive.

- A **combination of solids and liquids**

  For example: salt water is a mixture of salt and water.

- A **combination of liquids and gases**

  For example: soft drink is a mixture of a gas called carbon dioxide and a liquid.

Activity 2

1. Write down three mixtures you can find in your home.

   a) _____

   b) _____

   c) _____

2. How is a mixture different to a pure substance? _____

   _____

   _____

3. Match the following mixtures with their type of mixture.

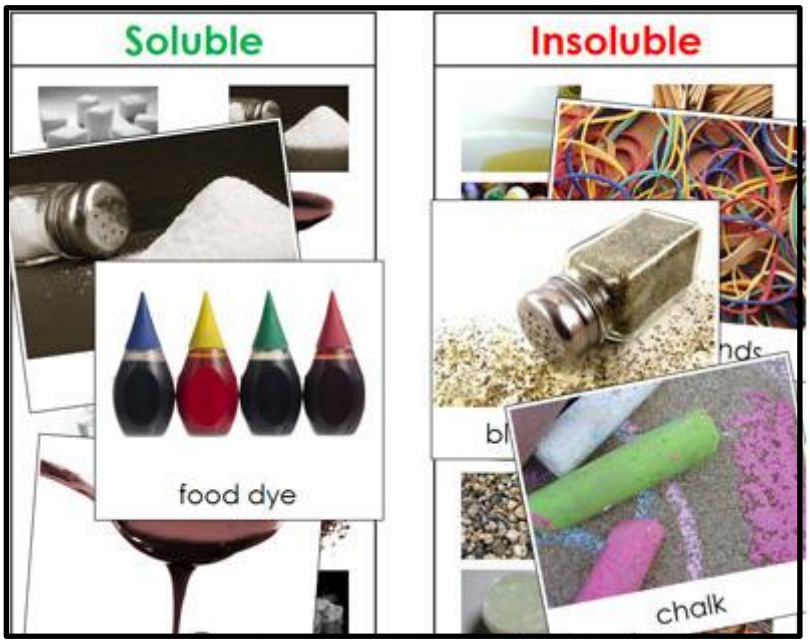
Mixture	Type of mixture
Smoke	Mixture of gases
Lemonade	Mixture of liquids
Air	Mixture of gas in a liquid
Soil	Mixture of solids in a liquid
Muddy water	Mixture of solids
Wine	Mixture of solids and gases

Mixing Solids and Liquids

Substances like salt, sugar and coffee **will dissolve** in water. They are **soluble**.

Pepper and sand **will not dissolve** in water. They are **insoluble**.

When a substance dissolves in a liquid it forms a **solution**. This process is called **dissolving**.



Let's look at an example:

Tang mix water solution

The Tang mix **dissolved** in the water.

It is **soluble**.

Activity 3

1. Write down the names of four solids that dissolve in water and are used in the home.

   a) _____

   b) _____

   c) _____

   d) _____

Experiment 1

What materials will dissolve in water?

Equipment

Small glass	Pepper
Teaspoon	Soil
Water	Flour
Salt	Clock

Method

1. Half fill a small glass with water.
2. Add a small teaspoon of salt to the water.
3. Stir the water with the teaspoon for 30 seconds.
4. Look at the glass and tick the sentence that matches what you see.

Results

The salt:

- ☐ sank to the bottom of the glass
- ☐ can't be seen in the water
- ☐ can be seen spread out through the water
- ☐ floated

Empty and rinse the glass.

Repeat the experiment method using **pepper** and tick the sentence that matches what you see.

The pepper:

- ☐ sank to the bottom of the glass
- ☐ can't be seen in the water
- ☐ can be seen spread out through the water
- ☐ floated

Empty and rinse the glass.

Repeat the experiment method using **flour** and tick the sentence that matches what you see.

The flour:

- ☐ sank to the bottom of the glass
- ☐ can't be seen in the water
- ☐ can be seen spread out through the water
- ☐ floated

Empty and rinse the glass.

Repeat the experiment method using **soil** and tick the sentence that matches what you see. **Wait 2 minutes** before looking at the glass.

The soil: (you can tick more than one option, if needed)

- ☐ sank to the bottom of the glass
- ☐ can't be seen in the water
- ☐ can be seen spread out through the water
- ☐ floated

1. Complete the following sentences using words from the list below.

soil	flour	pepper	salt

a) The _____ can't be seen when mixed with water.

b) The _____ floated on the surface of the water.

c) The _____ sank to the bottom of the glass.

d) The _____ can be seen spread throughout the water.

2. Substances that dissolve are soluble. Substances that do not dissolve are insoluble.

   Complete the table to record whether the substances were soluble or insoluble.

Material	**Soluble (dissolves)**	**Insoluble (does not dissolve)**
Soil		
Flour		
Salt		
Pepper		

Time to Dissolve

Two things that affect the speed at which the solid dissolves are:

- **size** of the particles of the solid
- **temperature** of the solvent

For example, caster sugar is made of fine (small) particles and will dissolve quickly, but bigger sugar particles will take longer.

Solids generally dissolve faster in hot water than in cold water.

Experiment 2

Does temperature affect the speed at which a solid dissolves in water?

Equipment

Sugar	2 small cups
Teaspoon	Stopwatch (timer)
Hot water	Cold water

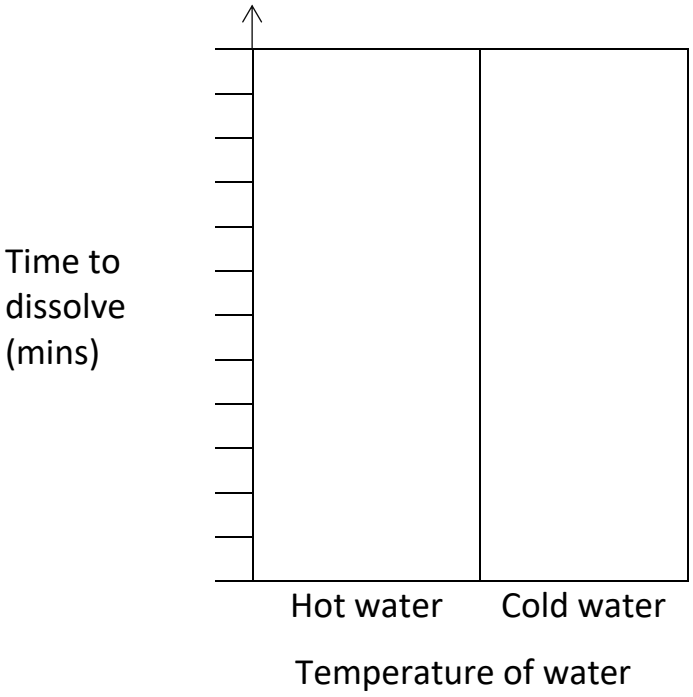
Safety – a supervisor must be present when completing this experiment.

Method

1. Half fill the first cup with hot water.
2. Half fill the second cup with cold water.
3. Add 1 teaspoon of sugar.
4. Start the timer.
5. Stir until dissolved.
6. Stop the timer when the sugar has all dissolved.
7. Record your results in the table below.
8. Repeat Steps 3-7 for the cup of cold water.
9. Complete the bar graph and question below.

Results

Dissolving time	Cup One (hot water)	Cup Two (cold water)



Observations

Explain how the temperature made a difference to how quickly the sugar dissolved.

Middle School Science Stage 4 Course

Mixture Separation Set 2

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Glossary

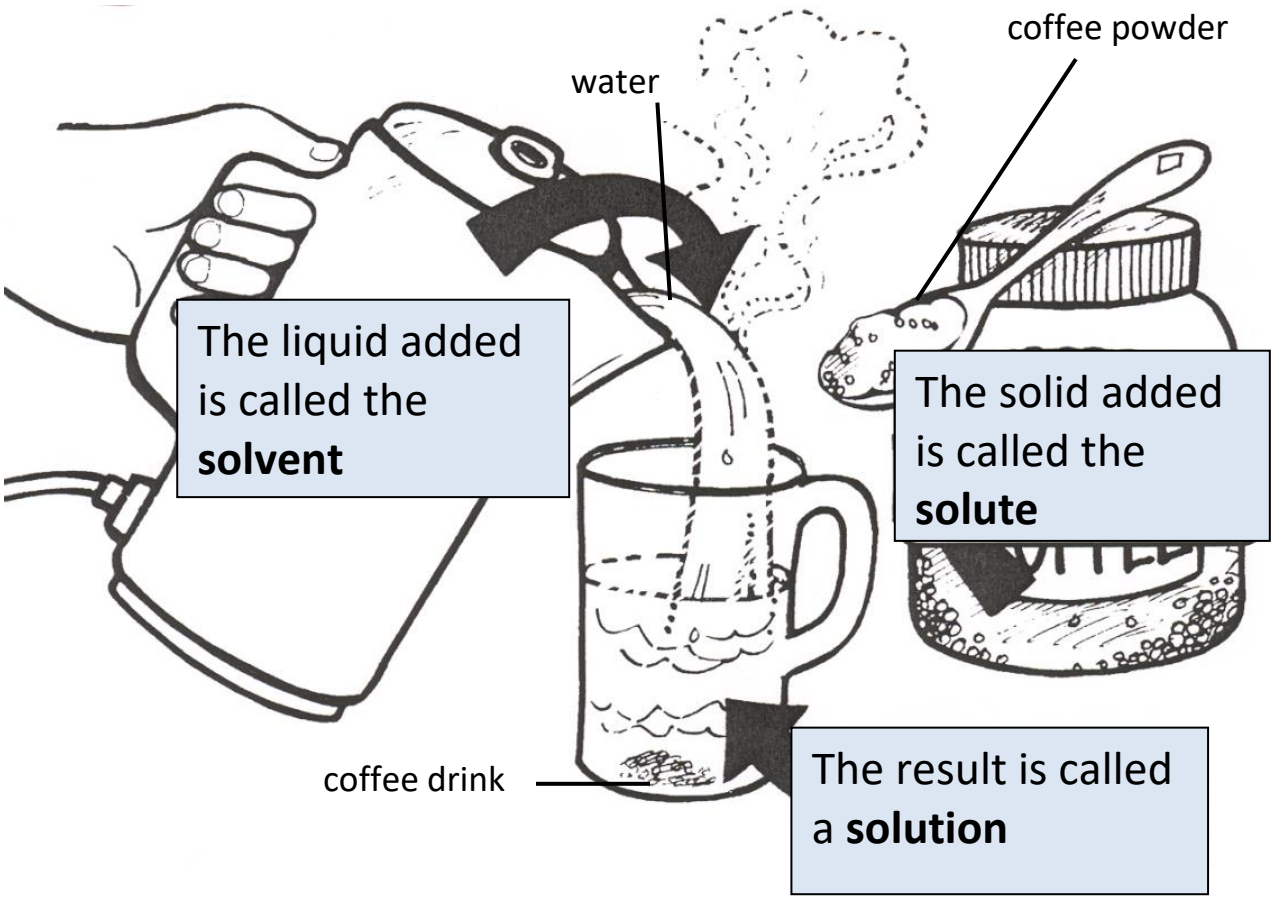
Use the word bank and a dictionary (or go online to www.dictionary.com) to complete the glossary table below.

solvent	insoluble	soluble

Term	Meaning
Dissolve	When a solute (substance) is mixed into a solvent (liquid) and disappears.
Filtration	To pass through a filter to remove solid particles.
	Cannot dissolve.
Mixture	A composition of two or more substances that are not chemically combined and can be separated from one another.
	A substance that will dissolve.
Solute	The substance that dissolves in a liquid to form a solution.
	The liquid in which a solute dissolves.
Solution	The mixture formed when a solute (substance) has dissolved in a solvent (liquid).
Suspension	Mixtures that have solid particles in them that settle out when left to stand.

Dissolving Solids

Imagine you have just made a mug of coffee as drawn below.



Notice in the boxes we have used some of the 'Science' words from our glossary: solvent, solute and solution.

- A **solvent** is the liquid that dissolves a substance.
  In the example above the solvent is the hot water.

- A **solute** is the substance that is added to the solvent.
  In the image above, the coffee is the solute.

- A **solution** is the result of mixing a solute into a solvent.
  The solution in the picture above is the hot coffee.

Water as a solvent

Water is a universal solvent.

This means it can **dissolve more substances** than any other liquid. It can actually dissolve thousands of substances.

Water is very important to every living thing on Earth because it picks up valuable minerals and nutrients when it goes through the air, the ground and even our bodies.

Activity 1

1. Match the term with the correct definition.

Solute	The result of mixing the solute into the solvent.
Solvent	The substance that is added to the liquid.
Solution	The liquid that a substance is mixed into.

2. Water is the most common solvent we can find around the home. One solute you may be familiar with is coffee.
   Can you think of two more solutes that can be found in your home?

   a) _____

   b) _____

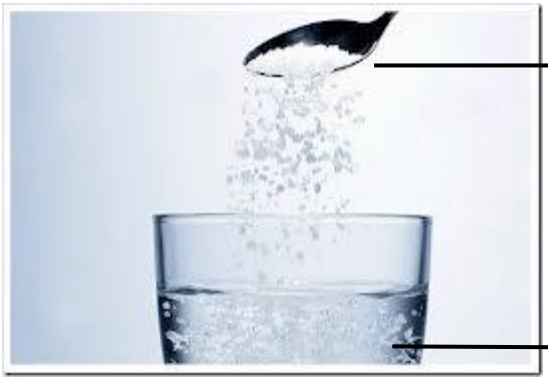
3. Lemon cordial and dish washing detergents are examples of solutions.
   Can you think of two more solutions that can be found in your home?

   a) _____

   b) _____

4. Use these words to label the diagram and complete the sentences.

solute	soluble	solution



After stirring, all the solute dissolves in the solvent, forming a _____.

The solute was _____.

5. Why is water called the 'universal solvent'? _____

_____

Suspensions

Do you remember what happened when you mixed flour with water? Write your answer below.

_____

_____

Did you write that the flour did not disappear, that it spread throughout the water, and you could still see it?

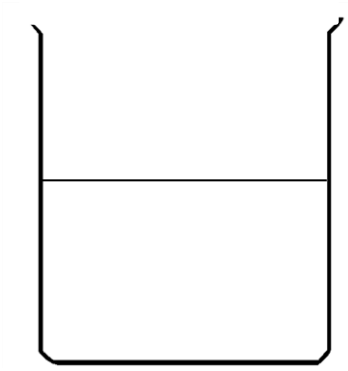
When you did that you formed a **suspension.** The flour did not dissolve.

A **suspension** is a mixture of a liquid and solid particles.
Over time, the solid particles will settle at the bottom of the liquid.

Activity 2

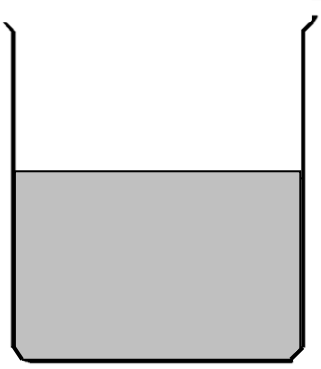
Let's investigate suspensions a little more. Have a look at the following two beakers.

A



Clear, colourless liquid

B



A grey liquid that you cannot see through

1. Which beaker do you think contains a suspension? A or B. _____

2. What feature lets you know that the liquid is a suspension?

   _____

3. Use the words below to fill in the spaces.

soluble	solvent	dissolves	solute	solution

When sugar is mixed with water, the sugar disappears. Another way of saying this is that the sugar _____ in the water, or that sugar is _____ in water. The sugar is the _____ and the water is the _____. The mixture that is formed is called a _____.

4. Complete the table below by putting the names of the solute and solvent for each solution.

Solution	Solute	Solvent
Jelly crystals and water		
Sea-water		
Coffee granules and hot water		
Washing powder and water		

Separating Mixtures

The different substances in mixtures are usually easily separated from one another. The way you separate the mixture depends on the type of mixture you have.

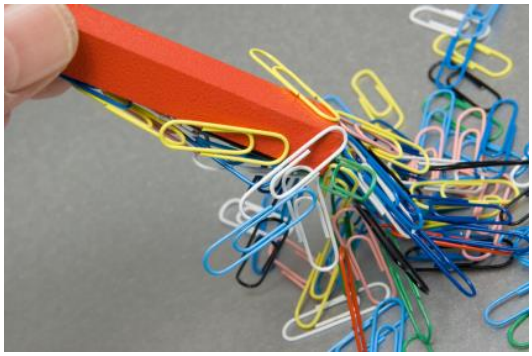
We will be investigating several different separation techniques. These techniques include:

- sieving
- filtration
- chromatography
- magnetic attraction
- evaporation
- distillation
- crystallisation
- decantation

Magnetic Attraction

Magnets will attract substances made of iron.
We can use magnets to separate substances that are made of iron from substances that are not made of iron.

Magnetic materials include iron, steel, nickel and cobalt.



Activity 3

1. Take the paperclips and magnet from your kit. Hold the magnet near them. What happened?

_____

_____

2. Could a magnet be used to separate the following mixtures? Explain your answer.

Mixture	Yes/No	Why?
Cheese and chalk		
Sand and iron filings		
Paperclips and pins		
Nails and wood chips		

Uses of Magnetic Separation

Magnets are used for a wide variety of purposes.

Magnets can:

- pick out iron scraps that might accidentally fall into food or medicines when they are made.

- pick up iron scraps at airports, docks and construction sites to stop damage to people and machines.

- be used in hospitals to remove iron splinters from a patient's eyes.

- remove steel and iron scrap metal at the junk-yard.

Experiment 1

How can we use a magnet to separate substances?

NOTE: **Wrap your magnet in cling wrap first.**
Do not allow the magnet directly near the iron filings.

Equipment

Magnet
Newspaper
Iron and sand mixture
Cling wrap

Method

1. Wrap your magnet in cling wrap.
2. Take the mixture of iron and sand from your kit.
3. Tip the mixture onto a large sheet of newspaper.
4. Hold your magnet under the newspaper and move the magnet around slowly.
5. Write down what you see in the results section below.

Results

Did the magnet separate the iron from the sand? Yes / No

Observation

Write a sentence or two about what you saw happen.

_____

_____

Centrifuging

How do you think a washing machine separates water from the clothes?

Did you write that it 'spins' it dry? Well done!

Scientists have a name for separating substances by spinning. It is called **centrifuging** or **centrifugation**.

The process of centrifuging can also separate suspensions from a liquid. It achieves the same thing as sedimentation or filtering, but is much faster.

Uses of Centrifugation

There are a lot of different ways centrifuging is used in industry.

- Sugar industry – separating sugar crystals from liquid
- Washing machine – separate water from clothing
- Water and waste water treatment – to dry sludges
- Oil industry – remove solids from drilling fluid
- Dairy industry – to separate cream from milk
- Blood – separating blood and blood plasma

Blood sample **after** centrifuging. It is now **separated** into two layers.

Blood sample **before** centrifuging. It is a **mixture** of blood and blood plasma.

Crystallisation

Crystallisation is a method of separating and retrieving a soluble solid from a solution.

For crystallisation to occur the liquid is evaporated and the **solid crystals** remain.

The **size** of the crystals depends on how **quickly the liquid evaporates**.

- **Fast evaporation** will result in a large number of small crystals.
- **Slow evaporation** will result in a smaller number of large crystals.

Experiment 2

Can crystals develop in a solution of water and sugar?

Equipment

Old glass jar (tall and narrow)

A wooden skewer (or a wooden chopstick)

Peg

1 cup water

3 cups sugar

Extra sugar for skewer

Saucepan

Stove

Food dye

Wooden spoon

For tips and hints– go to http://video.about.com/chemistry/3-Tips-for-Growing-Sugar-Crystals.htm

Safety – a supervisor must be present when completing this experiment.

Method

1. Add one cup of water to a saucepan.
2. Place saucepan on the stove and bring the water to the boil.
3. Carefully add ¼ of a cup of sugar to the boiling water and stir to dissolve.
4. Carefully add another ¼ cup of sugar to the boiling water and stir to dissolve.
5. Continue adding ¼ cups of sugar and stirring to dissolve until no more sugar will dissolve or until all the sugar has been added.
6. Remove saucepan from the heat and cool for 10 minutes.
7. Carefully pour the cooled solution into the glass jar.
8. Add 5 drops of coloured food dye to the solution.
9. Rinse the wooden skewer in water and roll in a small amount of sugar.
10. Slowly place your sugared skewer into the solution.
11. Use a peg to hold the stick in place. Do not let the stick touch the sides or bottom of the jar. (See image below)
12. Place the jar on a windowsill and allow to sit for the next 3-7 days.
13. Once crystals have grown, remove skewer from the solution.

Results

1. How long did it take before crystals grew in the jar? _____

2. Were the crystals large or small? _____

3. Did a large or small number of crystals grow? _____

4. Using your answers to the previous two questions, do you think your solution evaporated quickly or slowly? Provide a reason for your answer.

   _____

   _____

5. What would you need to do in order to get larger crystals?

   _____

   _____

Middle School Science Stage 4 Course

Mixture Separation Set 3

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http://www.ssc.education.ed.ac.uk/bsl/chemistry/filtrationd.html (accessed 11/12/1311:16am)
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You have the opportunity to learn:

- that mixtures, including solutions, contain a combination of pure substances that can be separated using a range of techniques (CW3)
- to assemble and use appropriate equipment and resources to perform an investigation
- to record observations and measurements accurately, using appropriate units for physical quantities
- to use a range of representations to present data and information

Glossary

Use the word bank and a dictionary (or go online to www.dictionary.com) to complete the glossary table below.

filtration	decantation	evaporation

Term	Meaning
Condensation	Changing a gas to a liquid.
	Pouring a liquid off a mixture of solid sediment and liquid.
Distillation	Separating liquids by boiling off and condensing the different liquid.
	Changing a liquid to a gas. Separates a soluble solid (solute) from a liquid mixture.
	Separation method using a filter.
Sedimentation	Process in which insoluble material separates from a liquid mixture by falling to the bottom.
Sieving	Separating a mixture of different sized particles by using a sieve which holds larger particles but allows smaller particles through.

Separating Mixtures

Sieving

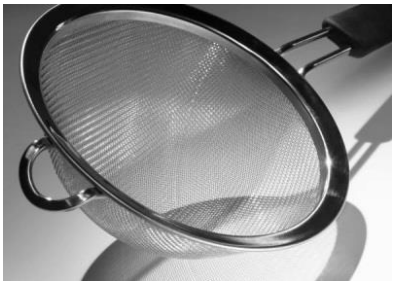
Sieving is the process of separating a mixture of different sized particles by using a sieve which holds larger particles but allows smaller particles through.

Sieving can be used to separate solids and also for separating a solid from a liquid.

A sieve must have the **right-sized holes** to trap the large parts in a mixture and let the smaller parts through.

You may have used a sieve in your kitchen to separate:

- vegetables from water after cooking
- flour from any larger particles when baking



Activity 1

1. What would happen if a sieve's holes were larger than the largest particles in a mixture being sieved?

   _____

   _____

2. If you sieve a mixture of sultanas and flour, the _____ goes through the sieve and the _____ stay in the sieve.

3. If you sieve a mixture of stones and soil, the _____ stay in the sieve and the _____ goes through the sieve.

Sedimentation

The process of letting a solid settle in a liquid is called **sedimentation**.

The shape and size of the particles determines how quickly they sink to the bottom of the tank. **Heavier particles sink to the bottom**.

Do you remember when we mixed soil and water? What happened to the soil in the mixture?

_____

Do you think you would have been able to carefully pour the water out and leave the soil behind? Why/why not?

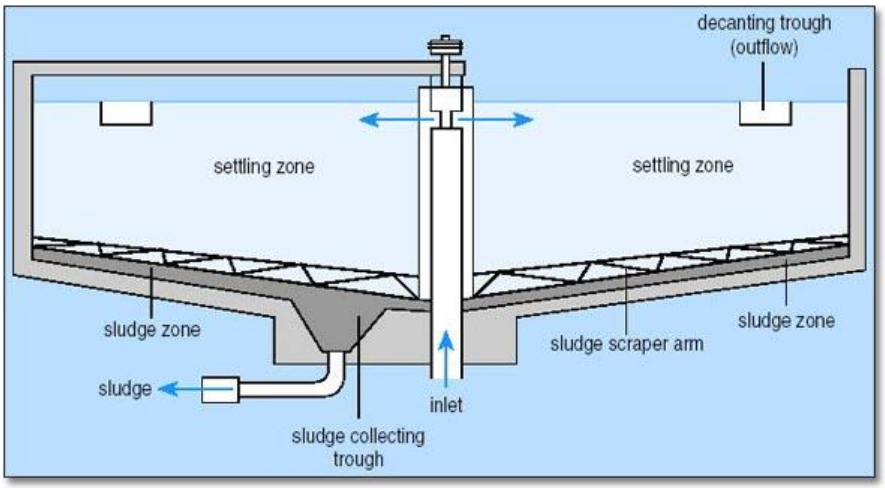
_____

_____

Uses of Sedimentation

Sedimentation has a variety of industrial uses.

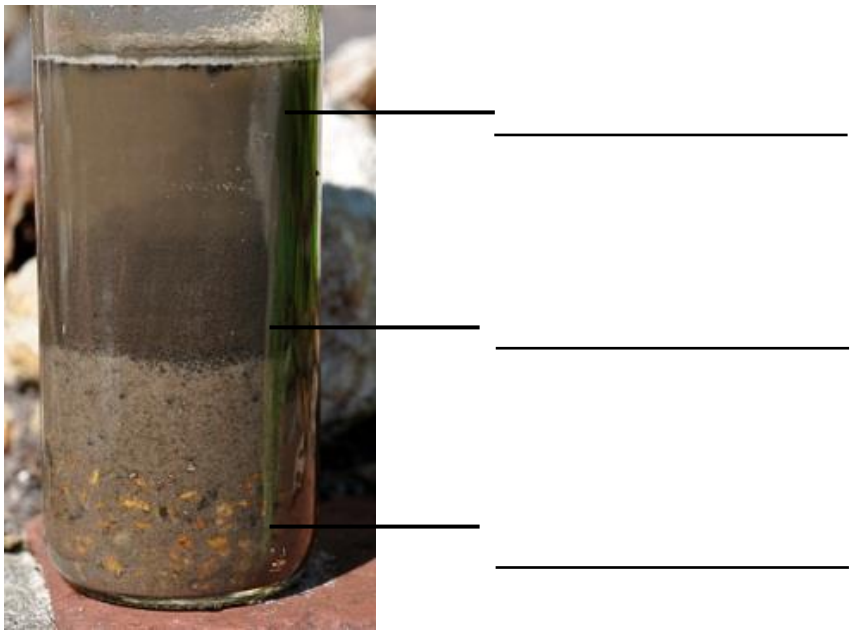
- Beer – the solid yeast particles settle at the bottom of a tank and are removed through a tap.
- Water treatment facilities – solid particles settle at the bottom of a large tank. This is called sludge. After settling the 'sludge' is removed.



A tank in a water treatment facililty. The sludge settles on the bottom of the tank and is then removed through a tap.

Activity 2

Label the different layers in the picture (fine particles, water, heavier particles)



Decanting

Once sedimentation has happened, you can separate the mixture by pouring or skimming the top liquid off. This process is called **decanting**.

Decanting can be used to separate a mixture of an insoluble solid and liquid (e.g. dirt in water) or two liquids that do not mix (e.g. oil and water).

Uses of Decanting

Here are some examples of mixtures that can be decanted:

- **Oil and water** - oil floats on top of water. Decanting the mixture allows the oil to be poured off the water.
- **Dirt and water** - muddy water can be cleared up by decanting. The soil will sink to the bottom allowing the clear water to be poured off.
- **Wine** - sediment from the fermentation process can spoil the taste of the wine. The liquid can be decanted to separate the wine from the sediments.
- **Cream and milk** - cream rises to the top of the milk and can be skimmed off.

This mixture was allowed to settle. The brown substance settles on the bottom of the beaker.

The clear liquid is decanted (poured) into a second beaker.

The brown substance remains in the first beaker.

Experiment 1

What happens when we mix oil and water?

Equipment

2 glasses
Tablespoon
Teaspoon
Oil
Water
Clock (stopwatch)

Method

1. Half fill a glass with water.
2. Add 2 tablespoons of oil to the same glass.
3. Watch the glass for 30 seconds.
4. Use a teaspoon to stir the mixture of oil and water.
5. Watch the glass for 30 seconds.
6. Try decanting the oil off the water into another glass.

Observations

1. What did you see happen when you added the oil to the water?

   _____

2. What happened after you stirred the mixture with the teaspoon?

   _____

3. Did you find decanting the mixture an easy process? Why/Why not?

   _____

   _____

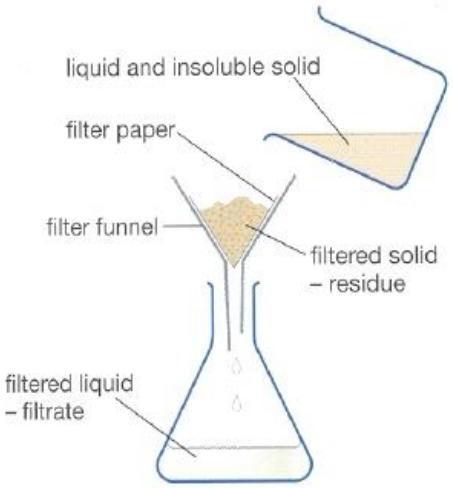
Filtration

The process of using a filter to separate solid particles from a liquid or gas is called **filtration**.

The filter acts like a fine sieve in order to trap insoluble solid particles.

The liquid that passes through the filter is called the **filtrate**.

The solid that is trapped in the filter is called the **residue**.



Filtration can also be used to separate two solids when one solid is soluble (dissolves in a liquid) and the other solid is insoluble (does not dissolve in the liquid).

We have already discovered that salt dissolves in water and sand does not. So we can add water to the salt and sand mixture and then filter the solution to remove the sand.

Uses of Filtration

If you look around you will see lots of examples of filtration being used.

- Air and oil filters in your car – to remove small particles from the oil and the air.
- Filter in your vacuum cleaner – to trap dust and dirt particles.
- Water filters in drink bottles or water jugs – to remove small particles from the water we drink.
- Washing machines and dryers – to catch the lint from clothing.
- Filter in a coffee machine – to trap the larger coffee particles.
- Air conditioners – to trap dust and dirt particles from the air.
- Hair in our nostrils – trap dust particles we breathe.
- Sewage treatment – to trap particles in water.

Filters are also used in the **food and beverage (drinks) industry**. Filters are used in manufacturing processes to ensure that the food and drinks look and taste right.

Activity 3

1. Complete the following sentences.

residue	separate	filtrate	filtration

We can _____ a mixture of liquid and solid particles using filter paper. We call this separation method _____.

The solid left behind in the filter paper is called the _____. The liquid that passes through the filter paper is called the _____.

2. Filters are used in air conditioning and heating units. What do you think the filters are trying to trap?

_____

_____

3. Lots of different filters are used in a car to keep petrol, oil and air clean. What substances do you think each type of filter is trying to trap and why is this important?

_____

_____

_____

_____

4. Would filtration be a suitable method to separate a mixture of salt and water? Explain your answer.

_____

_____

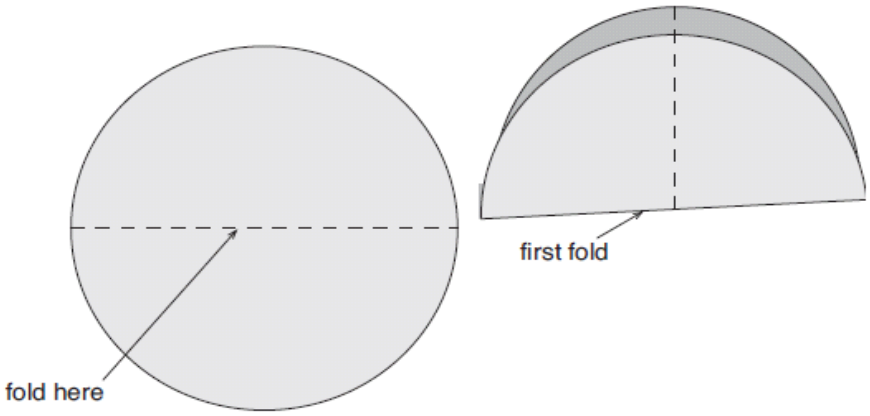
Activity 4

Folding filter paper

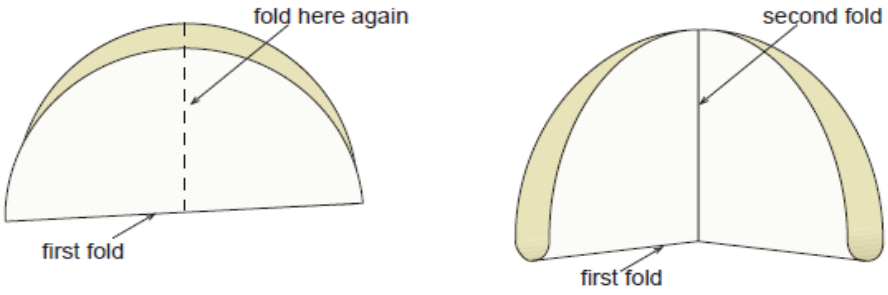
Watch a video on how to fold filter paper and place it in a filter funnel here:
http://www.youtube.com/watch?v=MFdibg-UbqY

Folding a filter paper

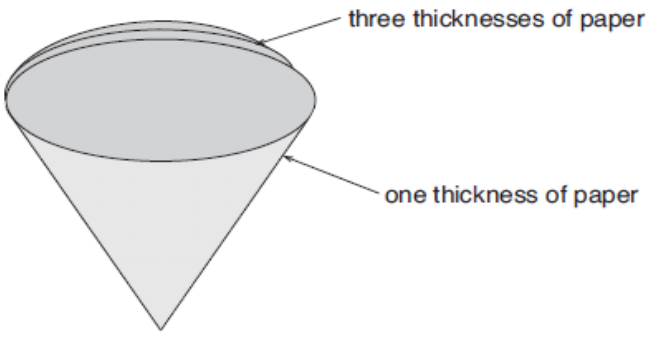
Start by folding the filter paper in half.



Now fold the paper in half again. It is now ¼ of the original size.



Hold the paper so that it makes a cone with three thicknesses of paper on one side of the cone.



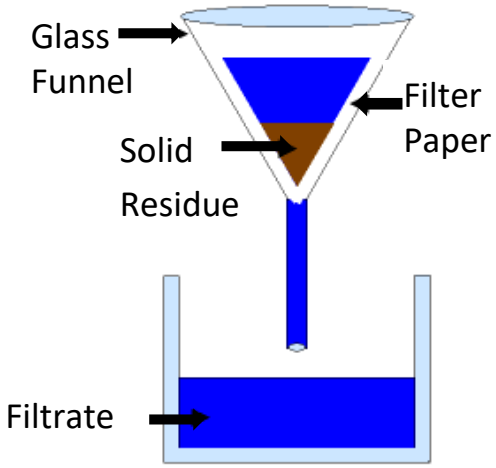
Practise this technique with one filter paper from your kit.

Experiment 2

What happens when we filter a mixture containing an insoluble solid and a liquid?

Equipment

Folded filter paper (from Activity 4)
Filter funnel
Glass
Teaspoon
Pepper
Salt
Water



Method

1. Place the folded filter paper into the filter funnel (if you are unsure about this, refer back to the video on page 13)
2. Place the filter funnel into the glass.
3. Mix half a teaspoon of pepper with half a teaspoon of salt in the glass.
4. Quarter fill the glass with water and stir well to dissolve the salt.
5. Pour all the mixture into the filter paper.
6. After all the solution is filtered, remove the filter paper and lay on a table.
7. Record your findings to the questions below.
8. Keep the solution in the glass for later.

Observations

1. What do you see on the filter paper? _____

   _____

2. Where is the salt? _____

   _____

3. Has the filtering separated all the pepper from the water? _____

4. Circle the correct response.

Filtration can/cannot separate a salt-and-pepper mixture.

Evaporation and Condensation

Evaporation and condensation are changes of state.

Evaporation involves changing a liquid to a gas.

When a liquid changes into a gas we say that the liquid **evaporates**. Evaporation is the reason why wet clothes dry on a washing line.

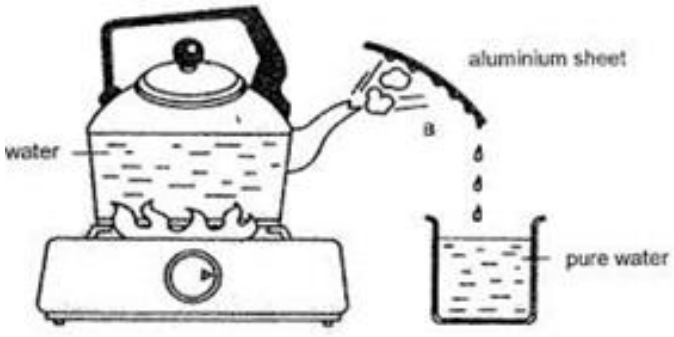
Evaporation is a useful method for separating a **soluble solid from a liquid**. Remember: a soluble substance dissolves in a liquid to form a solution.

The solution can be heated up and when it reaches a high enough temperature the liquid solvent in the solution changes to a vapour (gas), leaving the solid solute behind.

Condensation involves changing a gas to a liquid.

When a gas converts to a liquid we say that the gas **condenses**. Condensation is the reason why windows become foggy on a cold day and why a glass of cold water sometimes has water droplets on the outside of the cup.

We can use condensation to separate a liquid from a soluble solid using evaporation. When the gas is cooled down it can convert back to a liquid.



Uses of Evaporation and Condensation

There are many uses of evaporation and condensation. These include:

- Drying wet clothes
- Drying hair with a hair-dryer
- Salt - the salt we buy in the supermarket comes from the ocean. Sea water is pumped into large salt pans and allowed to evaporate. The salt is collected and packaged
- Evaporated milk and condensed milk – the milk has been heated to remove water
- Powdered milk – condensed milk is heated until only the milk solids remain
- Fridges – contain an evaporator and a condenser to maintain temperature

Activity 5

Use the words in the list to complete each of the following sentences about getting salt from evaporation.

Sun	salts	water	rivers	salt
evaporate	salt pans	seawater	supermarkets	

Salt lakes are found in desert areas of Australia. They are formed when r_____ running into lakes carry water which has s_____ dissolved in it.

In the dry season, the hot s_____ makes all the w_____ evaporate, leaving the s_____ behind.

The salt we buy in the supermarket comes from the ocean. S_____ is pumped into large s_____ p_____ and allowed to e_____. The salt is collected and packaged. Trucks transport the packaged salt to s_____.

Experiment 3

Can water be evaporated from a salt water solution until only salt crystals remain?

Equipment

Glass with salt water solution from Experiment 2.
Small saucer

Method

1. Pour a thin layer of salt water onto a small saucer.
2. Place saucer in a sunny location. For example on a sunny window sill.
3. Leave the saucer for several hours (or several days) until all water has disappeared.

Observations

1. What happened to the water? _____

   _____

2. What has been left behind in the saucer? _____

3. How long did it take for the water to disappear? _____

4. In the boxes below, draw a picture of the saucer at the start of the experiment and at the end of the experiment. (Don't forget to label your diagrams)

Beginning of experiment.	**End of experiment.**

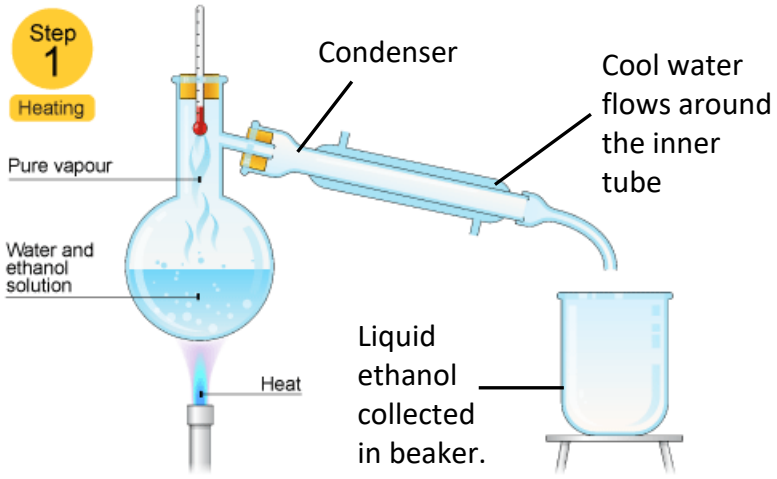
Distillation

Distillation is a process to separate a pure liquid substance from a mixture.

Distillation involves evaporation of a liquid and condensation of a gas in order to collect a pure liquid substance.

Distillation can also be used for separating a mixture of liquids. The **two liquids must have different boiling points** for distillation to be an effective separation technique.

Simple distillation involves heating a liquid mixture to change the state of the liquid to gas. The gas is then cooled and the pure liquid substance collected.



In the picture above:

- The ethanol (alcohol) and water solution is heated in a flask.
- The ethanol changes to a gas and travels through the middle of the condenser.
- Tap water flows around the condenser and cools the gas.
- The gas cools and condenses and becomes a liquid ethanol again.
- Ethanol is collected in the beaker.

Uses of Distillation

Distillation is used in many **commercial processes** to make distilled water, alcohol, gasoline and paraffin.

Some desalination plants also use distillation processes to separate salt and water. Sea water is boiled to evaporate the water while leaving the salt behind. The water vapour is then condensed and collected in a separate container.

Fractional distillation

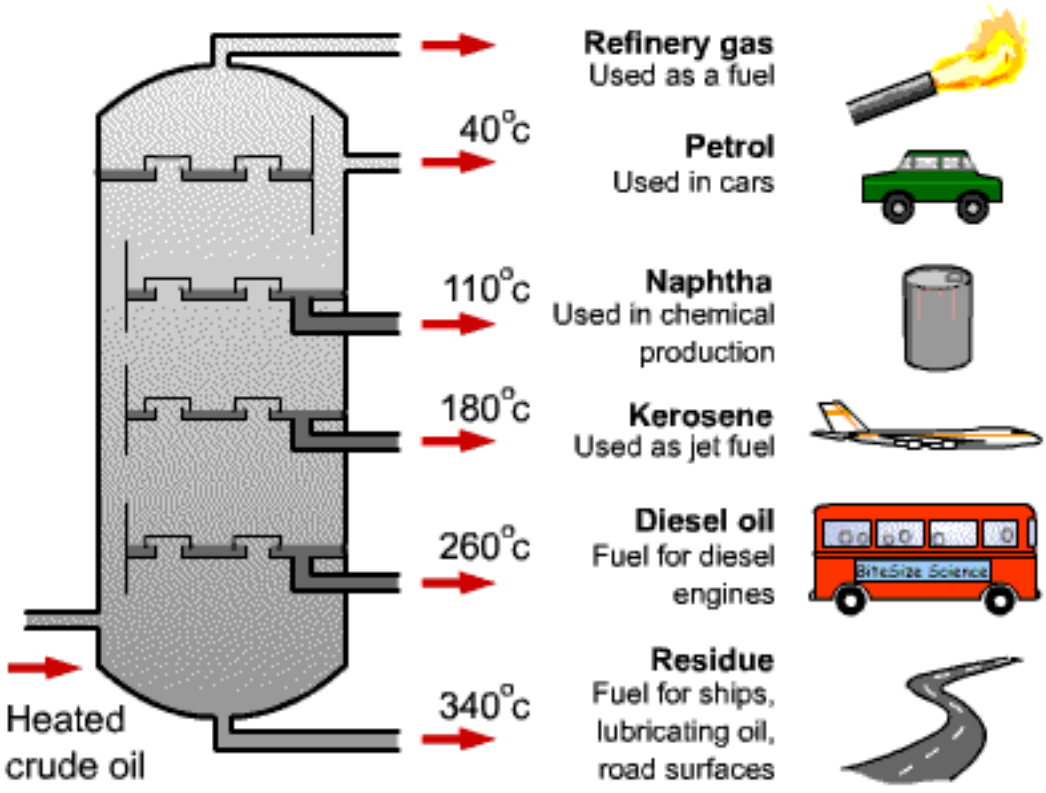
Fractional distillation involves heating a liquid mixture and separating a mixture into different parts depending on the boiling point of the liquid.

This process is used to separate crude oil into different useful parts.

Crude oil is made up of different substances. The diagram below summarises the main substances in crude oil.

Each substance has a **different boiling point**.

- The substances with the **lowest boiling point evaporate first**.
- The substances with the **highest boiling point evaporate last**.



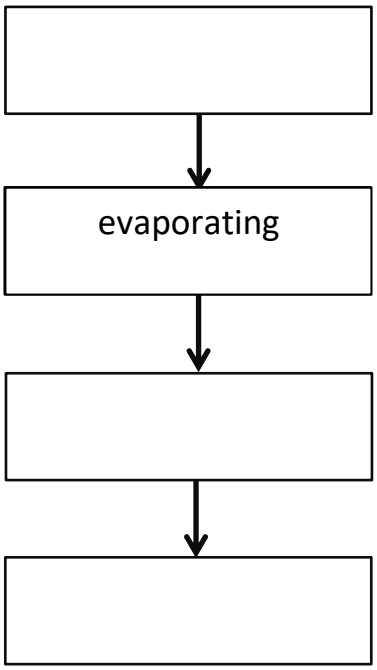
Activity 6

1. Name three commercial processes that use distillation. _____

_____

2. Sequence the events in distillation in the correct order in the boxes below.

condensing	heating	evaporating	cooling



3. Describe the process of fractional distillation.

_____

_____

_____

Middle School Science Stage 4 Course

Mixture Separation Set 4

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http://demo.physics.uiuc.edu/LectDemo/descript/264/more%20info.html (accessed 19/02/14 10:00am)

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Glossary

Use the word bank and a dictionary (or go online to www.dictionary.com) to complete the glossary table below.

flotation	chromatography

Term	Meaning
Centrifuging	Separation of substances by spinning.
	Separation by the movement of different colours through paper.
Crystallisation	Growth of crystals.
	Separation of substances by whether they sink or float.

Chromatography

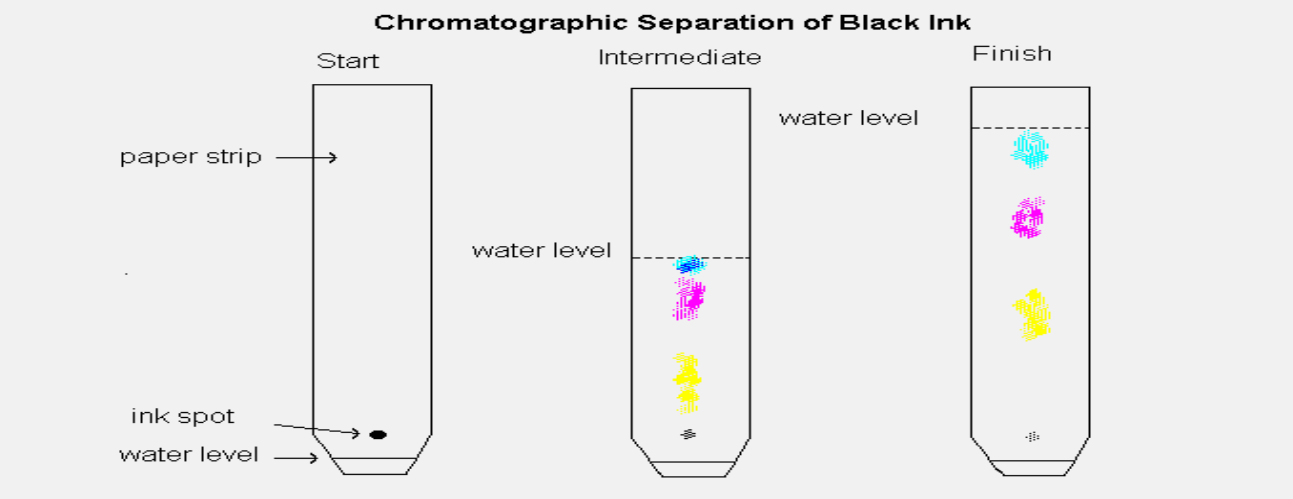
Chromatography is used to separate substances or colours in inks, food dyes and other mixtures of colours.

Chromatography works because:

- substances are all different sizes
- large substances move slowly across the paper
- small substances move quickly across the paper.

If the colour pigments are soluble in water (remember soluble means able to dissolve), then **water** can be used as the solvent for the chromatography.

If the pigments are not soluble in water, we can use **alcohol** to improve the solubility (for example in a permanent marker).



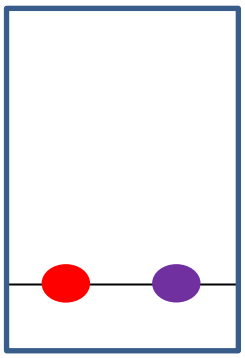
Start: A spot of black ink on filter paper is placed in water.

Intermediate: The water begins to rise through the filter paper and separate the colours.

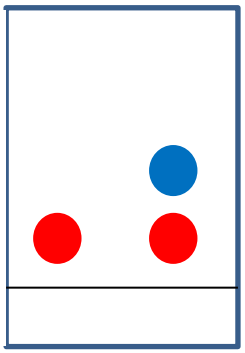
Finish: The colours have separated out on the filter paper. The black ink contained yellow, pink and blue coloured pigments.

What's in a colour?

A spot of red ink and a spot of purple ink were drawn on the chromatography paper.



After 15 minutes the red ink has risen up the paper. The purple ink has separated into red and blue spots.

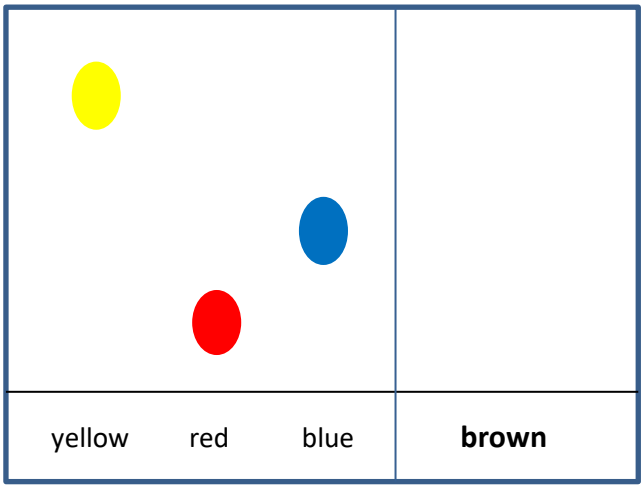


Activity 1

The chromatograph paper below shows that yellow, red and blue ink are not made up of other colours.

Brown ink is made from a mixture of yellow, red and blue ink pigments.

Use coloured pencils or textas to draw the separation of the colours in brown ink on the chromatograph below.



Experiment 1

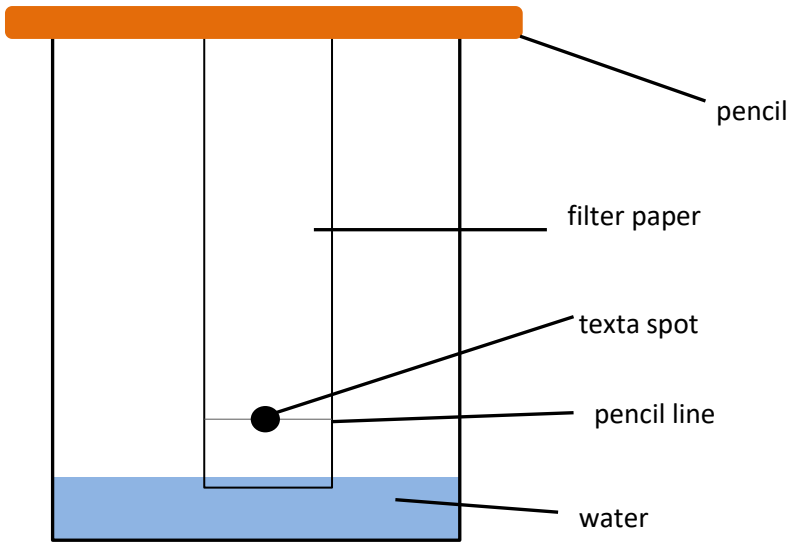
What colours are present in a water soluble black texta?

Equipment

Filter paper	Scissors
Glass	Pencil
Water soluble black texta	Sticky tape
Water	Ruler

Method

1. Cut a piece of filter paper into a rectangular strip 2cm wide.
2. Use a pencil to draw a short line 1 cm from one end.
3. Place a spot of water soluble black texta on the pencil line.
4. Pour a small amount of water into a glass.
5. Sticky tape the paper to a pencil sitting across the top of the glass so that the water is touching the base of the paper, but isn't as high as the line on the paper.
6. Leave for 10 minutes.



Results

Paste your chromatograph here

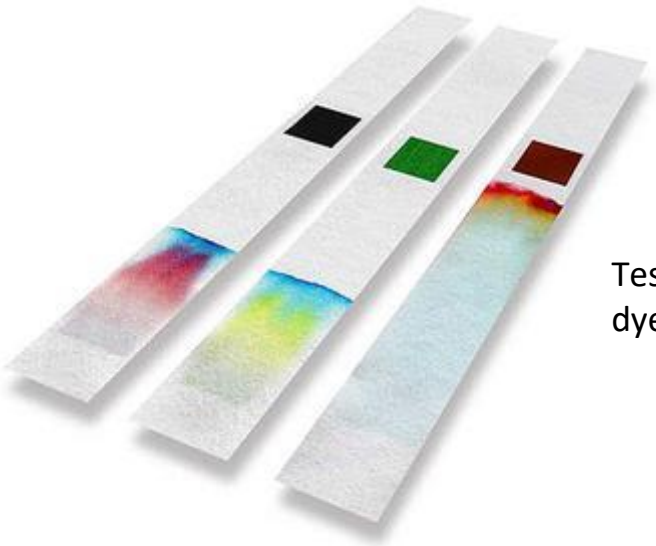
Observations

1. Is the ink made up of several colours or just one? _____
2. What colour are the dyes in the black ink? _____
3. Which pigment colour moved highest on the paper? _____

Uses of Chromatography

Chromatography is used for many different purposes.

- Testing ink dyes in forgery cases
- Testing food dyes to check the food colours used
- Testing pesticide levels on vegetables
- Checking for drugs in urine samples
- Testing colour dyes in fabrics



Testing of coloured dye in fabrics

Flotation

Flotation is the separation of substances by whether they sink or float.

An example of flotation is mixing sawdust and sand in water. The sawdust will float and the sand will sink.

Flotation is commonly used in the wastewater and wine industries. Unwanted substances can be skimmed from the top of water and wine.

Flotation can also be used when there is an oil spill. Spilt oil floats on water and forms a slick on the surface. Skimmers are then floated on the top of the oil and suck up the oil.

Oil Spill Investigation

Because oil spills cause many issues to the environment, particularly to marine life, they need to be cleaned up very quickly.

Many different methods can be used to clean up oil spills. We are going to investigate two different ways of cleaning up oil spills.

We need to shampoo our hair, because hair collects oil. Watch how hair can be used to clean up oil spills:
http://www.youtube.com/watch?NR=1&v=EwQOD_Ir2vQ&feature=endscreen

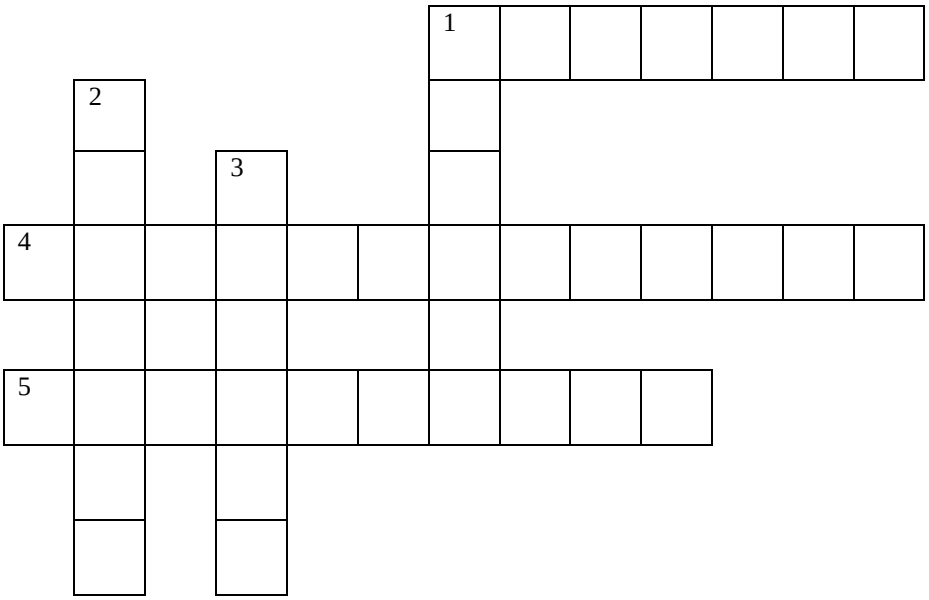
Oil skimmers are designed to collect oil from small or hard to reach places. Watch how they work: http://www.youtube.com/watch?v=g4Pku98QBOA&feature=related

Activity 2

After watching the two YouTube videos. Choose one of the oil clean-up methods and describe how it works.

Activity 3

Complete the crossword below about separation methods.



Across

1. Made up of different substances which are not joined chemically.
4. The process where a solid is allowed to settle in a liquid.
5. Uses filter paper.

Down

1. Iron is attracted by this object.
2. Relies on the fact that particles are each a different size.
3. A paper that can be used to filter a liquid, _____ paper.

Activity 4

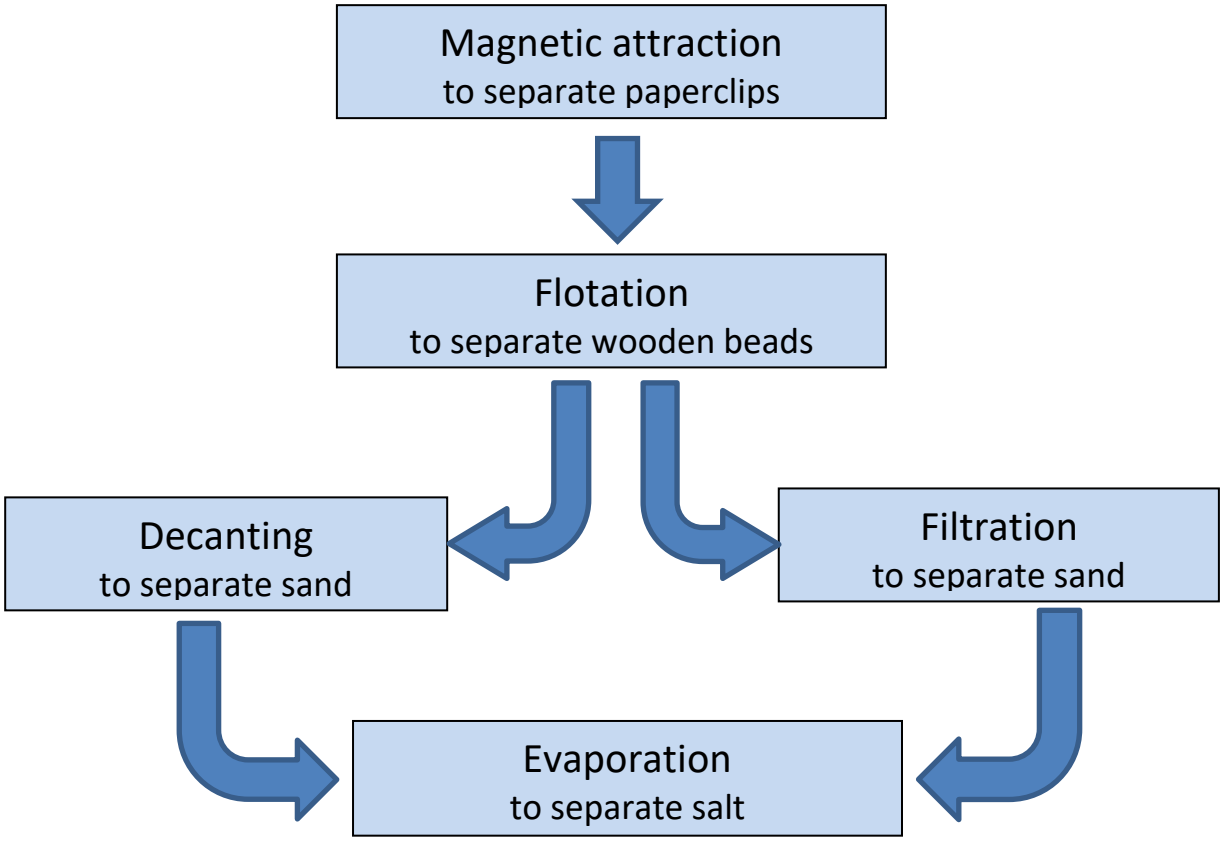
1. Match the separation term with its definition.

Term	Definition
Magnetic	Separation by spinning
Distillation	Separation by the movement of different colours through paper
Filtration	Separation of a mixture of liquids
Centrifuging	Separation of magnetic iron metals from non-magnetic substances
Crystallisation	Separation of dissolved salts from the liquid they are dissolved in
Chromatography	A change of state from liquid to gas
Evaporation	Separation of solid particles from a liquid or gas
Flotation	Separation of solids that float from those that sink.

Mixture Separation

Five students were asked to separate a mixture containing wooden beads, sand, salt and paperclips.

The students drew a flow chart of how they could separate their mixture.



Activity 5

1. The flow chart has two ways to separate the sand: decanting or filtration. Which method do you think the students should use to separate the sand?

2. Why is decanting not always the best method for separating an insoluble solid and a liquid?

_____

_____

3. Draw a line from the substance to its matching physical property and a line from the physical property to the matching separation method.

Substance	Physical property	Separation Method
Paperclips	Float on water	Evaporation
Wooden beads	Attracted to magnet	Magnetic attraction
Sand	Is soluble in water	Filtration
Salt	Is insoluble in water	Flotation

Experiment 2

Now let's try to separate a mixture of paperclips, sand, salt and wooden beads.

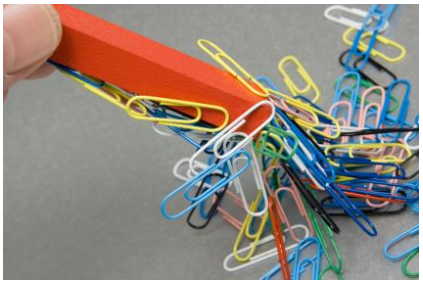
Equipment

Plate	Saucepan	Water
Funnel	Glasses	Stove
Filter paper	Magnet	Spoon

Method

Step 1

1. Pour the mixture onto a plate.
2. Move the magnet over the mixture to remove the paperclips.



Results

1. What separation method did you use? _____

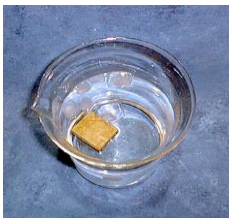
2. Did you remove all the paperclips? _____

3. Why does this method work to remove paperclips? _____

_____

Step 2

1. Pour the mixture into a glass.
2. Quarter fill the glass with water.
3. Using a spoon, scoop the beads from the mixture. Make sure that you don't remove any water.



Results

1. What separation method did you use? _____

2. Did you remove all the wooden beads?_____

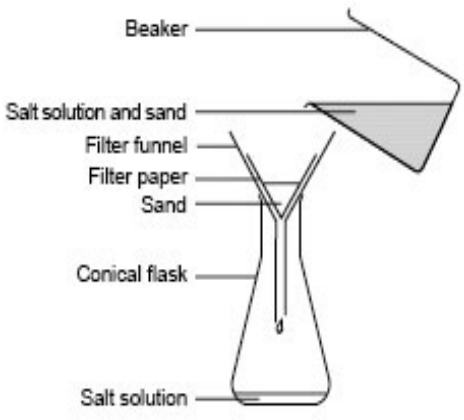
3. Why does this method work to remove wooden beads? _____

_____

4. What two substances still need to be separated? _____

_____

Step 3



1. Using a spoon, stir the mixture.
2. Fold the filter paper and place in the filter funnel.
3. Place the filter funnel into a second glass.
4. Pour the salt water and sand mixture into the filter funnel.

Results

1. What separation method did you use? _____

2. Why was the mixture stirred? _____

   _____

3. What was the residue? _____

4. What was the filtrate? _____

Step 4

Safety: A supervisor must be present when completing these steps.

1. Pour the salt water into a small saucepan.
2. Place the saucepan on the stove and turn onto a low heat.
3. Allow the water to come to the boil.
4. Turn off the stove and remove the saucepan from the heat.

Results

1. What separation method did you use? _____

2. Why might the salt still have some sand in it? _____

   _____

3. Did you lose any part of the mixture? Explain your answer. _____

   _____