Science & play®

LAB

Chemistry



WARNING. • Warning. Not suitable for children under 8 years. For use under adult supervision. • Contains some chemicals which present a hazard to health. • Read the instructions before use, follow them and keep them for reference. • Do not allow chemicals to come into contact with any part of the body, particularly the mouth and eyes. • Keep small children and animals away from experiments. • Keep the experimental set out of reach of children under 8 years old. • Eye protection for supervising adults is not included.

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V75157

Read and keep these instructions for future reference.

Clementoni®

SAFETY RULES

- Read these instructions before use, follow them and keep them for reference.
- Keep young children, animals and those not wearing eye protection away from the experimental area.
- Always wear eye protection.
- Store this experimental set out of reach of children under 8 years of age.
- Clean all equipment after use.
- Make sure that all containers are fully closed and properly stored after use.
- Ensure that all empty containers are disposed of properly.
- Wash hands after carrying out experiments.
- Do not use any equipment which has not been supplied with the set or recommended in the instructions for use.
- Do not eat or drink in the experimental area.
- Do not allow chemicals to come into contact with the eyes or mouth.
- Do not replace foodstuffs in original container. Dispose of immediately.
- Store this experimental set and the final crystal(s) out of reach of children under 8 years old.
- Do not grow crystals where food or drink is handled or in bedrooms.
- Take care while handling with hot water and hot solutions.

GENERAL FIRST AID INFORMATION:

- In case of eye contact: Wash out eye with plenty of water, holding eye open if necessary. Seek immediate medical advice.
- If swallowed: Wash out mouth with water, drink some fresh water. Do not induce vomiting. Seek immediate medical advice.
- In case of inhalation: Remove person to fresh air.
- In case of skin contact and burns: wash affected area with plenty of water for at least 10 minutes.
- In case of doubt, seek medical advice without delay. Take the chemical and its container with you.
- In case of injury always seek medical advice.

Note: first aid information may also be found in the instructions for carrying out the experiment.

Write the telephone number of your local poisons center in the space below. They may be able to provide information on countermeasures in case of poisoning.

.....

MAIN UK POISON CENTRES

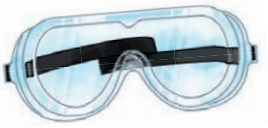
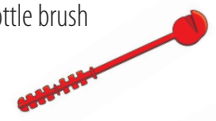
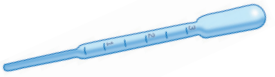
Emergency calls for life-threatening situation: 999
If you are deaf, hearing impaired or have a speech impediment, you can text 999 and the emergency services will be able to reply to you.
N.B.: You will need to register your mobile phone before using the emergency text service (emergencySMS service).
Visit: http://www.emergencysms.org.uk/

ENGLAND & SCOTLAND
If you urgently need medical help or advice but it's not a life-threatening situation, you should use the NHS 111 service.
Call: 111 (NHS nonemergency number). If you use a textphone or are deaf, hard of hearing or speech impaired please dial: 18001 111 to access the NHS 111 service.
More information on the NHS 111 service can be found at: https://www.nhs.uk/NHSEngland/AboutNHSservices/Emergencyandurgentcareservices/Pages/NHS-111.aspx or https://www.nhs24.scot/ for Scotland.

WALES
0845 4647 (NHS Direct Wales - Galw Iechyd Cymru) - Information in English and Welsh. If you are deaf, hard of hearing or speech - impaired please dial: 0845 606 4647 (NHS Direct Wales textphone number) - 1 8001 0845 46 47 (BT Typetalk)
Information at: http://www.nhsdirect.wales.nhs.uk/

NORTHERN IRELAND
BELFAST AREA: Royal Victoria Hospital (Royal site) – Emergency Department Reception (for Children): 028 9063 2251
NORTHERN AREA: Antrim Area Hospital: 028 9442 6262 - Causeway Hospital, Coleraine: 028 7034 6086
SOUTHERN AREA: GP Out of Hours Service (available after 6pm Monday to Friday and - all day Saturday, Sunday and Bank Holidays) – Telephone 028 3839 9201
WESTERN AREA: Out of Hours GP service number: 028 7186 5195 - Further information at: http://www.gpoutofhours.hscni.net/how-to-contact-us/what-is-an-emergency/

Chemistry lab equipment and materials

- safety goggles 
- measuring cylinder 
- beakers with lids 
- funnel 
- test tubes with stoppers 
- test tube rack 
- bottle brush 
- spatulas 
- stirrer 
- filter paper 
- pipette 
- tweezers 
- balloons 
- bubble-blowing tool 
- test tube safety key 
- chemical substances
  (tartaric acid, sodium carbonate, bleeding universal indicator paper) 

NOTE! **This set does not contain all materials needed for the experiments or common household materials.**

WARNING. **Children under eight years can choke or suffocate on uninflated or broken balloons. Adult supervision required. Keep uninflated balloons from children. Discard broken balloons at once. Made of natural rubber latex that may cause allergic reactions.**

Safety information on chemical substances

Substance no. 3 - Tartaric Acid $C_4H_6O_6$ CAS: 87-69-4



Danger

H318 Causes serious eye damage.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310 Immediately call a POISON CENTER or doctor/physician.

Substance no. 5 - Sodium Carbonate Na_2CO_3 INDEX: 011-005-00-2



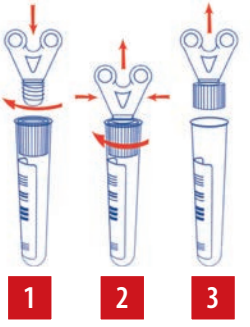
Warning

H319 Causes serious eye irritation.
P264 Wash hands thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P337+P313 If eye irritation persists: Get medical advice/attention.

Substance no. 9 - Bleeding Universal Indicator Paper

How to open chemical substance containers

1. Turn the safety key until it is fully in the stopper.
2. Pull the key and tilt the stopper slightly and wiggle from side to side.
3. Remove the stopper keeping the plastic container upright.



Important! Close the container immediately after removing the chemical by clicking it into place.

DISPOSAL OF USED CHEMICALS

When you need to dispose of chemical substances, it is necessary to make reference to national and/or local regulations. In any case make sure you never throw chemicals into sewers and/or the rubbish. For more details please refer to a competent authority. For disposal of packaging make use of the specific collection points.



Instructions for using the goggles

- Put the goggles on at the beginning of the experiment, they are for protecting your eyes during the experiment; only wear them during the experiment.
- Clean the goggles with soap and water and dry them with a soft cloth, in case of damaged goggles substitute them with a pair with the same characteristics.

Advice for supervising adults

- Read and follow these instructions, the safety rules and the first aid information, and keep them for reference.
- The incorrect use of chemicals can cause injury and damage to health. Only carry out those experiments which are listed in the instructions.
- This experimental set is for use only by children over 8 years.
- Because children's abilities vary so much, even within age groups, supervising adults should exercise discretion as to which experiments are suitable and safe for them. The instructions should enable supervisors to assess any experiment to establish its suitability for a particular child.
- The supervising adult should discuss the warnings and safety information with the child or children before commencing the experiments. Particular attention should be paid to the safe handling of acids, alkalis and flammable liquids.
- The area surrounding the experiment should be kept clear of any obstructions and away from the storage of food. It should be well lit and ventilated and close to a water supply. A solid table with a heat resistant top should be provided.

Advice for lab experiments

DOs

- Choose a suitable place to work in. Make sure that it is well lit, ventilated and near a tap.
- Before starting an experiment read the instructions, follow them, and keep them handy to consult them.
- Keep small children, anybody not wearing safety goggles and animals away from your working area.
- Have a cloth handy, to use for wiping up any spills.
- Always wear your safety goggles.
- Close the containers with chemical substances and place them in their spaces in the box.
- Prepare the necessary equipment to keep the pipette clean: two plastic containers, one with pure water and the other empty to rinse the pipette after use. Always clean them and then put them back in the test tube rack. Use hot tap water to clean the equipment.
- If you have used food (such as pieces of bread, fruit etc.) in an experiment, throw it away after you have finished.
- Before starting an experiment, make sure that you have got all the necessary substances not included in the set, but easily found at home (such as salt, vinegar, lemon, distilled water, tap water etc.)
- At the end of the experiments, clean the equipment, making sure all the containers are tightly sealed and placed in the box correctly. The box must be kept out of reach of small children.
- Wash your hands thoroughly with soap and water once you have finished.
- Dispose of the substances with the help of an adult. Follow national and local waste disposal laws on chemical substances so that you don't pollute the environment.
- **When storing coloured liquids for short periods of time, keep out of reach of small children and animals.**

DON'Ts

- Do not eat, drink or smoke in your working area.
- Never smell a container to see what is in it.
- Do not let the chemical substances touch your face or eyes during an experiment.
- Never taste the substances and do not ingest them.
- Never make up your own experiments.
- Do not try to memorise what is in the test tubes, write the contents down in your notebook and use labels.
- Do not try to pick up large amounts of solid substances with the spatula.
- Do not use any equipment other than the equipment supplied with the set.
- Do not not exceed the amount of chemical substance given in the instructions.
- Do not put test tubes down on the work surface because they could roll away. Always put them in the special test tube rack.
- Never use fire or flame, it is not required for any type of experiment.

This chemistry set has been developed based on the European safety standard EN 71-4 which contains safety standards for chemistry sets .

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IN THE LAB:



THE EQUIPMENT AND HOW TO USE IT

SAFETY GOGGLES

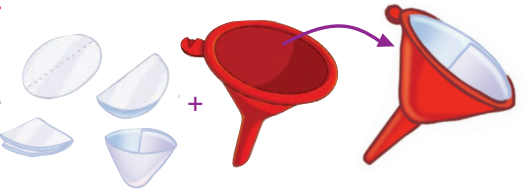
The safety goggles are especially designed to protect your eyes, only wear them while you are doing the experiments. Clean your goggles with soap and water and dry them with a soft cloth. Replace your goggles if they get damaged.



FUNNEL AND FILTER PAPER

The funnel and filter paper (with tiny holes) are used to filter mixtures and separate liquids from solids.

Advice: *When you have finished the filter paper, you can replace it with white tissues or paper serviettes.*



SPATULAS

Spatulas are similar to small spoons so you can scoop up very small amounts of powder.

There are two different spatulas in the set.



STIRRER

The stirrer is similar to a plastic stick and is used to mix substances in the test tubes or to guide liquids as you filter them.



TWEEZERS

Use the tweezers instead of your fingers to pick up and move small materials (small pieces of rock, salt granules, small pieces of paper, etc).



MEASURING CYLINDER

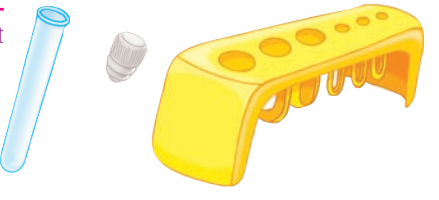
A measuring cylinder is used to measure liquids.

You can see that the lines indicating the volume (measurements) are very close together. This means that you can measure very small amounts of liquid. The measuring scale starts at the bottom.



TEST TUBES WITH STOPPERS - TEST TUBE RACK

You will find a set of test tubes for liquids and mixtures. The rack keeps the test tubes upright in the set.



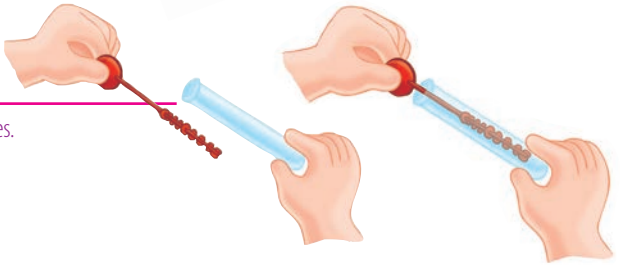
PIPETTE

Pipettes are graded laboratory instruments (look at the measurements on the side) and are used to transport a measured volume of liquid.



BOTTLE BRUSH

The bottle brush is used to clean inside the small test tubes.

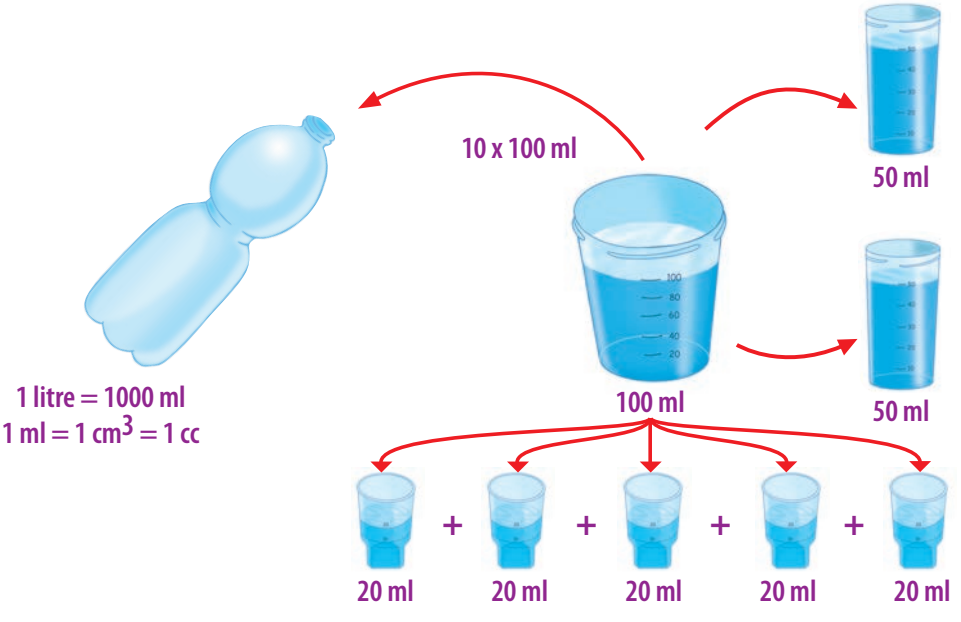


BEAKERS WITH LIDS

These containers hold different capacities (look at the measurements on the sides of the beaker) and are used to hold liquids and to dissolve substances.







ACTIVITIES:

Learn how to measure liquids and get to know the volumes of the containers.



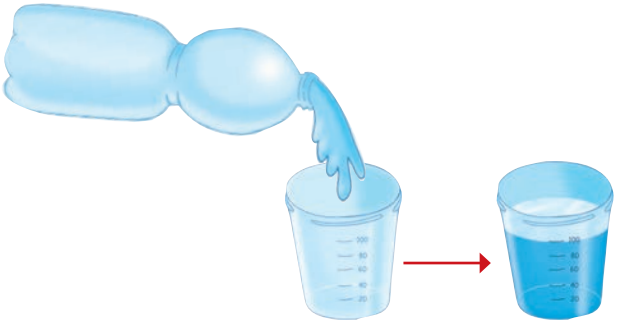
UNITS OF MEASUREMENT FOR VOLUME

1 ml = 1 cc = 1 cm³

How many 100 ml beakers can you fill from half a litre of water? 1

Pour all the water from a 500 ml bottle into the 100 ml beakers.

OBSERVE THE FOLLOWING: while you pour the water slowly into the beakers, check the measurements on the side of the beaker that show the volume. Count how many beakers you fill.



How many 20 ml beakers can you fill from two 50 ml beakers? 2

Pour all the water from two 50 ml beakers into the 20 ml beakers.

OBSERVE THE FOLLOWING: check the measurements and count how many beakers you fill.



Learn how to use a pipette 3

squeeze the pipette to let out the air



suck up the liquid by releasing your fingers



squeeze the pipette to let the liquid out again



4 How to wash the pipette

1) Take two plastic cups of water (not included in the set). Fill one with clean water and do not put anything in the other one.

2) You must rinse the pipette twice straight after you have used it. Suck up some clean water and then release it into the empty plastic cup.

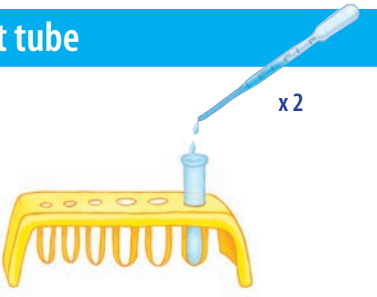
Repeat this process twice. It is a good way to practise measuring liquids with the pipette.



5 Two pipettes of water equal one test tube

Never empty more than two pipettes of liquid into a test tube.

OBSERVE THE FOLLOWING: each pipette can hold 3 ml max. The test tubes hold 6 ml of liquids safely.



6 Measure the maximum capacity of the pipette

Suck the water into the pipette.

OBSERVE THE FOLLOWING: carefully watch the water as it passes all the measurements until it reaches level 3.

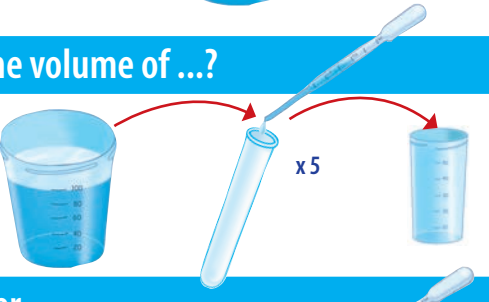
Practise sucking up the water. It isn't easy to fill it up to 3 ml.



7 The liquid in five test tubes has the volume of ...?

Use the pipette to transfer the water from the test tubes into one beaker.

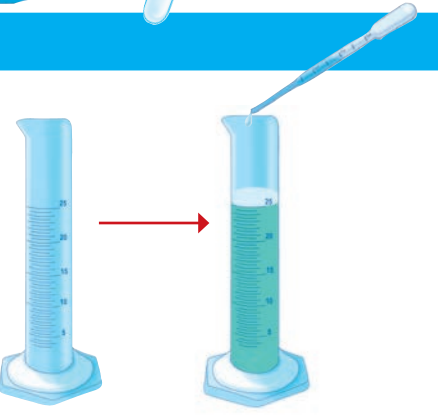
OBSERVE THE FOLLOWING: the volume of water.



8 How to use the measuring cylinder

Fill the cylinder with water using the pipette. Try to make the level of the liquid line up with the measuring line.

OBSERVE THE FOLLOWING: Make sure the liquid lines up with the measurement. Do this by keeping your eye at the same level as the line. Measurements are accurate when the liquid lines up perfectly.



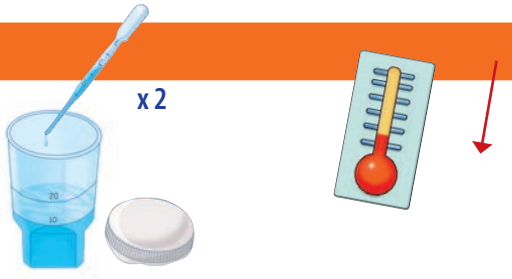
TURNING WATER INTO ICE



- Ice is the common name for water in a solid state.
- When water reaches 0 °C in normal conditions, it passes from a liquid state to a solid state.

Make an ice cube 9

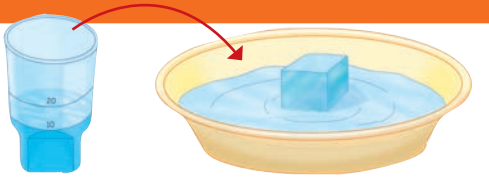
Transfer two pipettes of water into the small beaker and put it in the freezer for a couple of hours.



Advice: *Keep this for the next experiment.*

An iceberg on your plate 10

Pour a little water into a container (not included in the set) and place the ice cube from the last experiment into the water.



OBSERVE THE FOLLOWING: the ice cube floats because it is lighter than water.

In scientific language we say that ice has lower density than water.

The measuring cylinder measures how much the ice rises 11

Use the pipette to transfer the water until it reaches 15 ml on the measuring cylinder. You must do this accurately. Put the cylinder in the freezer for a couple of hours.



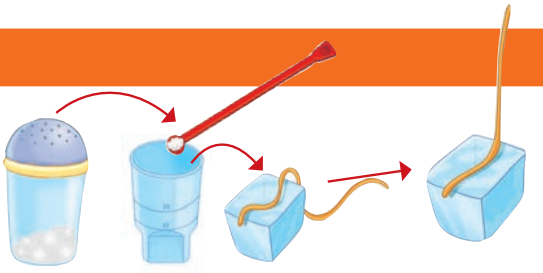
OBSERVE THE FOLLOWING: the edge of the ice is above the 15 ml mark. Measure the difference.

This is because the ice particles (molecules) take up more space.

String sticks to ice with salt 12

1) Place a piece of string onto an ice cube.

2) Pour a little table salt on the string.



OBSERVE THE FOLLOWING: after a few minutes the string sticks to the ice cube.

Salt lowers the freezing point of the ice, making it melt slightly. At the same time, the ice tries to take heat away from the string which causes it to stick to the ice cube.

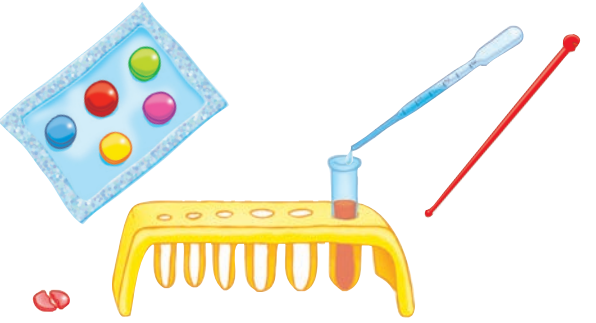
IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

13 Prepare a coloured solution

Ask an adult to help you

You will need some food colouring (not included in the set), which you can buy from any supermarket.

If it is liquid, pour a little into a test tube in the test tube rack. If it is a coloured tablet, place a little piece in a test tube and dissolve it with a pipette of water. Mix well with the stirrer.



You could even use a teaspoon of jam or fruit juice to colour the water.

Remember: rinse the pipette with clean water.

OBSERVE THE FOLLOWING: the coloured substance (**solute**) dissolves in the water (**solvent**) and makes the solution turn a pale colour.

Advice: *Save for the next experiment. Keep out of reach of small children and animals (and well away from food and drink).*

14 Colour the ice cube

1) Transfer two pipettes of water into a small beaker and add about two drops of the colour you prepared in the last experiment.

2) Put the beaker in the freezer for a couple of hours.



OBSERVE THE FOLLOWING: the ice has changed colour.

IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

15 Tubes of coloured ice

1) Transfer just over one pipette of water into three test tubes.

2) Then after you have prepared the coloured liquid (experiment 13), add a few drops of it into each test tube: 20 drops, 10 drops and 5 drops respectively.

3) Put the test tubes in the freezer for one hour.

Check if the liquid in one test tube is freezing faster than the others. The relative amounts of sugar and colouring ingredients may have an effect on the freeze rate.



IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

ACTIVITIES:



- LAB TECHNIQUES

- HOW TO PREPARE SUBSTANCES

It is very important in chemistry to know the difference between **compounds** and **mixtures**.

- A **compound** is made up of atoms bonded together to form a chemical substance.
- A **mixture** is made up of different components which are not chemically bonded.

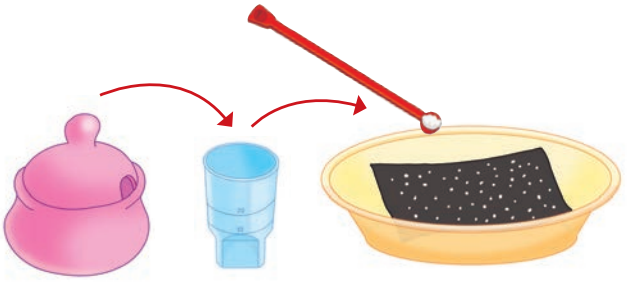
COMPOUNDS

Sugar 16

Put a black piece of paper into a container (not included in the set) and sprinkle some granules of sugar onto it.

OBSERVE THE FOLLOWING: sugar is made up of small granules like sparkling crystals. Each granule is a different size depending on how the sugar has been ground.

Sugar is a natural compound that is extracted from plants and worked into sugar crystals.



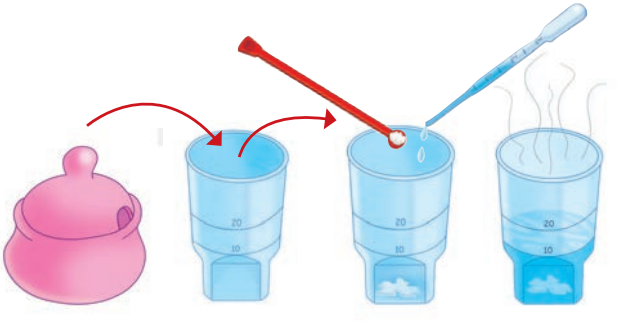
IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

How to produce sugar granules *(slow experiment)* 17

1) Take the large beaker and try to dissolve as much sugar as you can in some hot water. Dissolve well by mixing continuously until small sugar crystals form on the bottom.

2) Let the water from the solution evaporate completely and observe.

OBSERVE THE FOLLOWING: the water evaporates and you can see the sugar crystals. If you ground them they would look like they did before they were dissolved.



***EVAPORATION** is a natural phenomenon where particles of a heated liquid (or solvent) become vapour. Evaporation can happen at room temperature too, but it doesn't happen so quickly.*

18 Water (distilled water)

Ask an adult to help you

Distilled water is water that we use for batteries and irons. It doesn't have minerals in it.

When we say drinking water, we mean a solution of salts made up of water and various compounds.

NOTE: Don't drink distilled water.



Distilled water



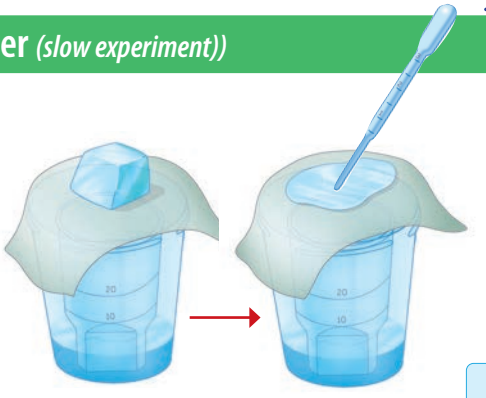
Drinking water

19 How to produce distilled water *(slow experiment))*

1) Put a small amount of tap water into the large beaker. You can use hot water. Put the small beaker inside the large beaker.

2) Cover the top with a circle of thin transparent film. Fix the film well to the sides to the beaker.

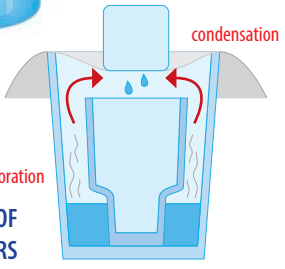
3) Put an ice cube in the middle of the film. When the ice cube has melted suck up the water with the pipette and then replace it with another ice cube.



OBSERVE THE FOLLOWING: after a while you will find a few drops of distilled water in the small beaker.

The pure water particles evaporate and rise. When they touch the cold film they return back to a liquid form and fall into the small beaker in the centre.

INFORMATION: *vapour produces distilled water when it condenses on cold surfaces: glass, bottles and beakers.*



SIDE VIEW OF THE BEAKERS

DISTILLATION: *is a laboratory procedure in which a solution is separated into its components by reheating the mixture and condensing the vapour to form a liquid. Distillation is also used to purify substances.*

MIXTURES

20 Water and flour

Ask an adult for a small amount of flour and put it in a test tube with a little water.

OBSERVE THE FOLLOWING: In this suspension it is very difficult to see the tiny particles.

You have made an opaque mixture of very small solid particles suspended in a liquid. The particles can fall down and settle on the bottom of the test tube.



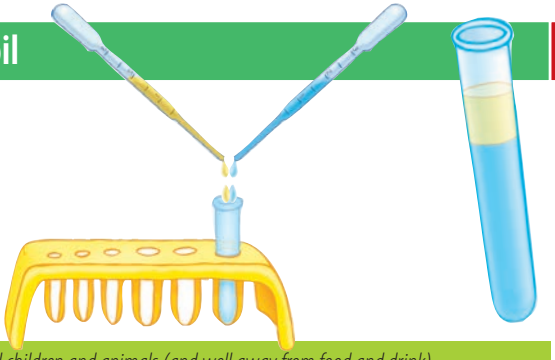
SUSPENSION: *liquid + solid*

IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

Non-mixable liquids: water and oil 21

Put half a pipette of cooking oil into a test tube with a pipette of water. Close with a stopper and shake gently.

OBSERVE THE FOLLOWING: after a while you will notice that the two non-mixable liquids have almost separated. The oil is lighter and sits on the top. Oil has a lower density than water.



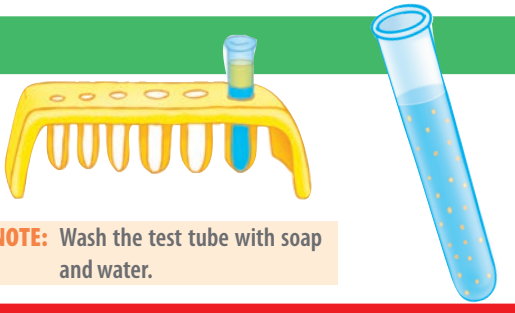
Advice: *Save for the next experiment. Keep out of reach of small children and animals (and well away from food and drink).*

How to make an emulsion 22

Take the test tube with oil and water from the last experiment and shake it for a long time.

OBSERVE THE FOLLOWING: the water and oil no longer separate. The oil has turned into tiny little drops that remain suspended in the water.

You have made an emulsion of oil and water.



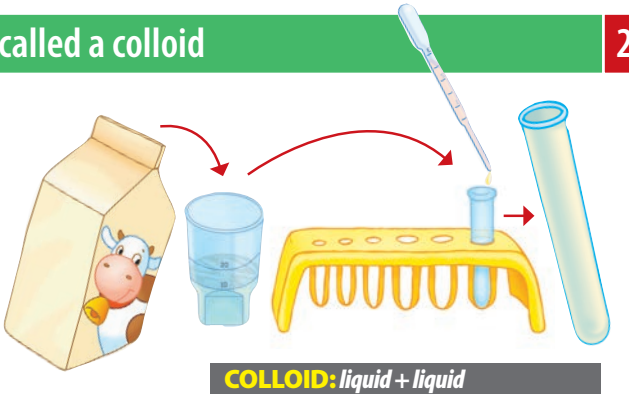
NOTE: Wash the test tube with soap and water.

IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

Milk is a very special mixture called a colloid 23

Pour some drops of milk into the sides of a test tube and see what it looks like through the light.

Colloid particles are bigger than atoms and molecules in solutions and smaller than particles in suspensions. They do not pass through a particular membrane and do not sink to the bottom of the container as they are very light. Milk can be separated into its components by centrifugation. In physics a centrifugal force is the one that causes an object moving in a circular path to move out and away from the center of its path.

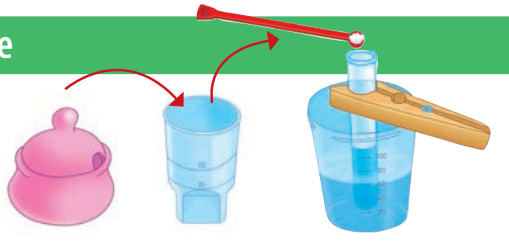


COLLOID: ***liquid + liquid***

IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

How to heat things in a bain-marie 24

Fill a test tube with the solution (water + sugar) that you want to heat and place the test tube in a beaker of hot tap water (see diagram). Use a clothes peg (not included in the set) as tongs to hold the test tube.



BAIN-MARIE: *is a way of heating the solution in a test tube without directly placing it on the heat. Instead it is simply immersed in hot water.*

IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

SOLUTIONS

25 Prepare a solution: water and coloured liquid

Ask an adult to help you

1) Pour a little coloured drink into the large beaker. Add half a pipette of coloured drink to a beaker with some water in it.

OBSERVE THE FOLLOWING: the solution has a pale colour.

2) Add another pipette of coloured drink.

OBSERVE THE FOLLOWING: the solution has more colour because it now contains more coloured parts.



IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

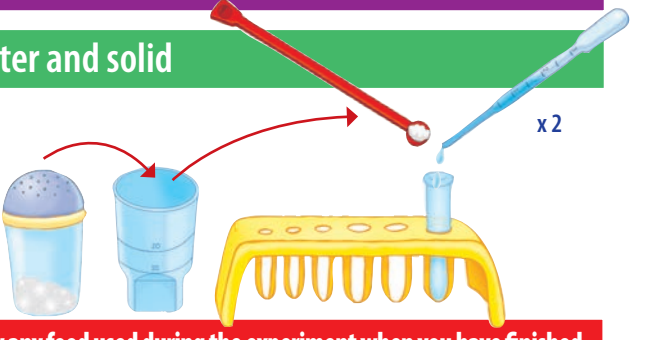
A SOLUTION: *is a mixture in which two or more substances are mixed together and cannot be told apart. When we talk about liquid solutions we mean that they are made up of a liquid solvent that contains a dissolved solute.*

26 Prepare another solution: water and solid

Take a small amount of cooking salt with the spatula and dissolve it in two pipettes of water.

Mix well with the stirrer.

OBSERVE THE FOLLOWING: the liquid is perfectly clear, you cannot see the salt.



IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

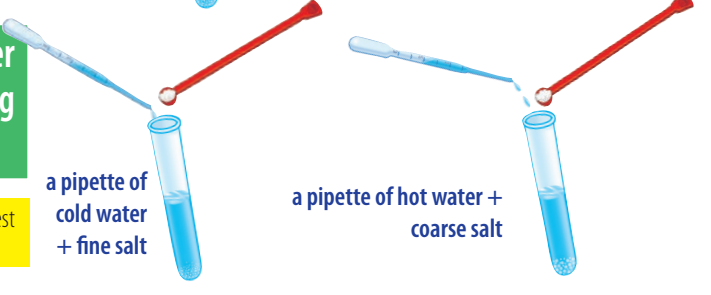
27 Prepare two solutions: water and cooking salt (fine and coarse)

OBSERVE THE FOLLOWING: in which test tube does the salt dissolve more easily?



28 Prepare two solutions: water (hot and cold) and cooking salt (fine and course)

OBSERVE THE FOLLOWING: in which test tube does the salt dissolve first?



IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

How to prepare a saturated salt solution 29

1) Take a little fine cooking salt and put it in the medium beaker. Put the salt away.

2) Put about 20 ml of hot tap water into the large beaker and then add the salt a little at a time. Mix with the stirrer, add salt, mix and add more salt until you see some solid crystals on the bottom.

OBSERVE THE FOLLOWING: some crystals on the bottom do not dissolve.

Advice: *Save for the next experiment. Keep out of reach of small children and animals (and well away from food and drink).*



SATURATED SOLUTION: *it is important to know that a liquid cannot dissolve any amount of solute (at a specific temperature). There is a limit beyond which the solute will no longer dissolve and will remain as a mass at the bottom of the solution. In these conditions the solution has reached maximum concentration and is known as saturated.*

How to get the salt out of a saturated solution *(slow experiment)* 30

1) Take a little saturated solution from the last experiment using the pipette and pour half the pipette into the small beaker.

2) Wait until the water has evaporated.

OBSERVE THE FOLLOWING: after a long time you will see salt crystals on the bottom.



IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

Observe how quickly the water evaporates *(slow experiment)* 31

1) Pour the same quantity of hot tap water into two beakers. Carefully check the volume of the two containers.

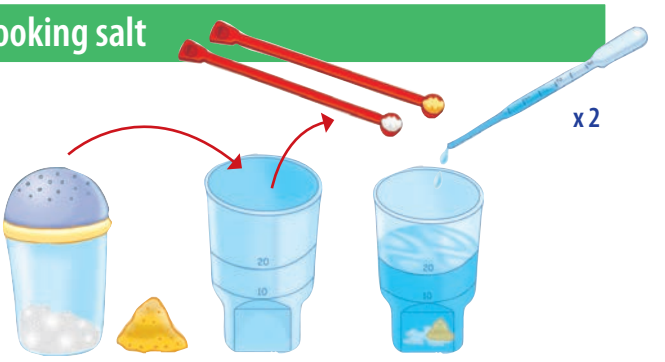
2) Put a lid on one of the two beakers.

OBSERVE THE FOLLOWING: in which beaker does the liquid reduce more quickly?
NOTE: The lid prevents the air particles from moving around freely, so water evaporates slower.



32 How to separate sand from cooking salt

EXPERIMENT WITH VARIOUS STAGES



A PREPARING A MIXTURE

1) Put a small spatula of sand (not included in the set) into the small beaker and add a spatula of cooking salt.

2) Add two pipettes of water.

OBSERVE THE FOLLOWING: the sand does not dissolve in the water because it is insoluble.

Advice: *Save for the next experiment. Keep out of reach of small children and animals (and well away from food and drink).*

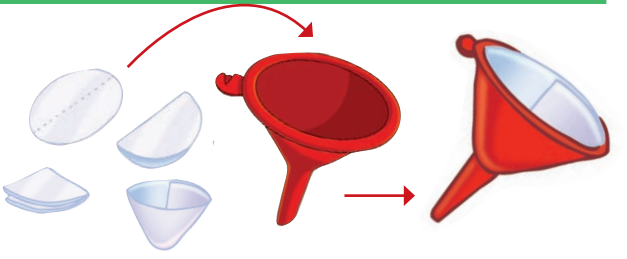
33 How to prepare a paper filter

B PREPARATION OF THE FILTER

Ask an adult to help you

1) Cut out a circle of filter paper that is twice as big as the funnel. Fold it as shown in the diagram.

2) Put the filter into the funnel and use a little water to stick it to the sides.



34 Filter the mixture: the sand stays in the filter

C FILTRATION

Advice: *If there is too much water to filter it all into one test tube, prepare another empty test tube.*

Pour the water and sand mixture through the filter paper in the funnel. Use the stirrer to help guide the liquid.

OBSERVE THE FOLLOWING: the sand is on the filter as it cannot pass through the holes in the paper. The salt solution is in the test tube as it can pass through the filter.



Advice: *Save for the next experiment. Keep out of reach of small children and animals (and well away from food and drink).*

35 Separating salt from water

D EVAPORATION

Pour the filtered liquid from the test tube into a container (not included in the set).

OBSERVE THE FOLLOWING: after a few hours you will see salt crystals on the bottom of the container.



IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

Separating salt from flour in water 36

TWO-STAGE PROCEDURE

A FILTRATION

1) Completely dissolve some cooking salt in some water. Add a pinch of flour and mix with the stirrer.

OBSERVE THE FOLLOWING: the flour does not dissolve.

2) Prepare a filter and separate the flour from the water with the salt dissolved in it.

OBSERVE THE FOLLOWING: the flour is on the filter and the dissolved salt is in the filtrate in the test tube.



Advice: *Save for the next experiment. Keep out of reach of small children and animals (and well away from food and drink).*

Separating salt from water 37

B EVAPORATION

Pour the filtered liquid from the test tube into a container (not provided in set).

OBSERVE THE FOLLOWING: after a few hours you will see salt crystals on the bottom of the container.



IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

Separating sugar from flour in water 38

TWO-STAGE PROCEDURE

A FILTRATION

1) Put a little flour in some water, add a pinch of icing sugar and mix with the stirrer.

OBSERVE THE FOLLOWING: the flour does not dissolve.

2) Prepare a filter and separate the flour from the water with the icing sugar dissolved in it.

OBSERVE THE FOLLOWING: the flour is on the filter and the icing sugar is in the filtrate in the test tube.



Advice: *Save for the next experiment. Keep out of reach of small children and animals (and well away from food and drink).*

Separating sugar from water 39

B EVAPORATION

Pour the filtered liquid from the test tube into a container (not included in the set).

OBSERVE THE FOLLOWING: after a few hours you will see sugar crystals on the bottom of the container.



IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

40 How to discover the colours ink is made up of

Ask an adult to help you

1) Find some ballpoint pens and felt-tipped pens of various colours.

2) Cut out a piece of filter paper or absorbent paper to fit vertically in the medium plastic beaker.

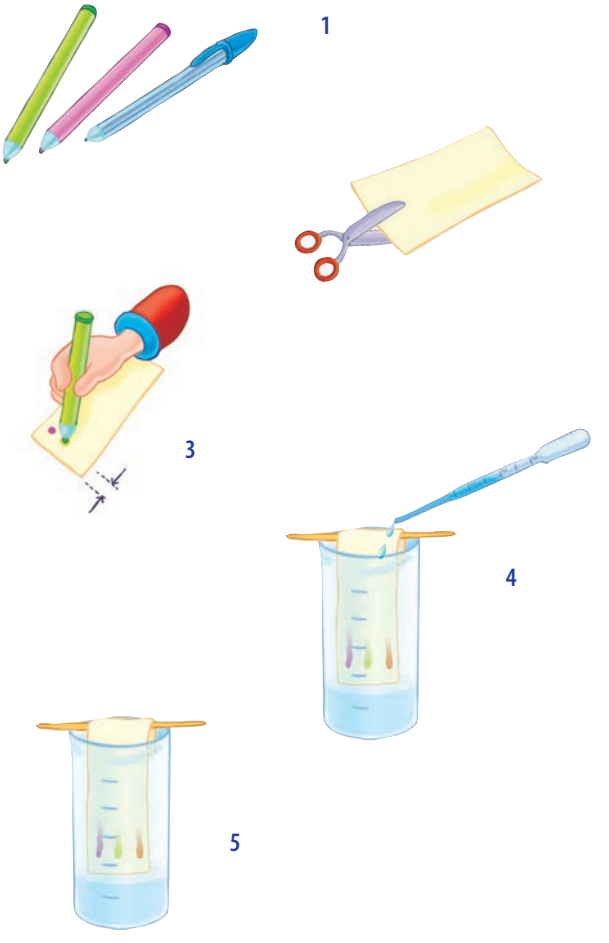
3) Draw several coloured dots with the pens and felt tips just above the bottom of the absorbent paper.

4) Fold the strip of paper over a toothpick and make sure it is well fixed. The marks should be on the bottom and should rest against the sides of the beaker.

5) Put a very small amount of water into the beaker using the pipette. The water should just touch the paper and not touch the coloured dots.

OBSERVE: after a while (10 minutes) you will notice the water travelling up the paper. As the water climbs up the paper strip, it drags along the components of the inks, the more soluble components (pigments) will ravel furthest on the strip, the least soluble pigments will trail behind.

This method is used to separate components of a coloured mixture. Any sample of ink can in fact be separated into its respective cyan, magenta, and yellow components.

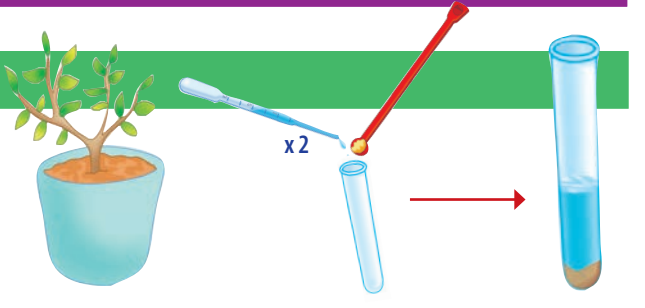


***CHROMATOGRAPHY:** is a very effective way of separating the different substances in a mixture. A liquid, for example water, can transport the compounds of a mixture along a strip of paper.*

41 Decanting mud

Put two pipettes of water and one spatula of soil into a test tube.

OBSERVE THE FOLLOWING: the earth slowly falls to the bottom and after a while the liquid is clear again.



***DECANTATION:** this method can separate a solid from a liquid in a mixture by simply using the weight of the solid component. The solid part falls to the bottom of the test tube and the liquid part stays on top.*

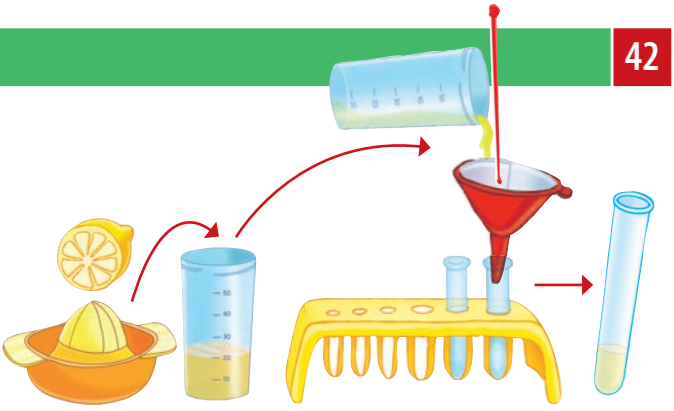
Filtering lemon juice 42

Ask an adult to help you

1) Take half a lemon and squeeze out the juice with a lemon squeezer. Pour it into a beaker.

2) Prepare a filter and separate the lemon juice from the pulp and pips.

OBSERVE THE FOLLOWING: the filtrate in the test tube only contains the juice.



IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

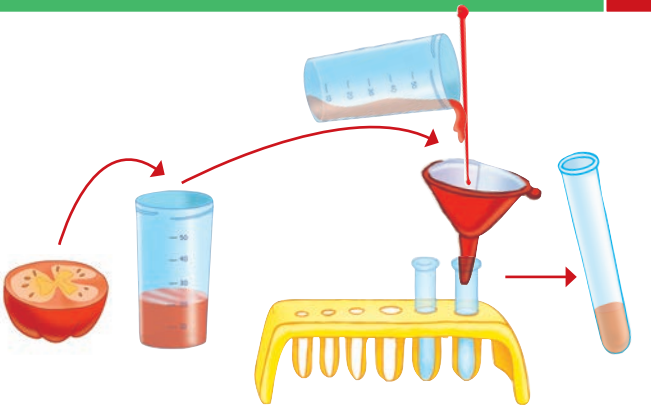
Filtering tomato juice 43

Ask an adult to help you

1) Take half a tomato, put it into a beaker and cut into a mush that can then be filtered.

2) Prepare a filter and separate the tomato juice from the pulp and seeds.

OBSERVE THE FOLLOWING: the filtrate in the test tube only contains the juice.



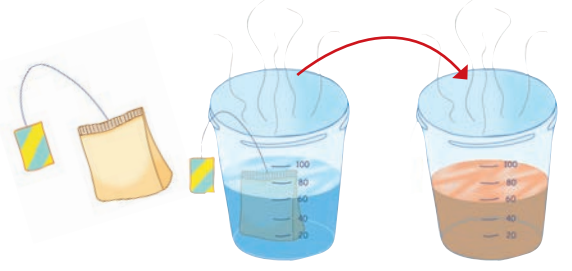
IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

Hot water and tea 44

Ask an adult to help you

Ask an adult to make some tea by putting a teabag into hot water. Leave it to brew for a while and then let it cool down.

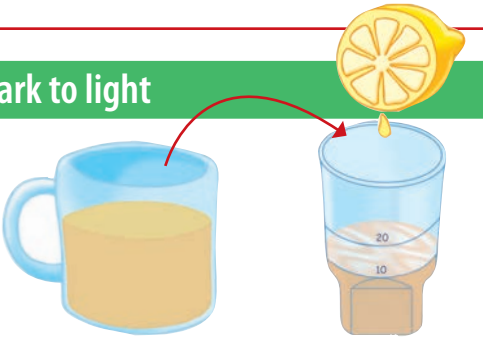
OBSERVE THE FOLLOWING: the solution slowly turns brown because hot water has the capacity to extract the substances from inside the leaves.



IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

EXTRACTION WITH A SOLVENT: *water is a powerful solvent that can dissolve many substances, heat helps this.*

45 The different shades of tea: from dark to light



Ask an adult to help you

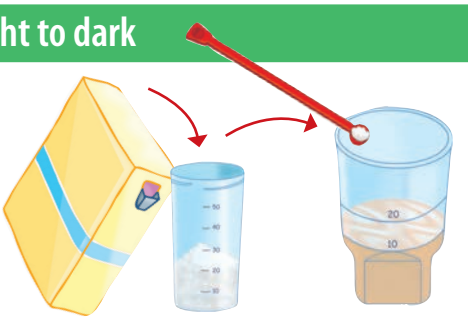
1) Ask an adult to make some tea without sugar and let it cool down. Then pour a little into the small beaker.

2) Squeeze some lemon drops into the tea.

OBSERVE THE FOLLOWING: the solution changes colour and becomes clearer. There is a colorant in the in tea leaves that changes colour when it comes into contact with the acidic substance in the lemon.

Advice: *Save for the next experiment. Keep out of reach of small children and animals (and well away from food and drink).*

46 The different shades of tea: from light to dark



Ask an adult to help you

Pour a little sodium hydrogen carbonate (bicarbonate of soda - not included in the kit) into the medium beaker and also use the spatula to transfer a small amount of bicarbonate of soda into the tea.

OBSERVE THE FOLLOWING: the tea solution becomes dark again. The bicarbonate cancels out the acidity of the lemon.

NOTE: **Bicarbonate of soda** (not included in the set) has the IUPAC scientific name: **sodium hydrogen carbonate**. It is a common household ingredient and can easily be found at a supermarket or chemist's. From now on this substance will be referred to as bicarbonate of soda or bicarb.

IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

47 Even red cabbage changes colour

NOTE: Find a red cabbage from a greengrocer. There is a coloured substance in its leaves, which in scientific language is called an **INDICATOR**.

CHEMICAL INDICATORS: *are substances that can change colour when put in contact with certain compounds known as acids and alkalis.*

A Experiment: the red cabbage becomes...

Rub a cut piece of a red cabbage leaf onto a square of white paper to produce purple marks.

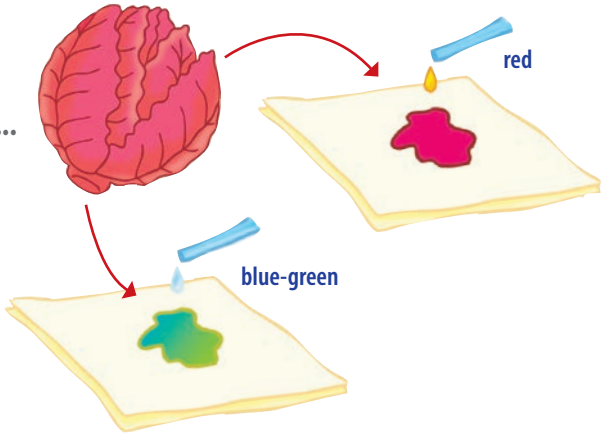
Drop some lemon juice onto the purple mark.

B Experiment: the red cabbage becomes...

Rub a cut piece of a red cabbage leaf onto a square of white paper to produce purple marks.

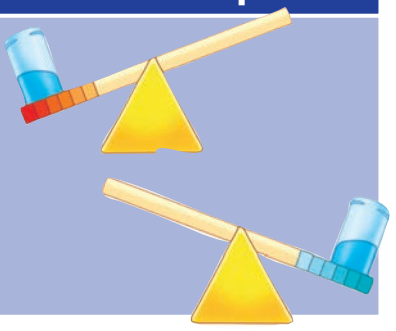
Put some bicarb and a drop of water on the mark.

OBSERVE THE FOLLOWING: compare the red colour of the cabbage with the lemon; compare the blue-green colour with the sodium hydrogen carbonate (bicarb).

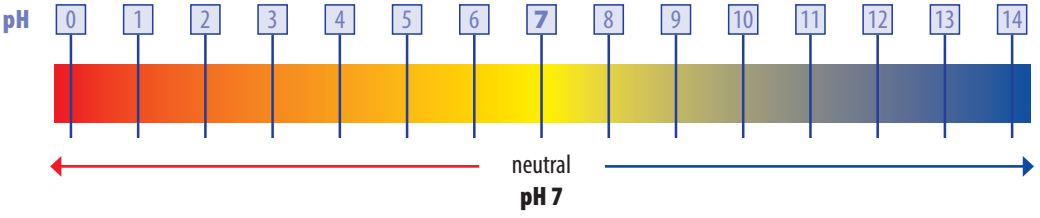


THE INDICATOR MEASURES ACIDITY AND ALKALINITY USING THE pH SCALE

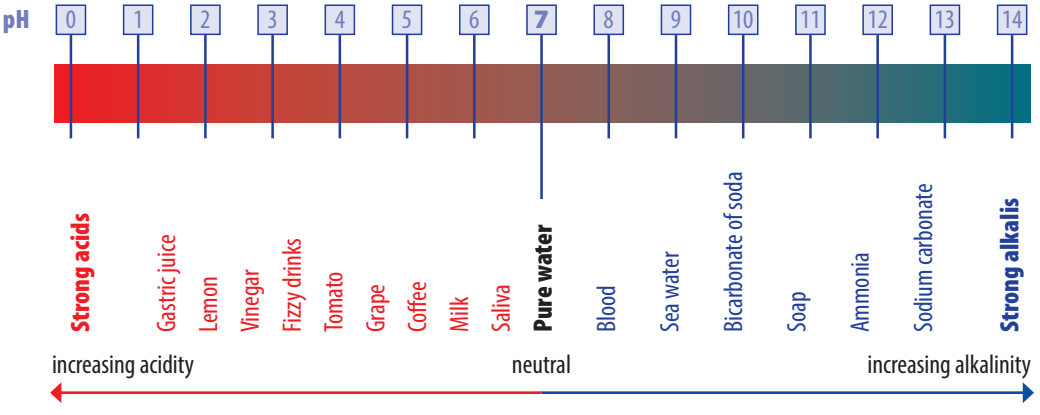
- Chemists can also use compounds that change colour to discover whether a substance is acidic or alkaline. They can even express how acidic or alkaline they are by using a special scale called "pH". These values range from 0 to 14.
- You need to match the colour of the indicator used to the level of acidity or alkalinity of the substance.

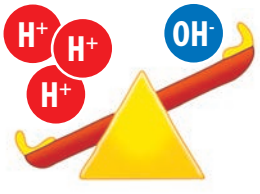


Coloured scale of the universal indicator

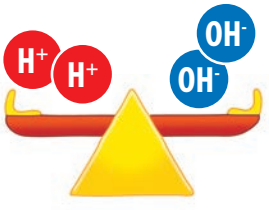


Coloured scale of the red cabbage indicator

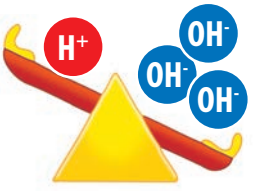




Lots of ions
H^+



Balance between ions
H^+ and OH^-



Lots of ions
OH^-

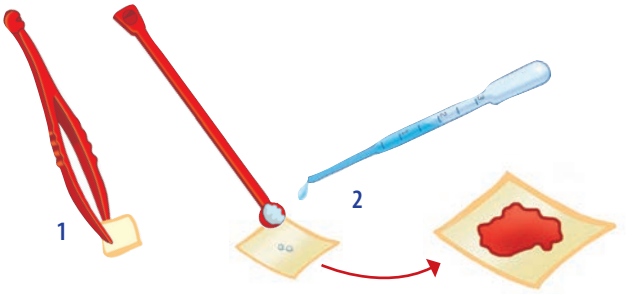
48 Test an acid on the universal indicator paper

1) Take a piece of the yellow universal indicator paper, do not touch it with your fingers. Use the tweezers.

2) Put two granules of **tartaric acid** on it and a drop of water.

OBSERVE THE FOLLOWING: the indicator will show the acidic pH value of the substance.

Tartaric acid has an acidic pH value



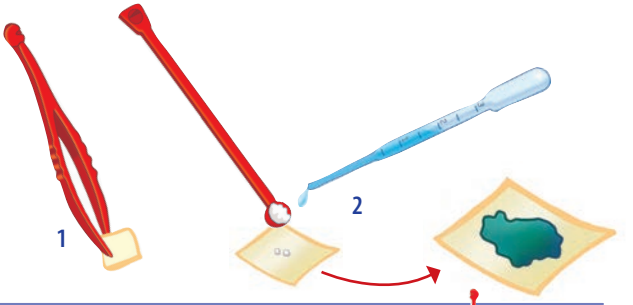
49 Test an alkali with the universal indicator paper

1) Take a piece of the yellow universal indicator paper, do not touch it with your fingers. Use the tweezers.

2) Put two granules of sodium carbonate on it and a drop of water.

OBSERVE THE FOLLOWING: the indicator will show the alkali pH value of the substance.

Sodium carbonate has an alkali pH value

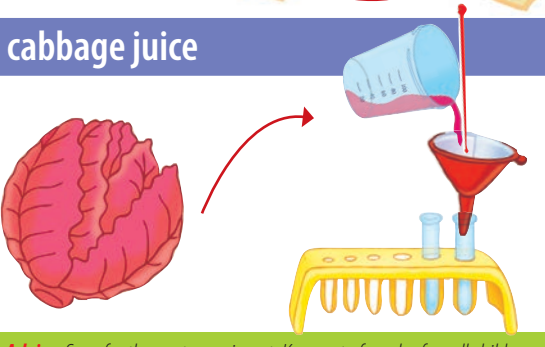


50 Prepare an indicator using red cabbage juice

Ask an adult to help you

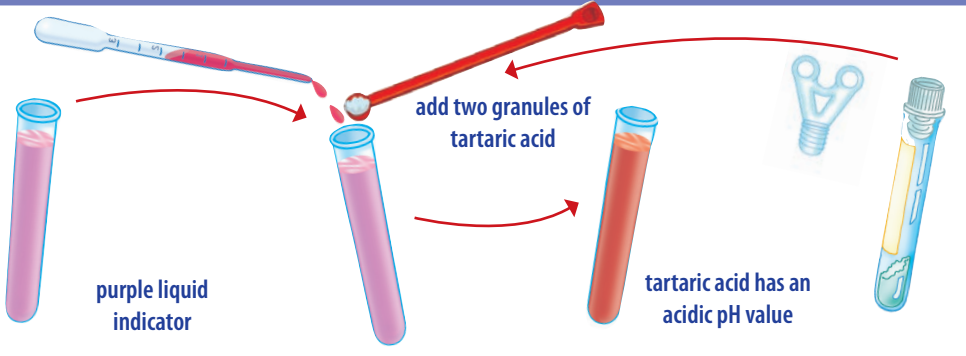
Ask an adult to put some hot tap water into the large beaker. Cut a red cabbage leaf into small pieces and put it into the water. Mix with the spatula for several minutes. Filter the red cabbage solution into a test tube.

OBSERVE THE FOLLOWING: the hot water has extracted the red cabbage indicator from the cabbage leaf. You can use it for your experiments.



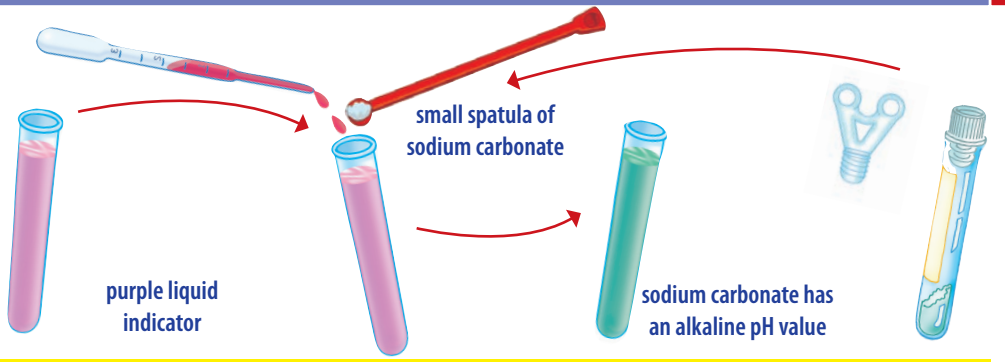
Advice: *Save for the next experiment. Keep out of reach of small children and animals (and well away from food and drink).*

51 Try the liquid red cabbage pH indicator



OBSERVE THE FOLLOWING: when the solution has a neutral pH value (in the centre of the scale) the colour is purple. When you add tartaric acid the indicator turns red. This means it has an acidic pH value.

Try the liquid red cabbage pH indicator 52



OBSERVE THE FOLLOWING: when the solution has a neutral pH value (in the centre of the scale) the colour is purple. When you add sodium carbonate, which is an alkaline salt, the indicator turns blue-green. This means it has an alkaline pH value.

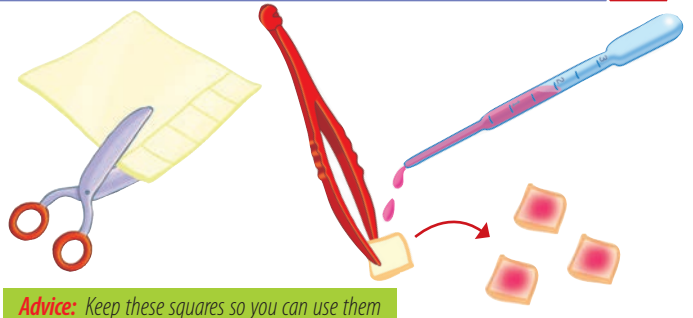
Prepare paper red cabbage indicators 53

Ask an adult to help you

1) Prepare lots of small squares from absorbent paper or filter paper.

2) Pour a drop of the red cabbage liquid indicator onto each square of paper and leave to dry.

NOTE: When you have finished the filter paper use paper tissues.



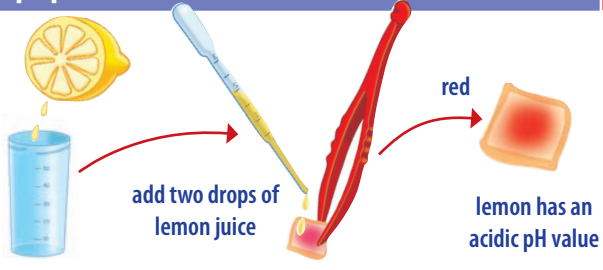
Advice: Keep these squares so you can use them to find out the pH values of other substances.

Test an acid with the indicator paper 54

Use the paper prepared with the red cabbage and use tweezers.



OBSERVE THE FOLLOWING: the indicator will show the acidic pH value of the substance.

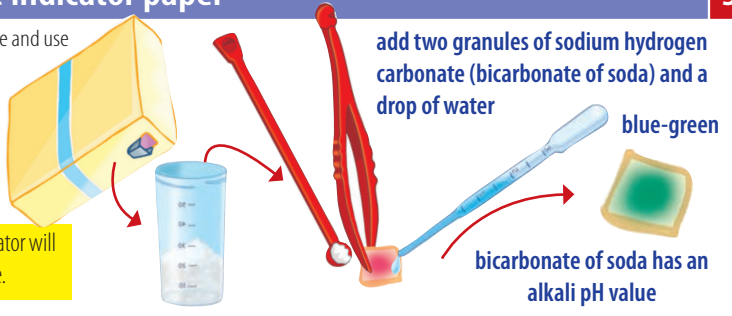


Test an alkali with the indicator paper 55

Use the paper prepared with the red cabbage and use tweezers.



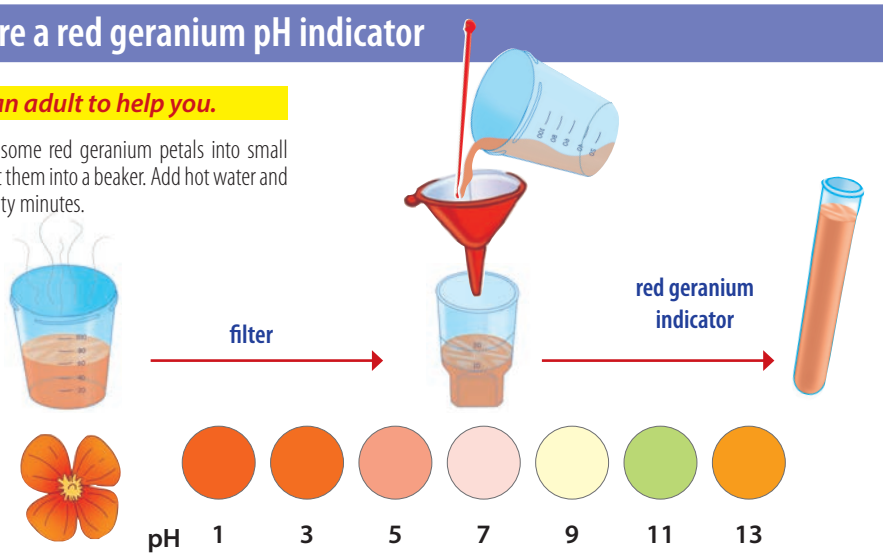
OBSERVE THE FOLLOWING: the indicator will show the alkali pH value of the substance.



56 Prepare a red geranium pH indicator

Ask an adult to help you.

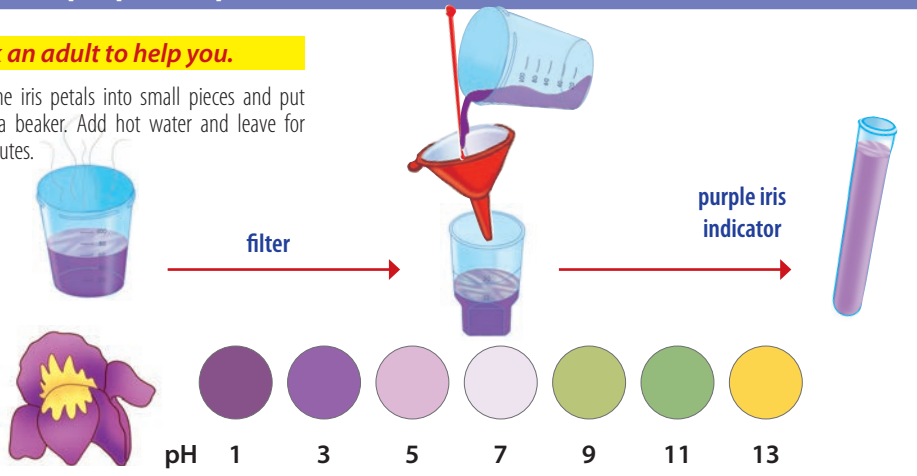
Cut up some some red geranium petals into small pieces and put them into a beaker. Add hot water and leave for twenty minutes.



57 Prepare a purple iris pH indicator

Ask an adult to help you.

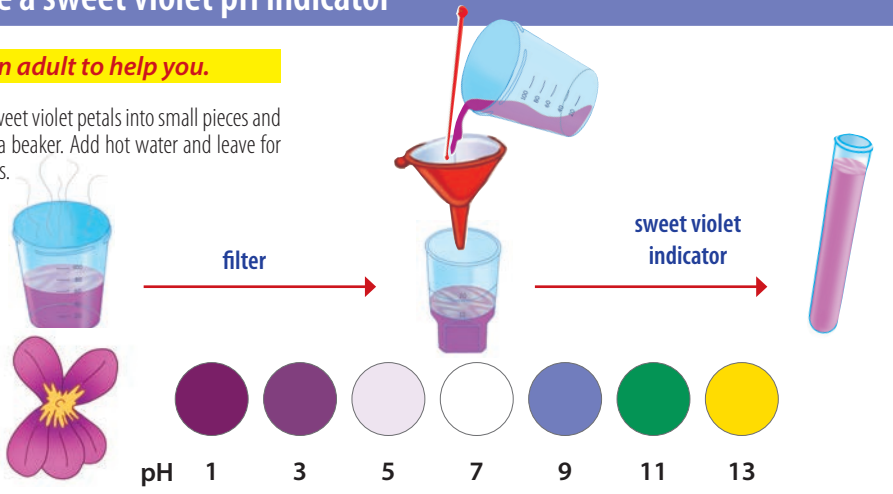
Cut up some iris petals into small pieces and put them into a beaker. Add hot water and leave for twenty minutes.



58 Prepare a sweet violet pH indicator

Ask an adult to help you.

Cut up some sweet violet petals into small pieces and put them into a beaker. Add hot water and leave for twenty minutes.



TIME FOR A BREAK - GAMES AND SURPRISES

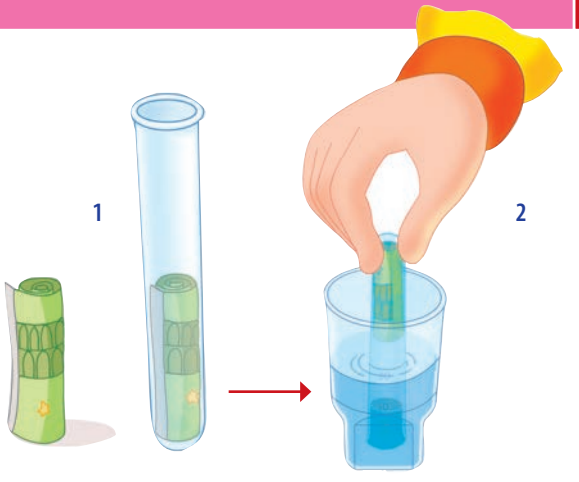


A rich man's game! 59

1) Ask an adult to lend you a ten pound note. Roll it up and put it inside a test tube. Use the stirrer to help you.

2) Turn the test tube upside-down, place it vertically into a beaker of water and then lift it out again. Take the ten pound note out of the test tube and check to see if it is dry.

OBSERVE THE FOLLOWING: the ten pound note is perfectly dry; the air (mixture of particles like oxygen and nitrogen) inside the test tube stops the water from rising up.



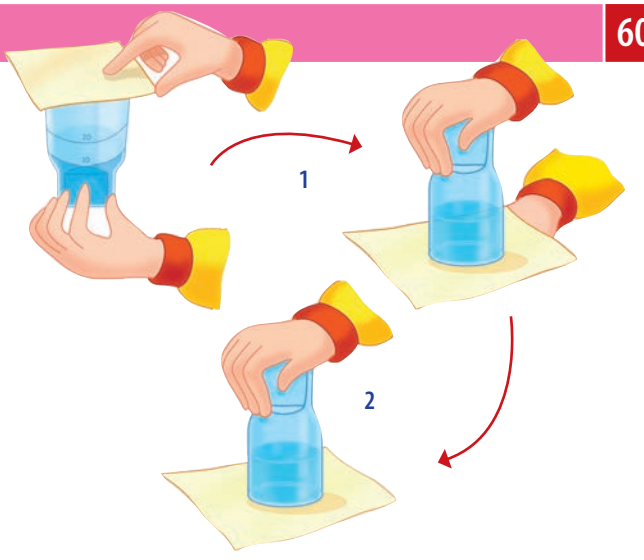
Air pushes in all directions 60

NOTE: Do this outside or over a sink.

1) Put a little water in a plastic beaker. Wet the rim of the beaker and stick a piece of card to it. Make sure the card is stretched tight. Check that it is stuck well to the rim.

2) With a quick, smooth movement - no jerks - turn the beaker upside-down and hold it up in the air.

OBSERVE THE FOLLOWING: the air pressure pushes in all directions and also pushes from the bottom of the piece of paper, stopping the water from escaping.

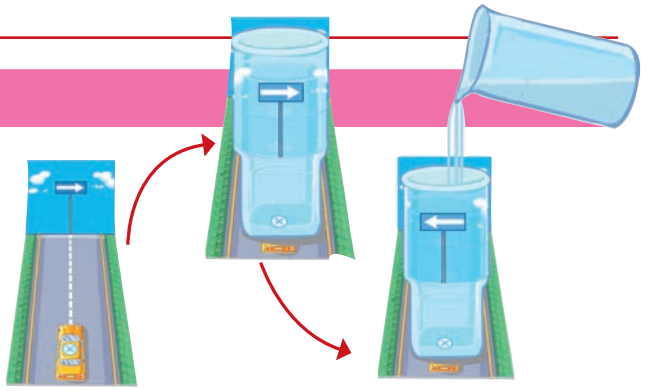


61 Reversing

Ask an adult to help you

1) Take a 25cm piece of card (not included in the set) and fold it about a quarter way down. Draw a horizontal arrow on the raised part and an X on the flat part, where the car is on the diagram.

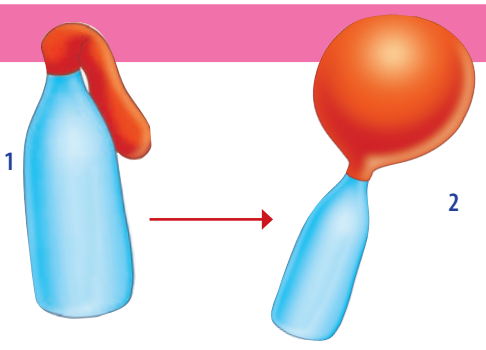
2) Place a beaker on the X. Look carefully through the beaker to see the direction of the arrow when it is still empty. Then fill the beaker with water and look through it again.



OBSERVE THE FOLLOWING: when the beaker is empty the arrow points in one direction and when it is full the arrow points in the opposite direction. This is because the water in the beaker acts as a lens and inverts the image when placed at a certain distance.

62 Heat dilates air

1) Put a rubber balloon onto an empty bottle (see diagram). Heat it on a radiator or in the sun: the balloon inflates.



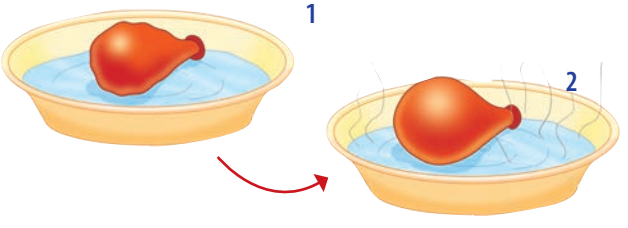
OBSERVE THE FOLLOWING: the balloon inflates because hot air particles move around a lot and take up more space in the balloon.

2) Cool the bottle down with cold water: the balloon deflates.

OBSERVE THE FOLLOWING: the balloon deflates because cold air particles only move a little and take up less space.

63 Balloons inflate with heat

1) Partly blow up a balloon. Tie it and put it into a container (not included in the set) for several minutes with water and ice.



OBSERVE THE FOLLOWING: nothing happens.

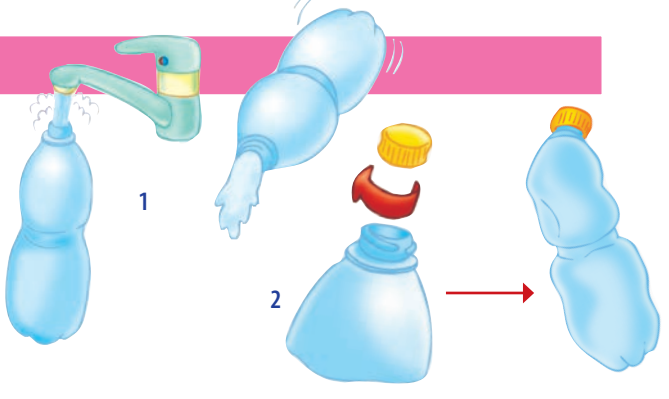
2) Take the balloon and put it in a container with hot tap water.

OBSERVE THE FOLLOWING: the heat increases the volume of the air particles in the balloon.

64 Crushing plastic bottles...

1) Fill a plastic bottle with hot tap water.

2) Empty it and put the lid on quickly. Keep your eyes on the bottle.

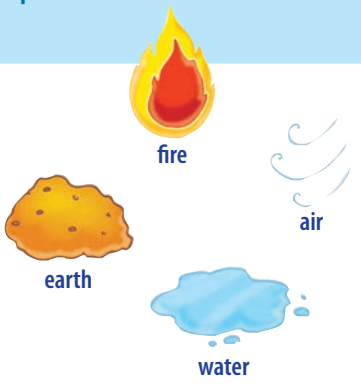


OBSERVE THE FOLLOWING: the sides of the bottle are sucked in because the **air pressure** (mixture of particles) outside the bottle is stronger than the air pressure inside.

CHEMISTRY STUDIES MATTER

Greek philosophers proposed different theories about matter 2,500 years ago.

Empedocles of Agrigentum believed matter was made up of four elements.



According to Democritus:



ATOMS

Atoms are made up of protons and neutrons that are found in the nucleus. The electrons orbit around the nucleus.

IONS

A positive ion is formed when an atom or molecule loses electrons. A negative ion is formed when it acquires electrons.

DIAGRAM OF HYDROGEN ATOM

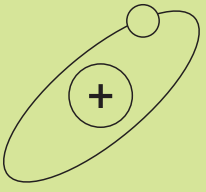


DIAGRAM OF HYDROGEN ION



FAMOUS CHEMISTS



R. Boyle 1627-1691
Known for formulating Boyle's law, which states that if the volume of a gas is decreased, the pressure increases in proportion. Boyle implemented many standard chemical tests, such as the litmus test.



A. Lavoisier 1743-1794
Considered to be the founder of modern chemistry, in part due to recognising and naming oxygen and hydrogen. He also invented new scientific instruments and precise methods to analyse chemical compounds.

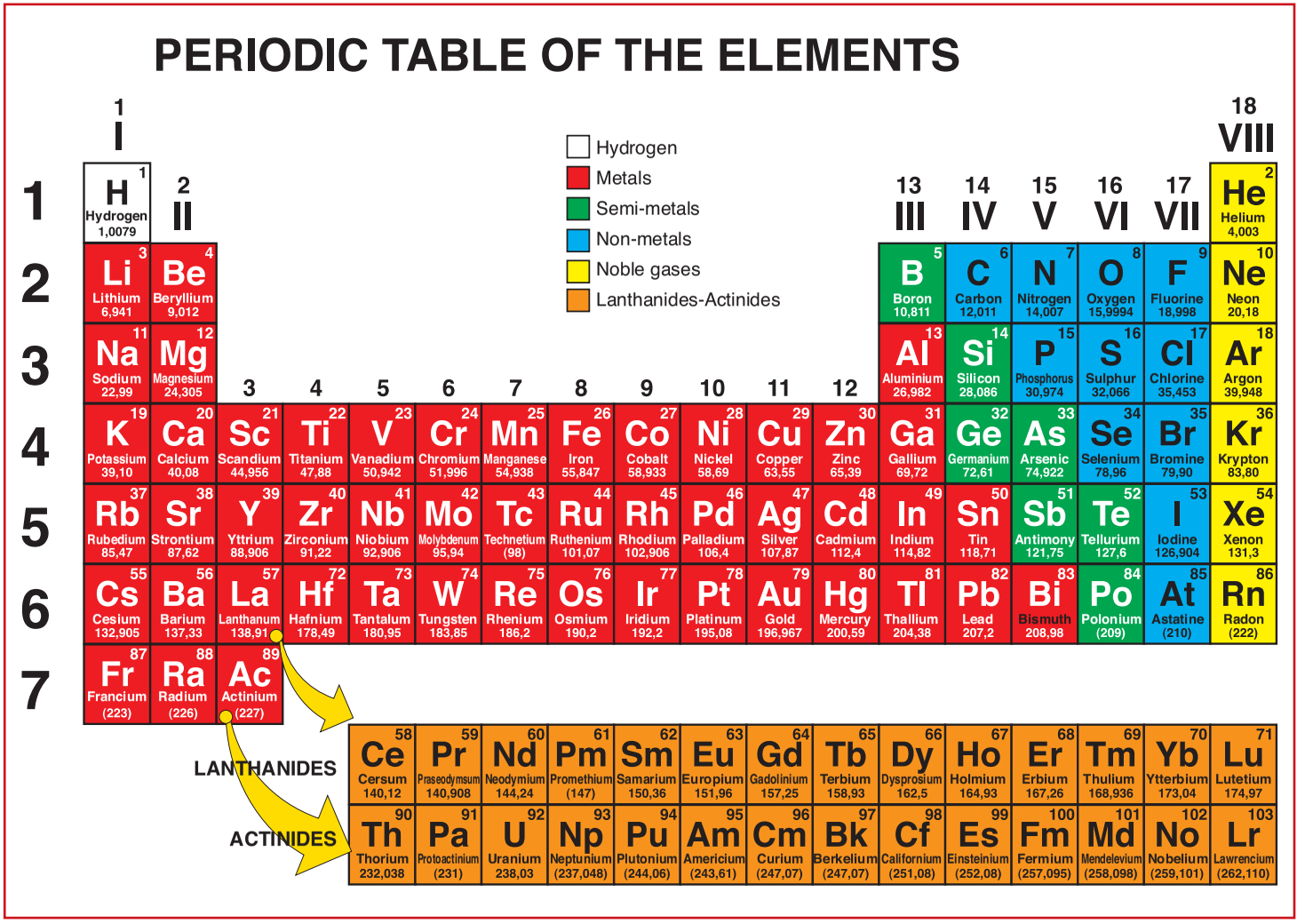


J. Dalton 1766-1844
A chemist, physicist and meteorologist.
Dalton suggested a new atomic theory which explained chemical reactions, based on the idea that atoms were indivisible.



M. Curie 1867-1934
The first scientist to receive two Nobel Prizes, one in physics for discovering two new elements (radium and polonium) and one in chemistry for her work on radioactivity.

PERIODIC TABLE OF THE ELEMENTS



PERIODIC TABLE OF ELEMENTS

Turn the manual sideways so you can look at the table of elements properly.

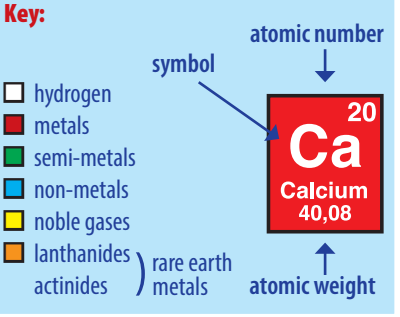
TODAY – here are about one hundred elements that make various substances when arranged in different combinations.

PERIODIC TABLE OF ELEMENTS

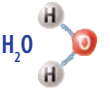
The periodic table is a useful tool to quickly check information about an element. You don't even need to be an expert! The elements are arranged according to their atomic number (number of protons in the atom), which increases along the horizontal lines, known as periods. As you go along the properties of the elements (punctuation and layout) vary, while elements in the same column, known as a group, have the same properties.

Key:

- hydrogen
- metals
- semi-metals
- non-metals
- noble gases
- lanthanides, actinides) rare earth metals



An **element** is made up of one type of atom with the same atomic number.
For example: *the element hydrogen is made up of very light hydrogen atoms. Different elements are made up of atoms with different atomic weight.*
A **compound** is a combination of atoms from different elements.
For example: *water is made up of hydrogen H and oxygen O atoms.*

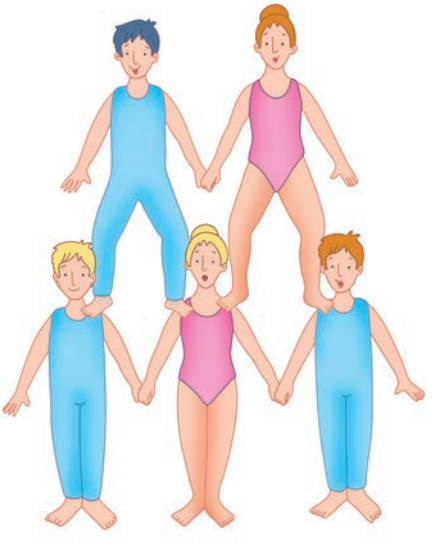


Compounds are divided into **inorganics**: water, chalk, mineral, salts, etc. and **organics** (**containing carbon**): methane, plastics and live matter.



The father of modern organic chemistry is the German scientist **F. WÖHLER** (1800-1882)

MODELS OF PHYSICAL MATTER



SOLIDS: the particles are "fixed" and arranged in order.



LIQUIDS: with heat the particles have more freedom and move around.





GASES: with a lot of heat the particles move around even more.

MOLECULES

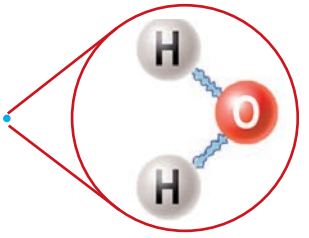
The **molecule** is the smallest part of the substance that has the chemical characteristics of that same substance. The atoms are joined (linked) in a specific order.



a large quantity of water is made up of **molecules**



a small quantity of water is made up of **lots of molecules**



the smallest part of water is made up of **one molecule**

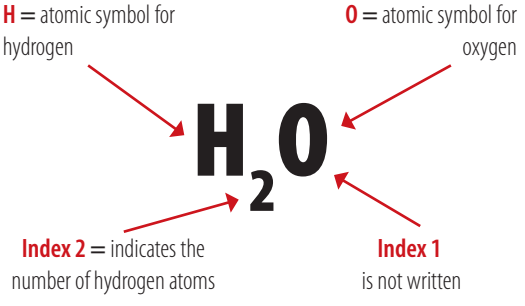
CHEMICAL FORMULAE

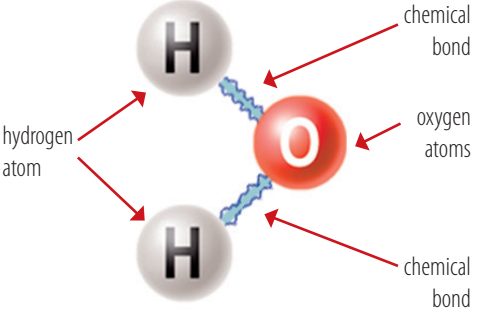
A **chemical formula** represents the molecule in symbols (the symbol of the atom) and numbers (the number of the atom in that formula).

E.g. **water**

EMPIRICAL FORMULA *(we say aitch-two-oh)*
It tells you which elements there are in the molecule.

STRUCTURAL FORMULA *(we say aitch-two-oh)*
It tells you how the atoms in the molecule are arranged.





A **chemical bond** between the atoms is the force that keeps the atoms in a molecule together.
Oxygen has two bonds because it has **2 valence electrons** and hydrogen has one bond because it has **1 valence electron**.

VALENCE: the amount of power of an atom which is determined by the number of electrons the atom will lose, gain, or share when it forms compounds.

Atoms join together naturally in different ways, creating millions and millions of compounds. All bonds, and therefore the valences in compounds, must be combined.

MATTER

Matter is everything that has mass and takes up space.



PURE SUBSTANCE

A **substance** has the same composition in each of its parts and pure substances contain **elements** and **compounds**.

ELEMENTS

An element is made up of one type of atom.

- **Carbon**
- **Aluminium**
- **Hydrogen**
- **Oxygen**

COMPOUNDS

A compound is made up of different types of atoms.

- **Water**
- **Carbon dioxide**
- **Sugar**
- **Cooking salt**

MIXTURES

A **mixture** is made up of two or more substances with **varying compositions**.

HOMOGENEOUS MIXTURES

A composition of different substances that cannot be told apart, not even with a lens.

- **Water and sugar**
- **Sparkling water**
- **Air**
- **Water and salt**

HETEROGENEOUS MIXTURES

A composition of different substances that can be told apart with the naked eye or with a lens.

- **Granite**
- **Milk**
- **Soap bubbles**
- **Smoke**

ELEMENTS

An **element** is made up of one type of atom.

65 Carbon in a pencil lead

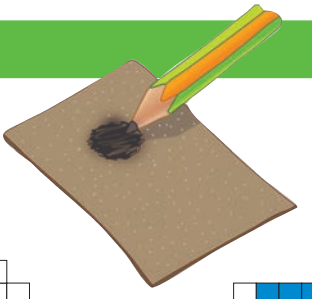
Take a pencil and sand a little lead onto a white piece of paper.

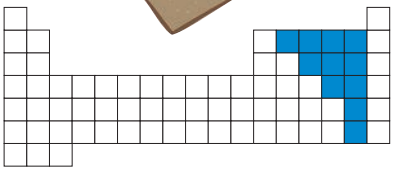
OBSERVE THE FOLLOWING: the blackish matter is a mineral called graphite.

Graphite conducts electric currents and is a material that is almost totally made up of pure carbon.

CHEMICAL SYMBOL **C**

Carbon is a non-metal.





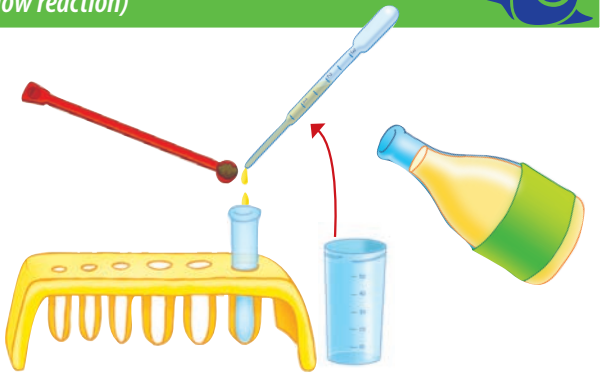
Try to find carbon in the periodic table.

66 Iron and vinegar: hydrogen *(slow reaction)*

Ask an adult to help you

Take a piece of iron (not included in the set. You can buy it from a hardware store).
Sand it into a point with sandpaper (not included in the set) and put it into a test tube with vinegar.

OBSERVE THE FOLLOWING: tiny hydrogen bubbles develop. Shake the test tube a little while you observe what is happening.



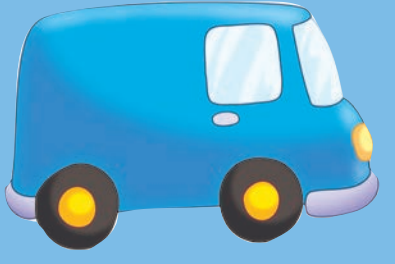
TECHNOLOGICAL NOTE

CARS OF THE FUTURE WILL BE RUN ON HYDROGEN

1st type: a car with a traditional motor except it uses hydrogen instead of petrol so the polluting emissions are reduced: it produces water vapour. There will probably be some problems with the construction and geographical spread of filling stations and the production of hydrogen.

2nd type: another type of car engine even more evolved is an electric engine that uses electricity produced by the car itself from combustible cells or "fuel cells" fed by hydrogen.



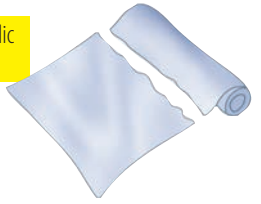


Metallic aluminium (kitchen foil) 67

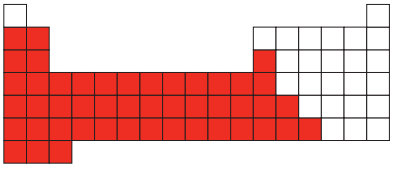
Ask an adult for a small square of kitchen foil (not included in the set).

OBSERVE THE FOLLOWING: this metallic material is shiny and malleable.

It conducts heat and electric energy.



Try to find aluminium in the periodic table.



CHEMICAL SYMBOL **Al**

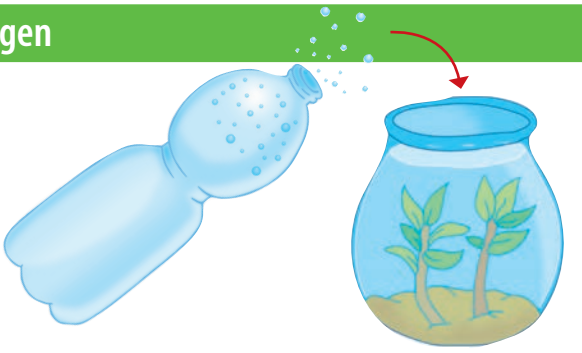
Aluminium is a metal.

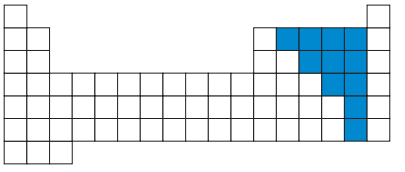
Plants and algae produce oxygen 68

Ask an adult to help you

1) Take an **ELODEA** plant (not included in the set). It's an aquatic plant and you can find it at a pet shop or garden centre.
2) Immerse the ELODEA plant into a basin of mineral water (you can also use sparkling water). Change the water from time to time (**do not use tap water**).

OBSERVE THE FOLLOWING: when it is exposed to the light it produces oxygen bubbles.





Try to find oxygen in the periodic table.

CHEMICAL SYMBOL **O**

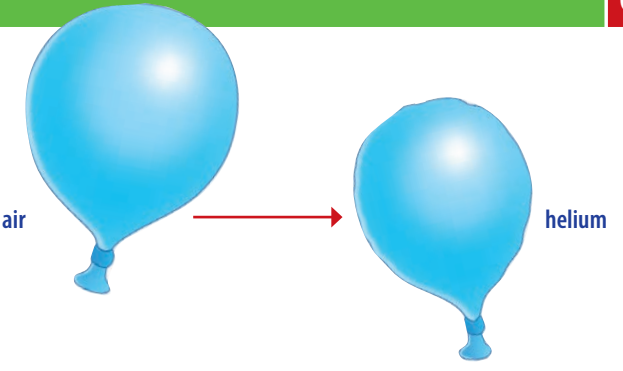
Oxygen is a non-metal.

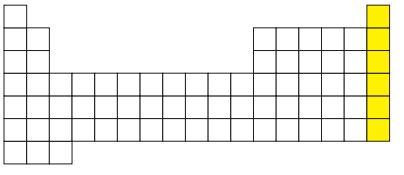
Gas inflates balloons 69

Ask an adult to help you

Buy a helium balloon from a party shop or joke shop. Inflate a balloon with air and compare it with the helium balloon.

OBSERVE THE FOLLOWING: the inflated balloon stays the same size for longer. The helium balloon (inflated with non-flammable helium) shrinks much quicker because helium atoms can escape through the sides of the balloon.





Try to find helium in the periodic table.

CHEMICAL SYMBOL **He**

Helium is a noble or rare gas.

HOMOGENEOUS MIXTURES

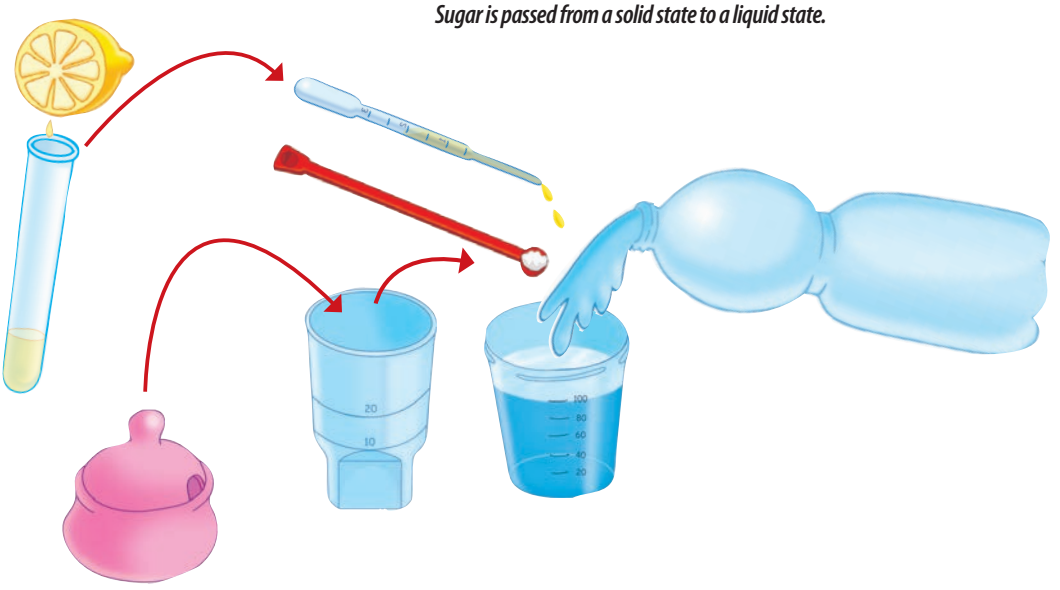
A **homogeneous mixture** is made up of different substances that cannot be told apart, not even with a lens.

70 Homogeneous solutions: water, lemon juice and sugar

Dissolve a little sugar in some water in a plastic beaker, add a few drops of lemon juice and mix together.

OBSERVE THE FOLLOWING: even with a lens the solution seems homogeneous and quite transparent.

Sugar is passed from a solid state to a liquid state.



IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

71 A sparkling solution: water and CO_2 bubbles

Take an unopened bottle of fizzy drink.

OBSERVE THE FOLLOWING: the liquid inside is transparent. You cannot see the bubbles. As soon as you open the bottle the carbon dioxide bubbles will appear and start travelling to the upwards.

When the bottle is opened the air pressure reduces and the gas inside the liquid starts to fizz.



HETEROGENEOUS MIXTURES

A **heterogeneous composition** is made up of different substances that can be told apart with the naked eye or with a lens.
Colloids have special characteristics but can be considered as heterogeneous.

Salt (fine and coarse) and pepper 72

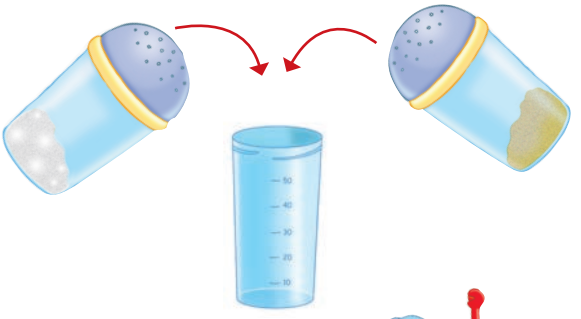
TWO-STAGE PROCEDURE

FIRST STAGE

Take some fine salt, coarse salt and a little pepper. Put them all together and then think how you can separate the components.

OBSERVE THE FOLLOWING: the salt and pepper particles are all different shapes and sizes.

Advice: *keep for the next experiment.*

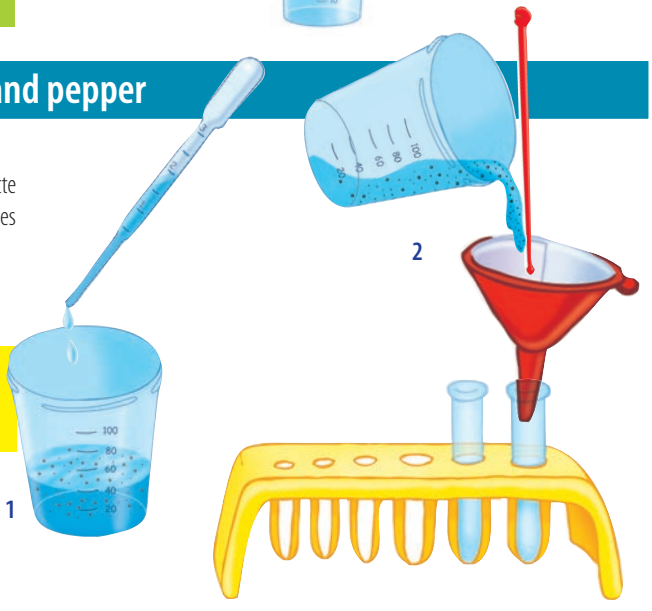


How to separate the salt and pepper 73

SECOND STAGE

1) Pour the mixture into a beaker and add a pipette of water. Mix well. The pepper is insoluble (it does not dissolve).
2) Filter the mixture.

OBSERVE THE FOLLOWING: the pepper is in the filter in a solid state; the dissolved salt is found in the filtrate in a liquid state.



IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

Hair gel 74

Take some hair gel, look at its consistency and observe.

COLLOID: ***liquid + solid***

Colloidal particles are bigger than atoms or molecules in solutions and smaller than particles in suspensions.
They do not pass through a particular membrane and do not sink to the bottom of the container as they are very light.



75 Soap foam

Take some soap foam, look at the consistency and observe what happens when you touch it.

COLLOID: *gas + liquid*

Colloidal particles are bigger than atoms or molecules in solutions and smaller than particles in suspensions.
They do not pass through a particular membrane and do not sink to the bottom of the container as they are very light.



76 Chimney smoke

OBSERVE THE FOLLOWING: If you look at the smoke through a ray of light you can better see the particles that make it up.

COLLOID: *gas + solid*

Colloidal particles are bigger than atoms or molecules in solutions and smaller than particles in suspensions.
They do not pass through a particular membrane and do not sink to the bottom of the container as they are very light.



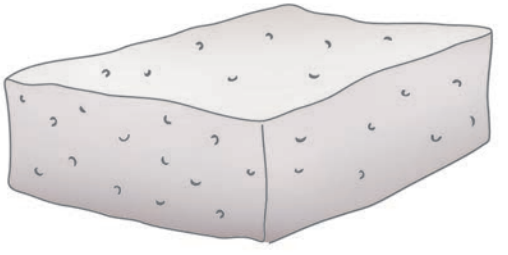
77 Very light polystyrene

Take a piece of polystyrene. It is a very light material that is often used for packaging.

SOLID FOAM: *solid + gas*

OBSERVE THE FOLLOWING: polystyrene has many cavities.

It is made made by blocking gas inside the tiny cavities in the plastic material.



TIME FOR A BREAK - GAMES AND SURPRISES



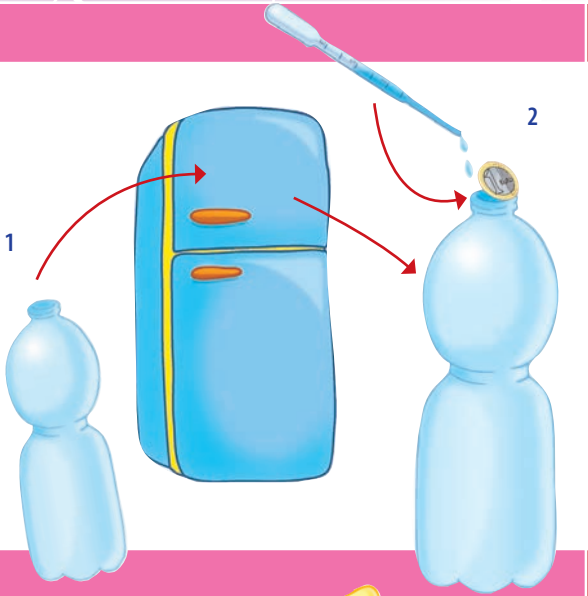
The dancing coin 78

1) Put an empty plastic bottle into the freezer for about 20 minutes.

2) Take the bottle out of the freezer and quickly wet the opening. Then carefully put a wet 10 pence piece over the opening of the bottle.

OBSERVE THE FOLLOWING: if you carefully watch the coin and don't make any noise, you will see that the coin suddenly lifts up on one side, makes a noise and then returns to its original position.

The air inside the bottles passes from the freezer to the outside where it warms up and dilates, which lifts up the coin.



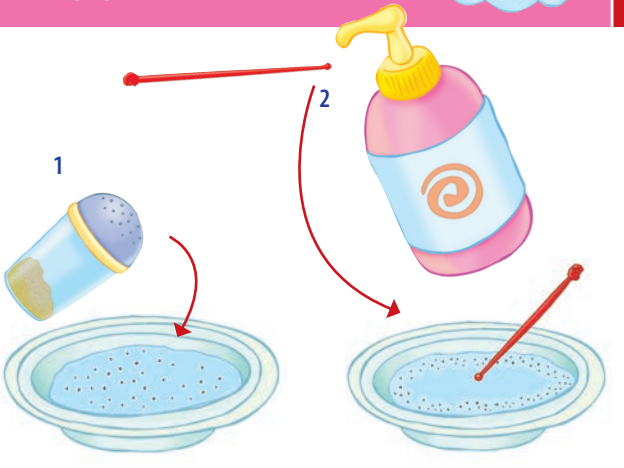
Water against soap 79

1) Pour a little water onto a plastic plate (not included in the set) and lightly spread some pepper granules on the surface.

2) Wet the end of the stirrer with liquid soap and then touch the centre of the water surface with the stirrer (do not immerse the soap deeply in the water).

OBSERVE THE FOLLOWING: the pepper granules "run away" from the end of the stirrer, in all different directions.

The soap has broken the bond between the liquid particles.



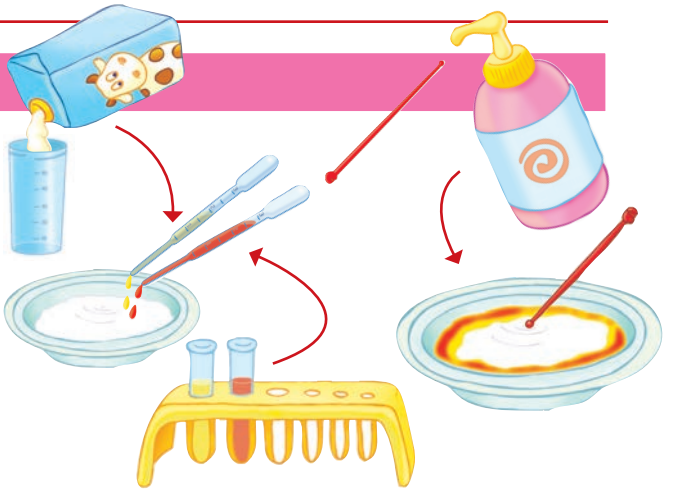
80 Escaping colours

1) Pour a little milk onto a plastic plate (not included in the set).

2) Prepare two coloured solutions as described in experiment no. 13 (the colours are not included in the set). Chose the colours yourself and use the pipette to transfer two drops of each colour onto the surface of the milk. Make sure the colours are far apart from each other.

3) Wet the end of the stirrer with liquid soap and then touch the centre of the milk surface with the stirrer (do not immerse the soap deeply in the milk).

OBSERVE THE FOLLOWING: the coloured marks "run away" towards the edge of the plate and create a coloured mixture.



The soap influences the surface tension of the milk.

MPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

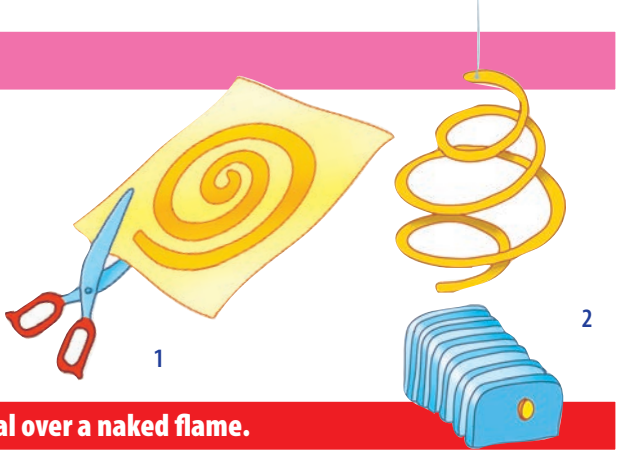
81 The rotating paper spiral

Ask an adult to help you

1) Cut a spiral out of a piece of paper. It should be the size of two palm widths (see diagram).

2) Make a hole in one end of the spiral and suspend it above a very gentle heat source.

OBSERVE THE FOLLOWING: the spiral begins to rotate.



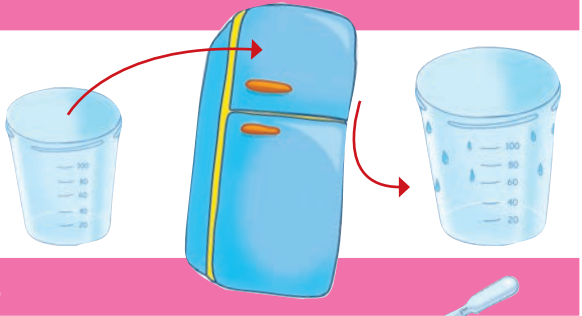
The heated air particles rise and hit the spiral.

WARNING! Do not hold material over a naked flame.

82 Cooling vapour: condensation

Put a dry beaker into the fridge and then take it out after a while.

OBSERVE THE FOLLOWING: it will cloud up quickly.



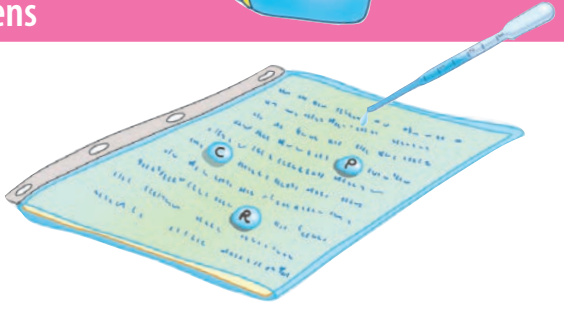
You cannot see the humidity in the air. Small water drops form as soon as the humidity comes into contact with the cold beaker.

83 A drop of water: enlarging lens

1) Place a transparent plastic sheet over a newspaper.

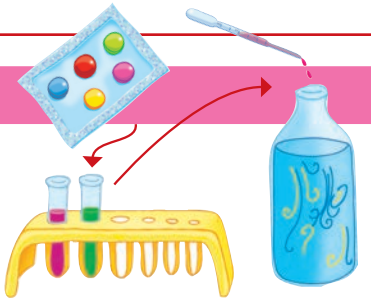
2) Use a pipette to put a few drops of water on the plastic.

OBSERVE THE FOLLOWING: the letters look bigger through the water drops.



The water drops act like a lens and makes the letters bigger.

Colour games 84



1) Take an empty plastic bottle and fill it with water three quarters full. Put the bottle in front of a white background.

2) Take some liquid food colouring (not included in the set) and add one or two drops of coloured liquid with the pipette at regular intervals. It is better if they are cold. Then put on the lid.

OBSERVE THE FOLLOWING: when the coloured drops fall in front of a white background, they slowly form circles, stripes and spirals until the whole liquid has changed colour.

This is the phenomenon of diffusion in a liquid.

⚠ **IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.**

Transparent spheres and coloured vortexes 85



1) Take an empty plastic bottle and fill it almost completely with water. Put the bottle in front of a white background.

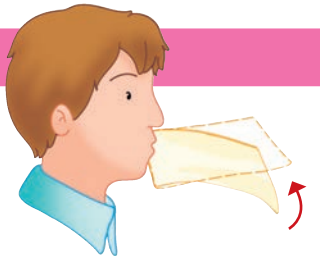
2) Add a few drops of cooking oil, a few drops of liquid food colouring (not included in the set). Close well, shake and observe.

OBSERVE THE FOLLOWING: small transparent spheres of oil form, which cannot be mixed with the water, as well as stripes of colour.

This phenomenon is called diffusion of colour.

⚠ **IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.**

Air pressure makes things fly 86



Take a new sheet of paper and hold it just under your mouth. It must be stretched tight. Strongly blow across the top part of the paper (see diagram).

OBSERVE THE FOLLOWING: the paper lifts up when you blow on it.

The air particles above the paper are moved. Therefore the pressure under the paper is greater than the pressure on to. This makes the paper lift up.* *Aeroplanes take advantage of this phenomenon.

Coloured flowers and vegetables *(slow experiment)* 87

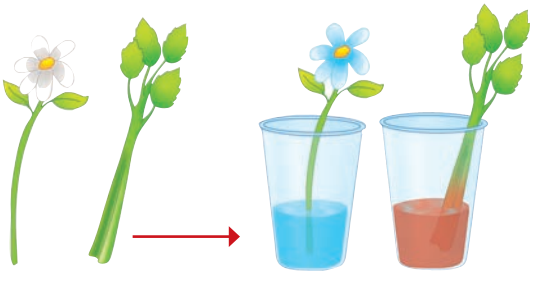


1) Take some white flowers and some celery with long stalks at least 10 – 15 centimetres long.

2) Put the flowers and vegetables in coloured solutions (not included in the set).

NOTE: This experiment can take a couple of hours.

OBSERVE THE FOLLOWING: the white flowers and vegetables change colour.



The coloured solutions go up through the cells and colour the plants.

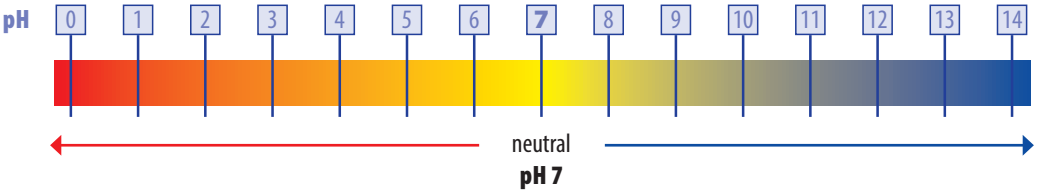
⚠ **IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.**

ACIDS AND ALKALIS

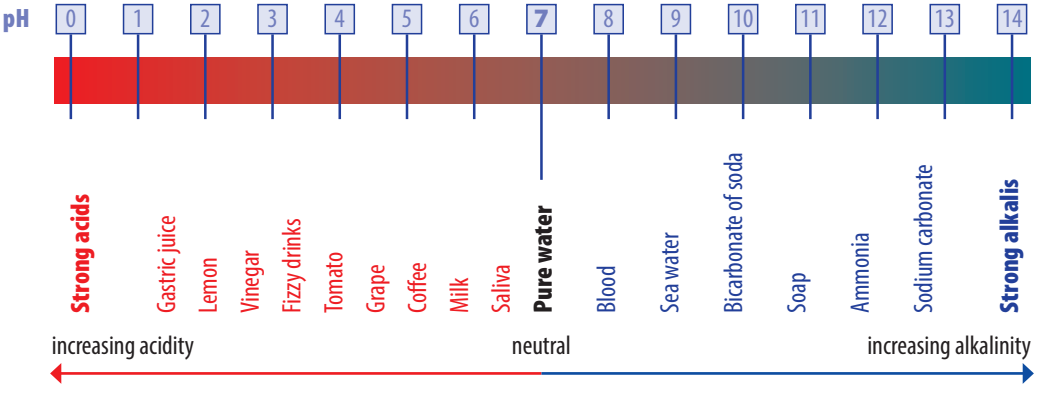
You need to match the colour of the indicator to the level of acidity or alkaline of the substance.



Coloured scale of the universal indicator



Coloured scale of the red cabbage indicator

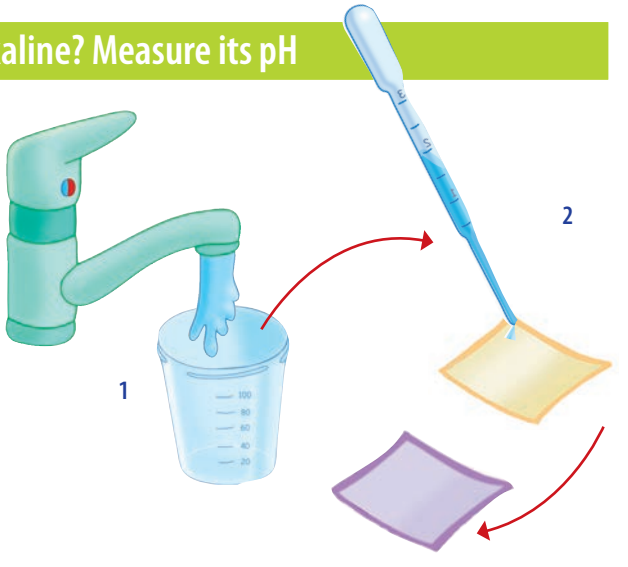


88 Is water acidic, neutral or alkaline? Measure its pH

1) Use the universal paper or the red cabbage indicator that you prepared in experiment 50.

2) Use a pipette to squeeze a drop of water onto the pH indicator paper.

OBSERVE THE FOLLOWING: the indicator will change colour. Look at the corresponding coloured scale to see if water has an acidic, neutral or alkaline pH value.



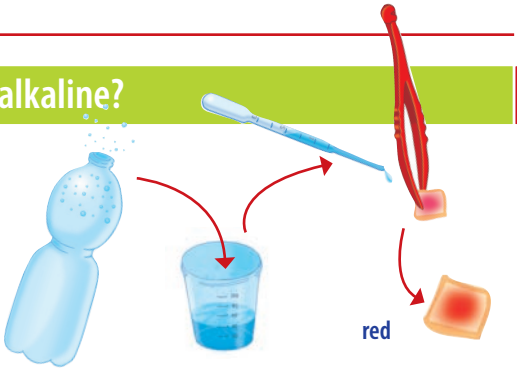
Drinking water normally has a neutral reaction and the pH value is about 7.

Is sparkling water acidic, neutral or alkaline? 89

1) Use the universal paper or the red cabbage indicator that you prepared in experiment 50.

2) Use a pipette to squeeze a drop of sparkling water onto the pH indicator.

OBSERVE THE FOLLOWING: the indicator will change colour. Look at the corresponding coloured scale to see if sparkling water has an acidic, neutral or alkaline pH.



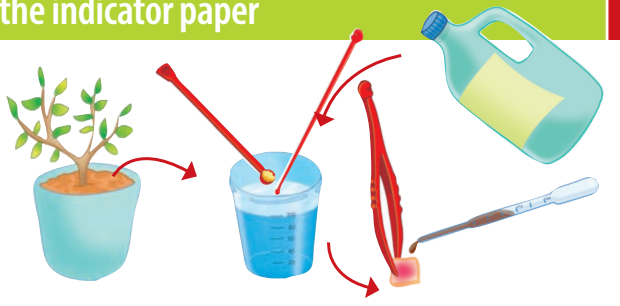
Sparkling water has an acidic reaction and therefore the pH value is less than 7.

Measure the pH of earth with the indicator paper 90

1) Put a pinch of soil into some distilled water (not included in the kit) and stir; then let the soil settle on the bottom.

2) After a while, use the pipette to squeeze two drops onto the indicator paper.

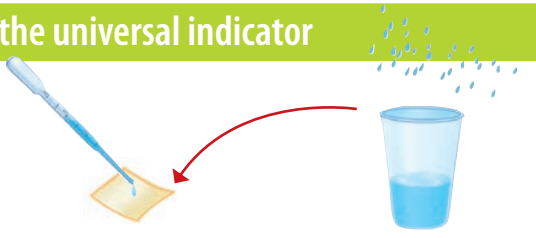
OBSERVE THE FOLLOWING: Observe the colour of the indicator paper and compare it with the coloured pH scale.



Measure the pH of rain with the universal indicator 91

Collect some rainwater in a container and use a pipette to squeeze two drops onto the pH indicator paper.

OBSERVE THE FOLLOWING: the indicator will change colour. Look at the corresponding colour on the scale to find out its pH value.



Measure the pH of rain with the red cabbage indicator 92

Collect some rainwater in a container and use a pipette to squeeze two drops onto the red cabbage indicator paper that you prepared earlier.

OBSERVE THE FOLLOWING: the indicator will change colour. Look at the corresponding colour on the scale to find out its pH value.

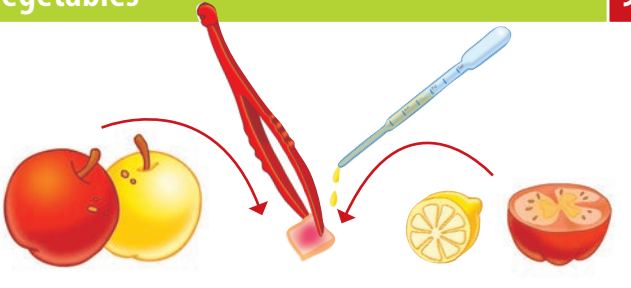


Measure the pH of fruit and vegetables 93

Ask an adult to help you

Use a pipette to squeeze two drops of juice onto the indicator paper (universal or red cabbage).

OBSERVE THE FOLLOWING: the indicator will change colour. Look at the corresponding colour on the scale to find out its pH value.

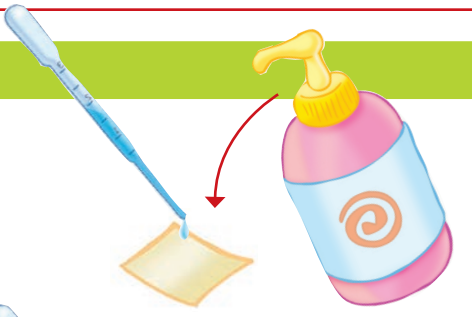


IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

94 Measure the pH of soap

Pour two drops of soap and two drops of water onto the indicator paper (universal or red cabbage).

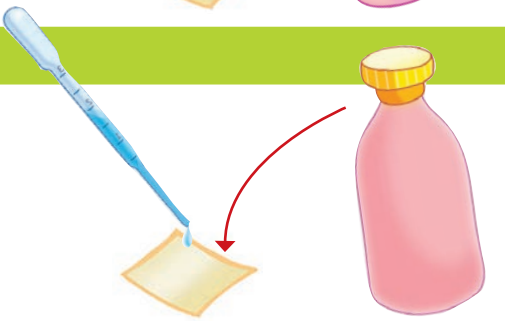
OBSERVE THE FOLLOWING: the indicator will change colour. Look at the corresponding colour on the scale to find out its pH value.



95 Measure the pH of shampoo

Pour two drops of liquid and two drops of water onto the indicator paper.

OBSERVE THE FOLLOWING: the indicator will change colour. Look at the corresponding colour on the scale to find out its pH value.

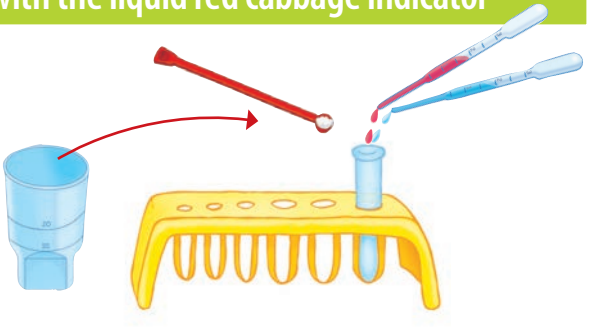


96 Measure the pH of substances with the liquid red cabbage indicator

1) Squeeze half a pipette of distilled water into a test tube and add two drops of the liquid red cabbage indicator you prepared earlier.

2) Now pour a little of the substance you want to test: **milk**, **cooking salt**, **tomato**, **sea water**, **detergent**...

OBSERVE THE FOLLOWING: the liquid in the test tube will change colour. Look at the corresponding colour on the scale to find out its pH value.



IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

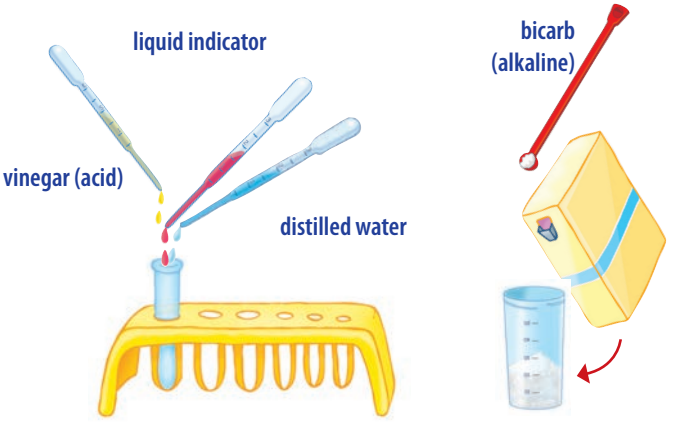
97 How an alkali "neutralises" an acid (with liquid indicator)

The materials in this experiment are not included in the set.

1) Squeeze half a pipette of distilled water into a test tube along with two drops of red cabbage liquid indicator and two drops of vinegar.

2) Use the spatula to add some sodium hydrogen carbonate (bicarbonate of soda - bicarb) and mix well until it turns purple.

OBSERVE THE FOLLOWING: the liquid will become purple, showing that the solution has become neutral. Look at the corresponding colour on the pH scale.



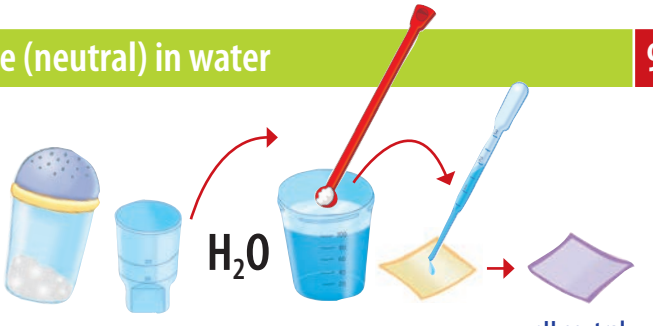
BEHAVIOUR OF SALT WATER SOLUTIONS

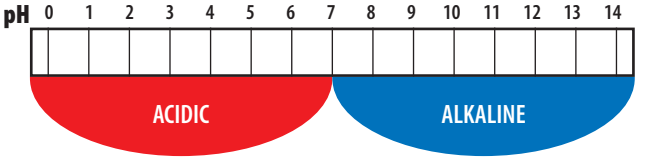
***SALTS** are formed from the reaction between an acid and an alkali. They are made up of two types of ions called: **anions** (negative charge) and **cations** (positive charge).*

Why rock salt has pH 7 value (neutral) in water 98

Dissolve some rock salt (table salt) in water.

OBSERVE THE FOLLOWING: the pH paper does not change colour, pH = 7.



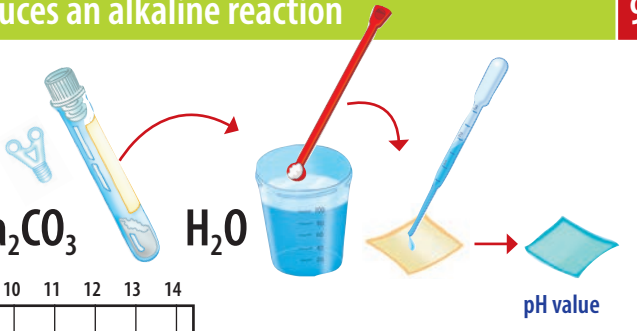


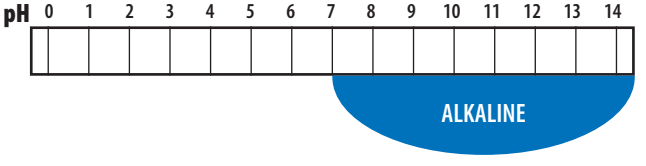
*This is because **rock salt** (**sodium carbonate**) **is a salt** made of the strong acid HCl (**hydrochloric acid**) and a strong alkaline NaOH (**sodium hydroxide**).*

Why sodium carbonate produces an alkaline reaction 99

Dissolve a little sodium carbonate in some water.

OBSERVE THE FOLLOWING: the pH paper changes to blue, which means it is alkaline.

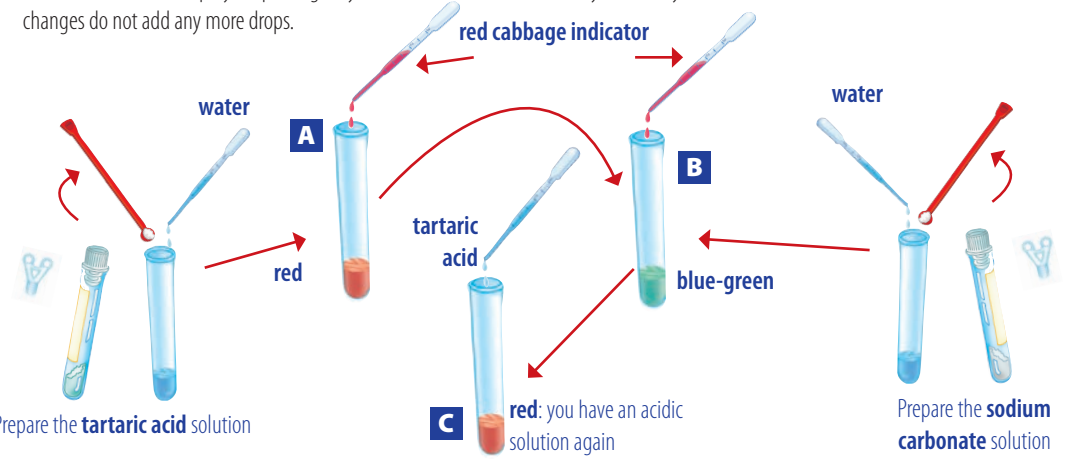




*This is because **salt** (**sodium chloride**) is made up of the weak acid H_2CO_3 (**carbonic acid**) and strong alkaline NaOH (**sodium hydroxide**).*

From acidic to alkaline pH and back again 100

Add the substances drop by drop and gently shake the test tube so that they are evenly distributed in the solution. As soon as the colour changes do not add any more drops.



CHEMICAL REACTIONS

In a chemical reaction new compounds appear that were not in the substance at the beginning.

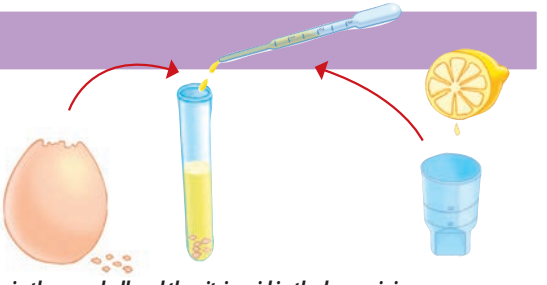


Chemical transformations take place as certain bonds inside a molecule (made up of atoms and ions) break away and form new bonds.

101 Lemon dissolves egg shells

Put some pieces of egg shell into a test tube and add a pipette of lemon juice.

OBSERVE THE FOLLOWING: after a while the lemon juice begins to dissolve the egg shell and bubbles of carbon dioxide appear.



A chemical reaction takes place between the calcium carbonate in the egg shell and the citric acid in the lemon juice.

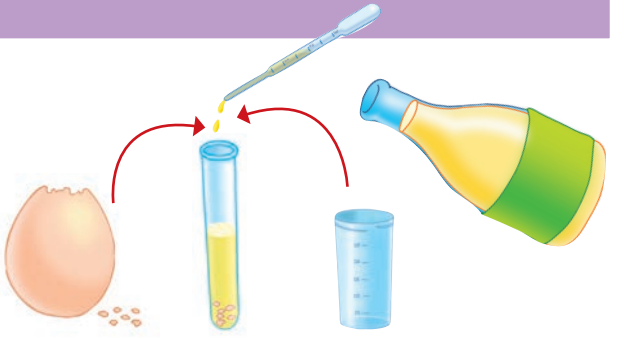
IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

102 Vinegar dissolves egg shells

Put some pieces of egg shell into a test tube and add a pipette of vinegar.

OBSERVE THE FOLLOWING: after a while the vinegar begins to dissolve the egg shell and bubbles of carbon dioxide appear.

A chemical reaction takes place between the calcium carbonate in the egg shell and the acetic acid in the vinegar.



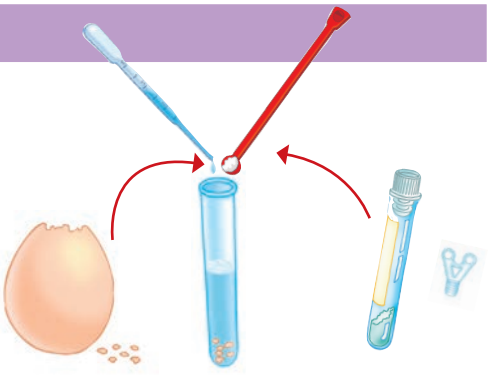
IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

103 Tartaric acid dissolves egg shells

Put some pieces of egg shell into a test tube and add a pipette of water and use the spatula (the tip) to add a tiny amount of tartaric acid.

OBSERVE THE FOLLOWING: after a while the tartaric acid begins to dissolve the egg shell and bubbles of carbon dioxide appear.

A chemical reaction takes place between the calcium carbonate in the egg shell and the tartaric acid.

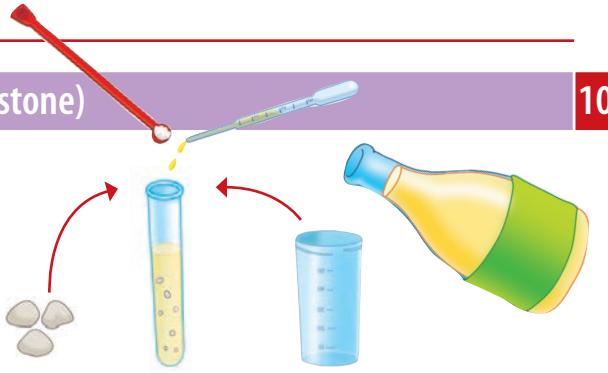


Vinegar with marble dust (limestone) 104

1) Put a pipette of vinegar into a test tube.

2) Add a spatula of marble dust or some whitish pebbles (not included in the set) that are often made of limestone like marble dust.

OBSERVE THE FOLLOWING: see if bubbles appear. If they do, this means the pebbles are made of limestone.



A chemical reaction takes place between the acetic acid in the vinegar and the calcium carbonate in the limestone.

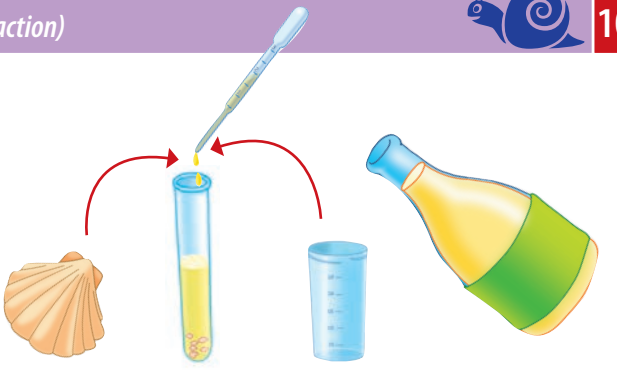
Vinegar dissolves shells *(slow reaction)* 105

1) Put some pieces of sea shell into a test tube.

2) Add a pipette of vinegar.

OBSERVE THE FOLLOWING: after a while the vinegar begins to dissolve the sea shell and bubbles of carbon dioxide appear.

A chemical reaction takes place between the calcium carbonate in the sea shell and the acetic acid in the vinegar.



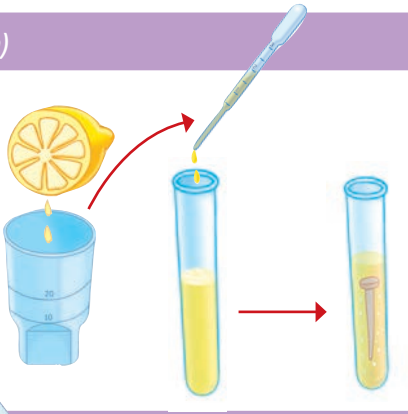
Lemon juice with iron *(slow reaction)* 106

Ask an adult to help you

Squeeze a pipette of lemon juice into a test tube and add a piece of iron (not included in the set) that you have rubbed with sandpaper (not included in the set).

OBSERVE THE FOLLOWING: after a while the citric acid of the lemon starts to react with the iron and hydrogen bubbles appear.

This is hydrogen that is "freeing itself" from the acid.



Rust: iron corrosion 107

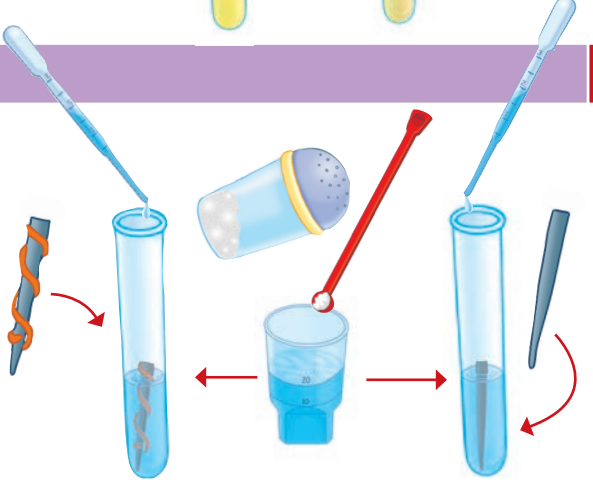
Ask an adult to give you two pieces of iron.

1) Put two pieces of iron about 3 centimetres long into two test tubes. One piece should have copper wire wrapped around it and the other piece should be bare, just a piece of iron.

2) Pour a water and salt solution into both test tubes without completely covering the wires.

OBSERVE THE FOLLOWING: the piece of iron with the copper wrapped around it rusts fairly quickly.

The iron atoms lose electrons that are "captured" by the oxygen in the air.



AIR AND WATER ARE BOTH NEEDED TO FORM RUST.

CHEMISTRY LAB FROM NOSE TO TONGUE

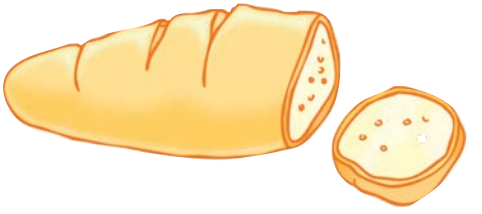
The lab equipment is in your nose and tongue. You will also need to use your memory (in your brain) to remember the substances.



The tastes and smells we perceive with our noses and tongues are simply caused by the actions of certain molecules on our senses.
The hundreds of molecules that detach from food, which is often because of heat, give food its smell and characteristics.
Each aroma corresponds to a specific natural chemical formula. The chemical industry can copy these formulae and produce the same aromas in labs but they are cheaper. This is why synthetic aromas have conquered the market.

108 In the mouth: from starch to sugar

After chewing a piece of bread for a while it begins to have a sweet taste.



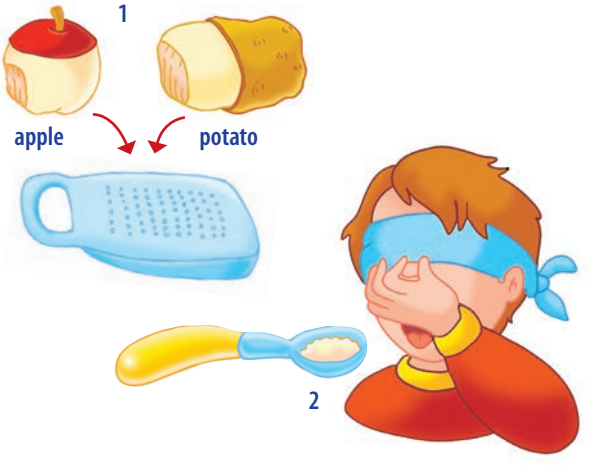
Why? This is because an enzyme (a chemical substance in saliva: ptyalin) dissolves the starch in sugar that tastes sweet.

109 In the mouth: from starch to sugar

***WARNING:** an adult must help with this experiment.*

1) Grate a teaspoon of peeled apple and a teaspoon of peeled potato.

2) Ask a friend or an adult to help you. Close your eyes and squeeze your nostrils closed. Taste the two foods without knowing which is which. You will find it difficult to recognise the two foods.



Why? This is because you use your tongue to taste things that are sweet, salty, sour (or acidic) and bitter, while all other tastes come from their smell and therefore you need your nose to taste them.

IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

HOT AND COLD INFLUENCE FLAVOURS

The temperature range in which flavours are the strongest varies between 30 °C and 40 °C.

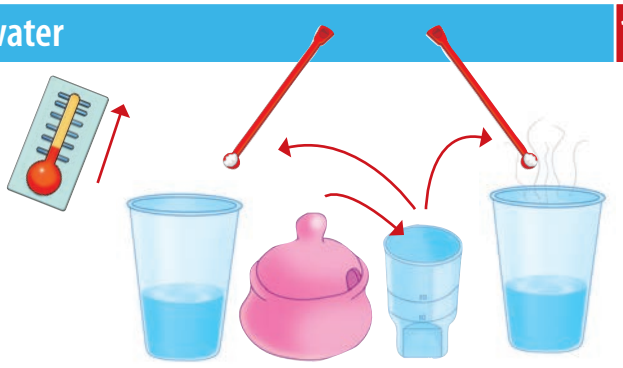
A drink is sweeter with hot water 110

Ask an adult to help you

1) Prepare two clean glasses: in one put a little cold water and a teaspoonful of sugar; in the other put a little hot tap water and a teaspoon of sugar.

2) First try the one with cold water and then the one with hot water.

OBSERVE THE FOLLOWING: the hot drink is more intense and has a sweeter flavour.



IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

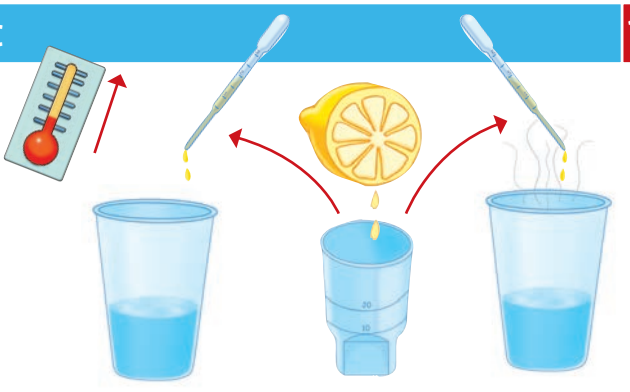
Hot lemonade is more acidic 111

Ask an adult to help you

1) Prepare two clean glasses: in one put a little cold water and a teaspoonful of lemon juice; in the other put a little hot tap water and a teaspoonful of sugar.

2) First try the one with cold water and then the one with hot water.

OBSERVE THE FOLLOWING: the hot drink is more intense and has a more acidic flavour.



IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

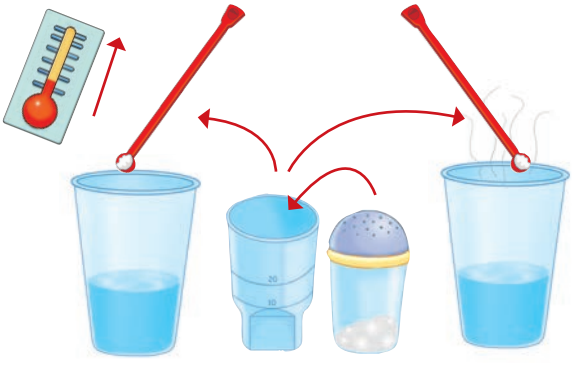
A drink is saltier with cold water 112

Ask an adult to help you

1) Prepare two clean glasses: in one put a little cold water and a half a spatula of fine salt; in the other put a little hot tap water and a half a spatula of fine salt.

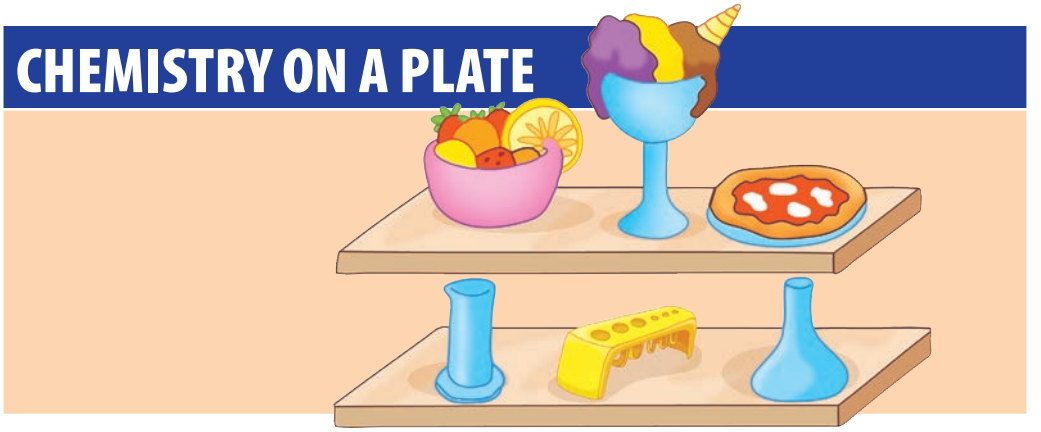
2) First try the one with cold water and then the one with hot water.

OBSERVE THE FOLLOWING: the hot drink is more intense and makes the flavour saltier.



IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

CHEMISTRY ON A PLATE



113 Brown apples

Ask an adult to help you

You can even observe chemical reactions every day in the kitchen. Ask an adult to cut up an apple into four pieces. Squeeze a little lemon onto two pieces and carefully observe the four pieces.

NOTE: The reaction will take place in less than an hour.

OBSERVE THE FOLLOWING: After a while the pieces without lemon on them start to go brown, while the ones with lemon on them remain unchanged.



The citric acid in the lemon stops oxygen in the air from making the apple go brown.

114 Cider vinegar *(slow chemical reaction)*

Ask an adult to help you

Here's another chemical reaction you can follow and observe in kitchen using everyday kitchen utensils.

1) Ask an adult to blend a couple of apples with their skins on in a blender or liquidiser.

2) Save a little of the apple pulp in a plastic cup and leave it for a few days.

NOTE: Part 3) of the experiment should be carried out after a few days.

3) Drop some juice on the pH indicator paper to discover the acidity of this liquid.

OBSERVE THE FOLLOWING: the pH is acidic because of vinegar.



Vinegar has been produced because yeast and bacteria have transformed the sugars in the apple.

Advice: *Save for the next experiment. Keep out of reach of small children and animals (and well away from food and drink).*

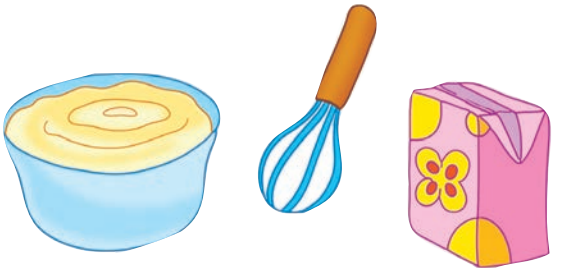
Homemade butter 115

Ask an adult to help you

Here's another chemical reaction that you can observe in the kitchen.

Put some whipping cream into a cold bowl. Whip the cream for a few minutes with a whisk.

OBSERVE THE FOLLOWING: small yellowish lumps (**butter**) begin to form.



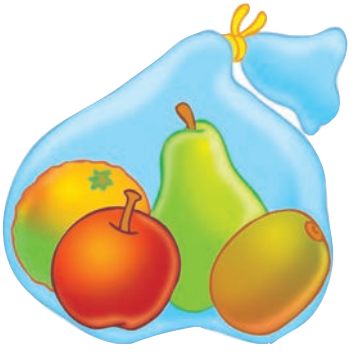
The cream is a suspension of fats in water; when you whip it you separate the fats from the water.

From unripe fruit to ripe fruit 116

Put a piece of very ripe fruit and some unripe fruit into a bag (not included in the kit). Then close the bag well.

Advice:Put the bag in a safe place away from small children.

OBSERVE THE FOLLOWING: the next day all the fruit is nice and ripe. This is because of a gas emitted from the one piece of ripe fruit.



During the night the ripe fruits lets off a gas called ethylene that ripens the other fruit.

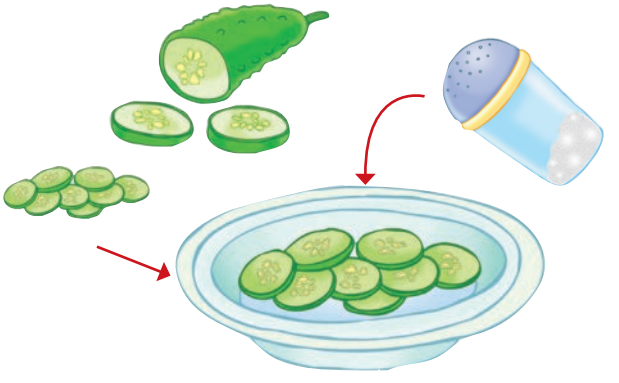
Crunchy cucumber slices 117

Ask an adult to help you

Ask an adult to cut a cucumber into thin slices. Lay them out on a plate with cooking salt and leave for two hours. The slices will start to lose water.

OBSERVE THE FOLLOWING: the salt extracts the water from the cucumber.

This chemical process is called "osmosis".



IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

TIME FOR A BREAK - GAMES AND SURPRISES

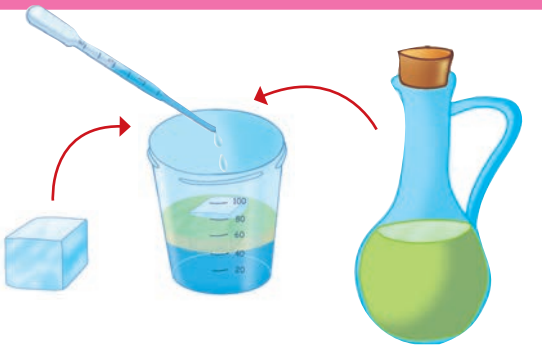


118 Layers of water, oil and ice

Pour 30 ml of water into a large beaker, then slowly pour a little cooking oil and then add an ice cube.

OBSERVE THE FOLLOWING: the water sits at the bottom and the oil and ice float on top.

They are arranged like this because of their different densities: oil and ice both float on water at the same level as they have the same density.



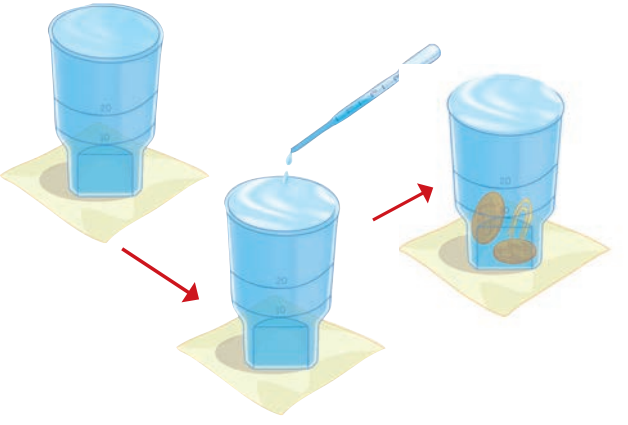
IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

119 A film of water

1) Fill a transparent beaker with water right up to the brim. You can also use the pipette.

2) Carefully immerse some coins and paperclips into the water but put them in sideways (not flat). Remember that the beaker was already full to the brim.

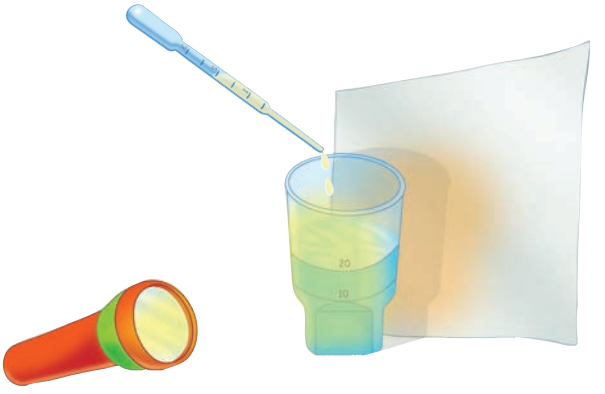
OBSERVE THE FOLLOWING: it is surprising that, even when the beaker is already full to the brim, you can add other small objects without the water overflowing. If you look carefully at the water surface, it is almost as if it has a curved film across it.



Many liquids have a film that forms because of the force of the surface tension between the water particles (molecules).

Sunset in the lab 120

Mix two or three drops of milk into a beaker of water. Light it up with a torch con (not included in the set).



OBSERVE THE FOLLOWING: if you put a piece of paper behind the beaker, you will see an orange coloured light - just like a sunset!

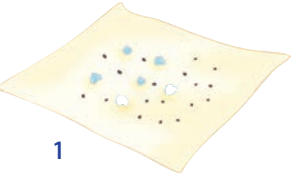
The mixture of water and milk favours the diffusion of the colour orange when light rays pass through it, as it disperses the light. Like colloids, it can be considered a heterogeneous mixture.

IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

A static balloon makes pepper jump 121

1) Prepare a solid mixture of coarse salt and pepper.

2) Rub an area of a balloon onto a piece of wool (a woolly jumper) for a little while, then put it near the mixture.



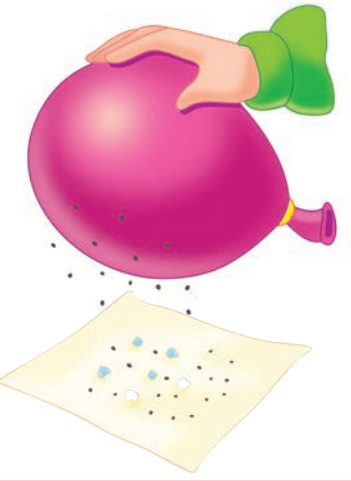
1



2

OBSERVE THE FOLLOWING: the pepper granules jump up and stick to the balloon.

NOTE: Do not put the balloon too close to the mixture as otherwise the salt will stick to it as well.



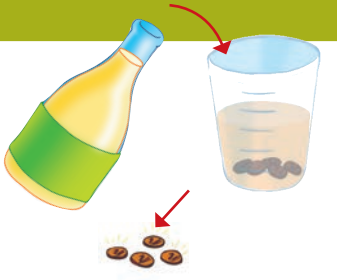
When the balloon is rubbed on wool it creates static electricity (an electric charge) that attracts particles with the opposite electric charge.

IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

USEFUL CHEMISTRY AT HOME



122 Sparkling coins



1) Pour a little vinegar into a large beaker.

2) Wash some copper coloured coins (one or two pence pieces) with a little soap and then put them into the vinegar.

3) Wait a while before taking them out of the vinegar again. Now they look like new!

OBSERVE THE FOLLOWING: there is an acidic substance in vinegar called acetic acid that can remove the compound that forms on the surface of coins when they come into contact with the oxygen in air.

123 Vinegar against limescale deposits



Ask an adult to help you

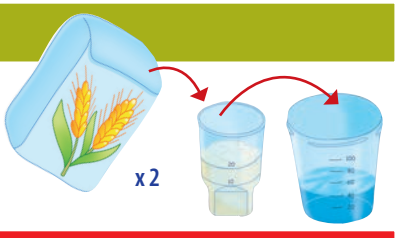
1) Drop a pipette of vinegar onto the limescale deposits that usually form where there is water (sinks, taps). Leave the vinegar for a few minutes.

2) Rinse well with water.

OBSERVE THE FOLLOWING: the area is now clean and sparkling.

Vinegar dissolves limescale deposits.

124 Flour and water: glue



If you ever need some glue, simply mix two beakers of flour with one beaker or water.

The glue effect of flour and water is based on the proportion of protein in flour which causes it to act like glue.

IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

125 Clean brass with lemon juice



You can use a slice of lemon to clean brass objects (yellow coloured metal material).

Brass is a solid mixture of two metals:

- ***copper***
- ***zinc***

How to recognise hard water with lots of mineral salts 126

PREPARE A MIXTURE FOR THE EXPERIMENT.

1) Dissolve a few soap flakes or a drop of liquid soap in a little distilled water (water for batteries and irons).

2) Add drops of this mixture to water using a pipette. Do this until the water starts to foam.

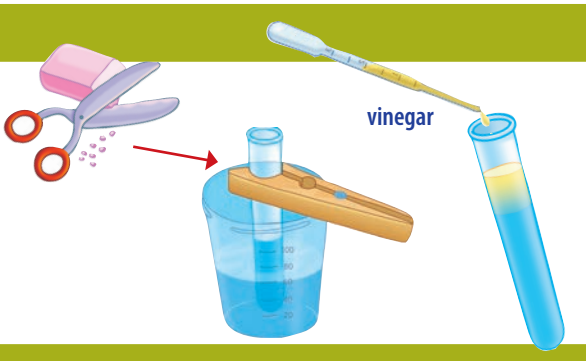


OBSERVE THE FOLLOWING: A few drops of soap = soft water with few salts. Lots of drops of soap = hard water with lots of salts.

From soap... to fat 127

1) Dissolve some soap flakes in some water then heat up the water in a bain-marie.

2) Once dissolved, remove from the bain-marie and add a little vinegar.

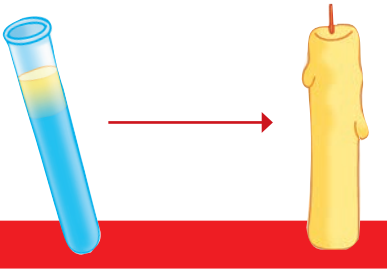


OBSERVE THE FOLLOWING: there is a white mass that floats on the liquid. It is made up of fatty acids.

From fat... to candles 128

Ask an adult to help you

Collect the white substance (**fatty acids**) obtained from the last experiment. Wash with water and leave to dry. You have made the substance that is used to make candles!
You can use a piece of string for the wick.

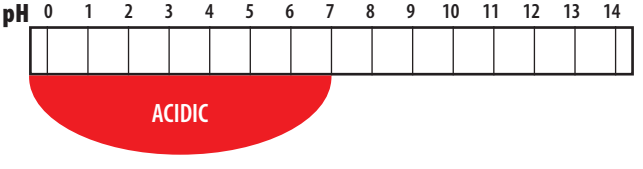


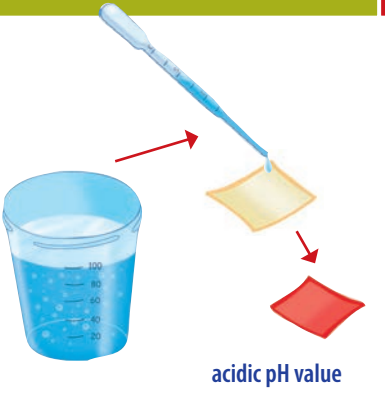
CAUTION! Do not light the candle.

Measure the pH of aspirin 129

WARNING: an adult must help with this experiment.

Dissolve a soluble aspirin in water. Take a little of the liquid with the aspirin and check the pH with the indicator paper.



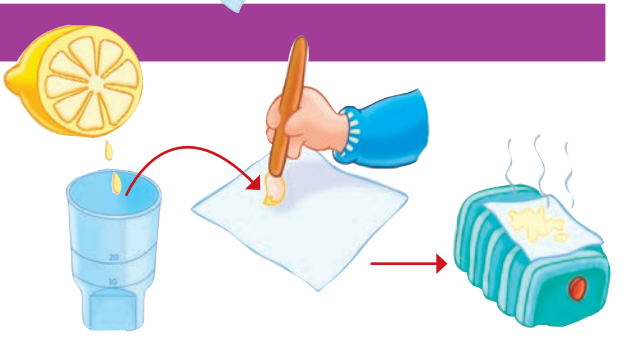


INVISIBLE INKS



Some natural substances are invisible in certain conditions.

130 Secret message juice



1) Squeeze a little lemon juice into a beaker.

2) Use a paintbrush (not included in the set) to write a secret message or to draw a map on a white piece of paper. Wait for it to dry.

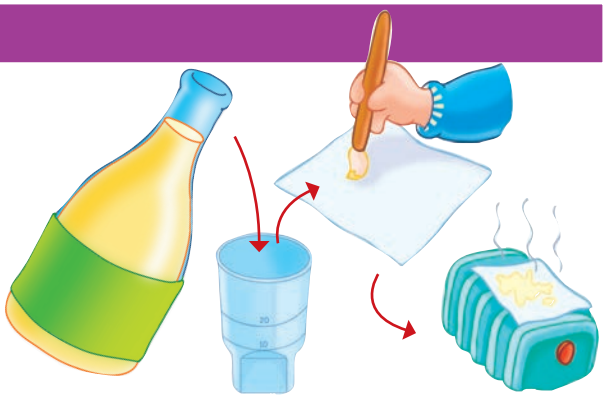
3) Put the paper on something warm and you'll start to see the writing or drawing.

OBSERVE THE FOLLOWING: with heat the writing darkens a little and you can see the hidden message.

IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

CAUTION! Do not hold paper over naked flame.

131 "Invisible" ink



1) Put a very small amount of white wine vinegar or spirit vinegar into a beaker.

2) Use a paintbrush (not included in the set) to write a secret message or to draw a secret map.

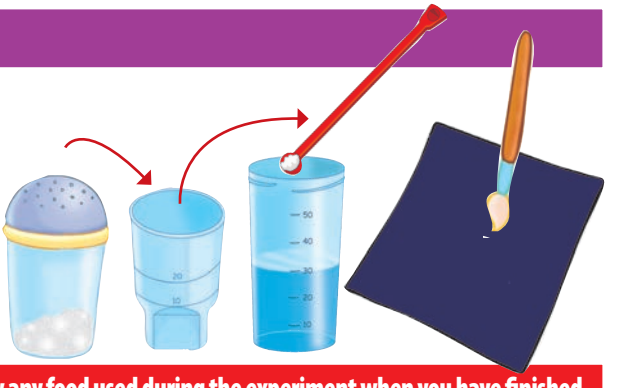
3) Put the paper on something warm and you'll start to see the writing or drawing.

OBSERVE THE FOLLOWING: with heat the writing darkens a little and you can see the hidden message.

IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

CAUTION! Do not hold paper over naked flame.

132 Special crystal drawings



1) Dissolve 10 ml of cooking salt in 30 ml of water.

2) Write or draw on black card with a paintbrush (not included in the set).

3) To make your creation visible and sparkle put the card somewhere warm to dry.

OBSERVE THE FOLLOWING: with the evaporation of the water the salt crystals look like they are stuck to the page.

IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

THE CRYSTAL LAB



Crystals are solid bodies with flat faces made up of atoms and ions arranged in a geometric and repetitive pattern.

Bright crystals form naturally over an extremely long period of time.

At home they can be formed:

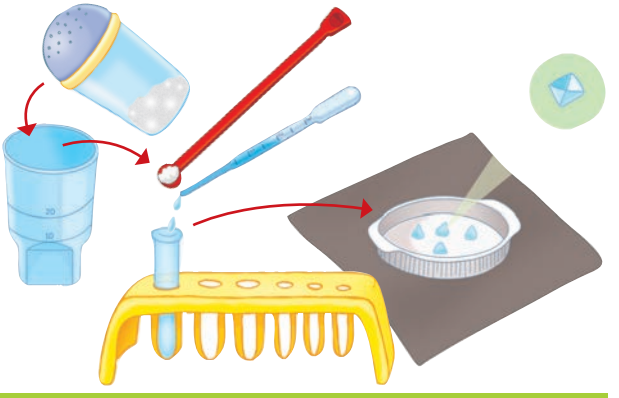
a) from cooling a solution

b) from evaporating a solution

A small pyramid-shaped salt crystal *(this experiment takes a few hours)* 133

1) Pour a pipette of water into a test tube, add a pinch of fine cooking salt and mix.

2) Leave a few drops of the salty solution to dry in an upside-down lid.



OBSERVE THE FOLLOWING: tiny, bright salt crystals will appear in the shape of a pyramid. You can see the crystals better if you put them on a dark background and light them up.

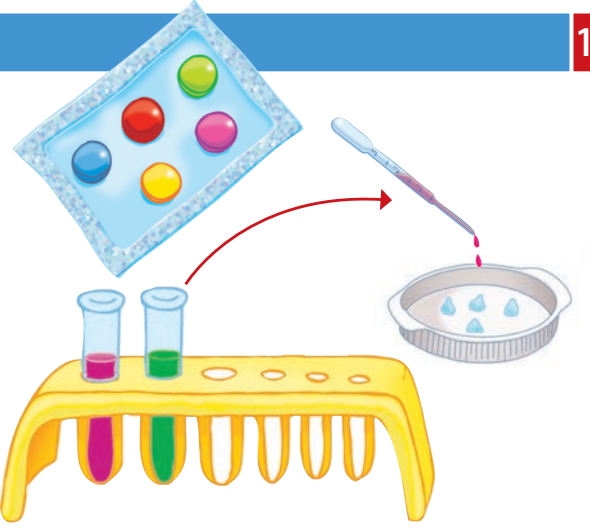
Advice: *Keep out of reach of small children and animals (and well away from food and drink).*

IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

Coloured salt crystals 134

Ask an adult to help you

Make white coarse salt into coloured crystals.



1) Find some food colouring (not included in the set). If it isn't already in a liquid form, prepare them in a test tube by dissolving a piece of a coloured tablet in 1 ml of water. Put the tablet back in its packet.

2) Put some coarse salt crystals in an upside-down lid. Pour a coloured drop onto the crystal with the pipette and wait for it to dry.

Advice: *Keep out of reach of small children and animals (and well away from food and drink).*

IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

135 How to prepare a saturated solution of salt or sugar crystals

IMPORTANT: to create crystals you need a **saturated solution of cooking salt** or **sugar** (i.e. you need to dissolve the salt or sugar in very hot water until you cannot see any more crystals on the bottom).



Using a large beaker, add fine salt (about half a beaker) or sugar (approximately two beakers) to 30 ml of very hot tap water and mix continuously with the spatula until you cannot see any more crystals on the bottom.

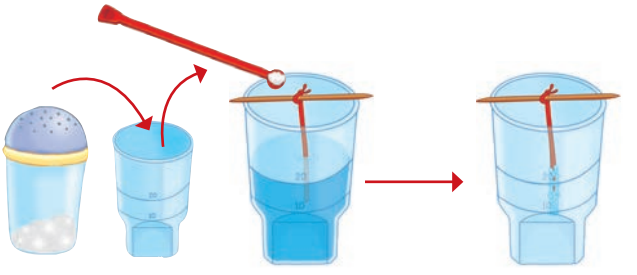
You have now prepared a saturated solution.

IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

136 Cultivate cooking salt crystals *(slow experiment)*

CAUTION! Do not touch the crystals with your fingers and do not get them wet.

Prepare a saturated solution of cooking salt like the one described in the last experiment for the salt solution. Tie a piece of string or cotton around a toothpick (not included in the set) and dangle it in the solution. After a few days, crystals will start to form on the string or cotton.



OBSERVE THE FOLLOWING: crystals form along the string.

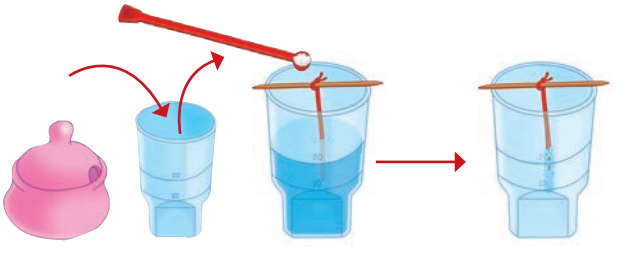
The solution goes up the string, the water evaporates and the salt is left in the form of crystals.

Advice: *Keep out of reach of small children and animals (and well away from food and drink).*

137 Cultivate sugar crystals *(slow experiment)*

CAUTION! Do not touch the crystals with your fingers and do not get them wet.

Prepare a saturated solution of sugar like the one described in the previous experiment for the sugar solution. Tie a piece of string or cotton around a toothpick (not included in the set) and dangle it in the solution. After a few days, crystals will start to form on the string or cotton.

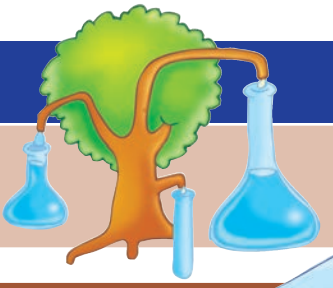


OBSERVE THE FOLLOWING: crystals form along the string.

The solution goes up the string, the water evaporates and the sugar is left in the form of crystals.

Advice: *Keep out of reach of small children and animals (and well away from food and drink).*

NATURAL CHEMISTRY



Vinegar transforms milk 138

Pour a little milk onto a plastic plate (not included in the set) and add half a pipette of vinegar.

OBSERVE THE FOLLOWING: a dense substance called rennet settles on the bottom and an aqueous substance, serum, is found on top.

Cheese is produced from rennet, which is made up of fats, minerals and casein.



IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

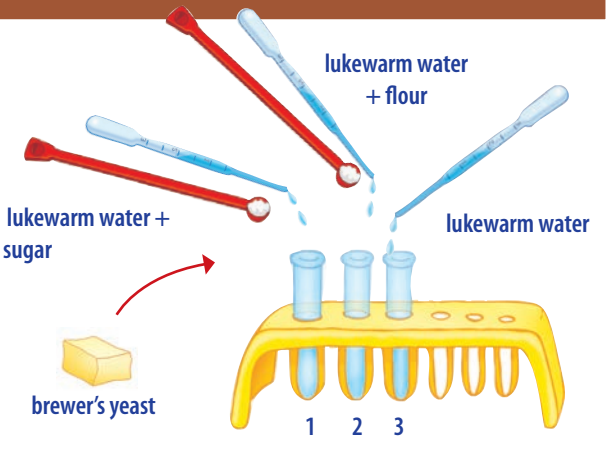
Yeast eats sugars 139

1) Ask and adult for a little brewer's yeast.

2) Mark three containers with the numbers 1, 2 and 3 and put a little lukewarm water into each one with a small amount of brewer's yeast.

3) Then, in container no. 1 add half a spatula of sugar, in container no. 2 add a pinch of flour and do not add anything to container no. 3.

OBSERVE THE FOLLOWING: after a few minutes container no. 1 has carbon dioxide bubbles, which shows the yeast is eating the sugar. Bubbles will also appear in beaker no. 2 after a while; there will be no gas in no. 3 as the yeast has no "food".



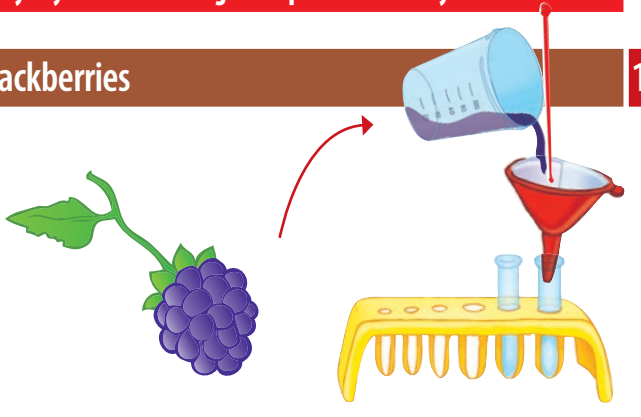
IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

Prepare a pH indicator with blackberries 140

NOTE: Buy some blackberries from a greengrocer.

Put a blackberry that you have cut into little pieces into a large beaker with some hot tap water. Mix with the spatula. Filter the liquid into a test tube.

OBSERVE THE FOLLOWING: the hot water extracts the pH indicator from the fruit.



IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

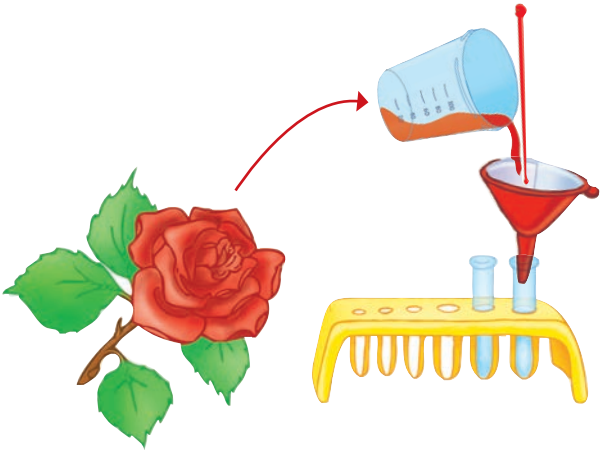
141 Prepare a pH indicator with rose petals

NOTE: **Buy a rose from a florist or ask permission to pick one from your garden.**

Put some rose petals into a large beaker with a little hot tap water. Mix with the spatula for a few minutes. Filter the liquid into a test tube.

OBSERVE THE FOLLOWING: the hot water extracts the pH indicator from the flower petals and this can be used for your experiments.

Advice: *Save for the next experiment. Keep out of reach of small children and animals (and well away from food and drink).*



142 Even carrots lose weight *(slow reaction)*

CAUTION: an adult must help with this experiment.

Add a piece of carrot to a some water and salt in a large plastic beaker.

OBSERVE THE FOLLOWING: after a while the carrot gets thinner.

It has lost the water in it because of osmosis. The water in the carrot is attracted by the salt in the solution.



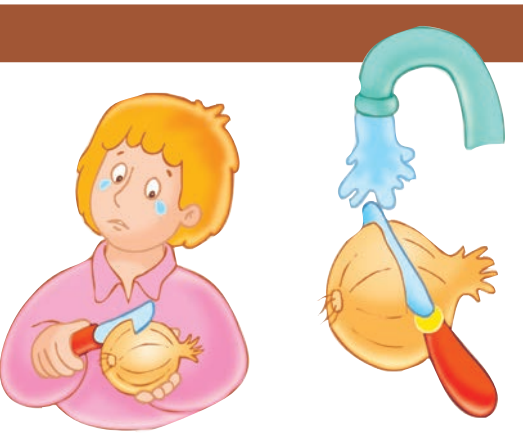
IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

143 Onions that don't make you "cry"

CAUTION: an adult must help with this experiment.

Everyone knows that you cry when you chop up onions. Ask an adult to cut an onion under running water to stop the tears. Another way to prevent crying is to put the onions in the fridge a few hours before cutting them up.

When we cut onions, we break the cells containing a volatile chemical substance with sulphur. This substance irritates the eyes. Running water or cold temperatures stop the gas from spreading too much in the air.



IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

Lemon slices get wet on their own *(slow reaction)* 144

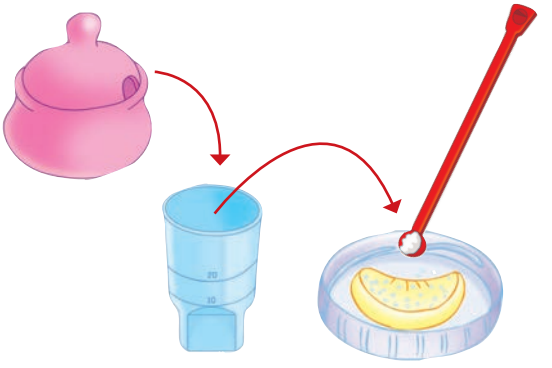
Ask an adult to help you

1) Peel a lemon and take one slice that is perfectly dry.

2) Lay it on a large lid that is turned upside-down and sprinkle some sugar granules onto it.

OBSERVE THE FOLLOWING: after a while the slice of lemon looks wet.

The water in the slice of lemon is drawn out by the sugar because of osmosis.



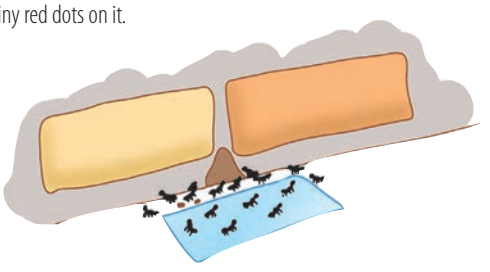
IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

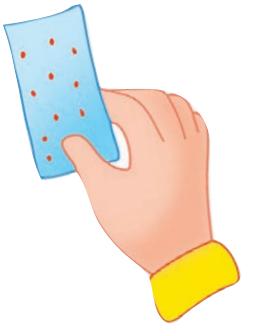
Ants' footprints 145

1) Find an ants' nest and put a piece of pH indicator paper in it.

2) After a little while remove the paper. You might be able to see some tiny red dots on it.

Formic acid, produced by ants, has made the indicator paper turn red (acid pH value).





CAUTION! This experiment is not suitable for children with insect allergies.

Cooking salt wets a slice of orange *(slow reaction)* 146

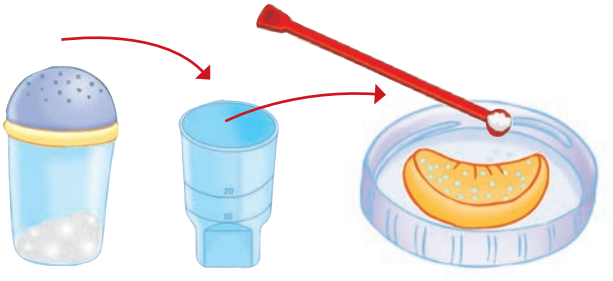
Ask an adult to help you

1) Peel an orange and take one slice that is perfectly dry.

2) Lay it on a large lid that is turned upside-down and sprinkle some fine cooking salt granules onto it.

OBSERVE THE FOLLOWING: after a little while the slice of orange looks wet.

The water in the slice of orange is drawn out by the salt because of osmosis.



IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

SOAP BUBBLES



A soap bubble closes around the air that pushes on its elastic, transparent skin.

The skin is a membrane made of water and soap molecules.

A soapy mixture (a solution of different water-based substances) is needed to make bubbles, which can have different variables.

PREPARING SOAPY MIXTURES

Information

Ask an adult to help you

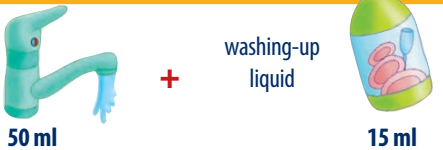
Put together the substances in the following order and carefully mix them after each compound has been added. The quantities used in the mixtures are only approximate and can vary according to the products used: type of water, detergent and soap. For the best results, place the mixture in the fridge overnight. To prepare the mixtures you will need the following equipment: plastic beaker (not included in the set), beaker and a spatula.

IMPORTANT INFORMATION: An adult should provide the child with a mild, non-irritant detergent.

Warning: *keep the soapy mixture out of reach of small children and animals (and well away from food and drink).*

147 Simple mixture for bubbles

tap water **50 ml** + washing-up liquid **15 ml**



148 More effective mixture for bubbles

distilled water **50 ml** + washing-up liquid **15 ml** + sugar **5 spatulas**



IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

149 Mixture for resistant bubbles

distilled water **50 ml** + washing-up liquid **15 ml** + honey **6 spatulas or 3 ml**



IMPORTANT INFORMATION: Throw away any food used during the experiment when you have finished.

The perfect conditions for bubble making:

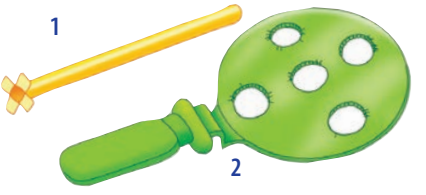
- damp air
- no wind
- not too hot

Preparations for making bubbles 150

Ask an adult to help you

Ask an adult to provide you with some straws (not included in the kit).

Now, make a type of straw with a special end that will be referred to as **special** (***fig. 1***) from now on. You can make it by asking an adult to cut the end of a straw into four equal parts (1 cm) and then open them out. This helps the bubbles stick to the straw. Use the circular-shaped bubble-blowing tool (fig.2) in the kit to make bubbles.



How to use:

To make bubbles, first wet the instrument in the soapy solution and then lightly blow down the straw or in the centre of the bubble-blowing tool (square or circular) where you can see the soap membrane.

A bubble inside another 151

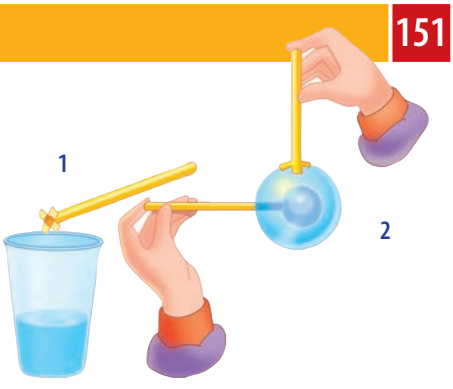
1) Ask an adult for 2 straws with the special end (see experiment 150).

2) Wet the special end of the straw in the bubble solution, take the straw out of the liquid. Put the other end into your mouth and blow until you make a bubble a little less than 10 cm in diameter. Quickly tap the straw from the end you blew into.

3) Wet the other end of the straw in the soapy solution, remove the straw from the liquid and insert it into the bubble you have already made. Blow until you make a bubble inside the other one, quickly tap the straw.

OBSERVE THE FOLLOWING: you have a small bubble inside a big bubble.

4) At the end of the experiment wash the straw well under running water.



A cluster of bubbles 152

Pour the soapy solution into a container (not included in the set) and wet bubble-blowing tool in it. Make lots of bubbles with one simple blow!



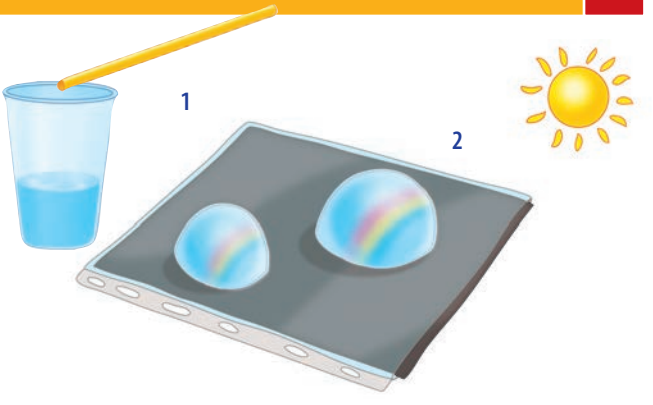
Transparent domes 153

1) Ask an adult for a straw with the special end (see experiment 150).

2) Find a dark and smooth table and wet the surface with the soapy solution, or take a plastic sleeve and put a black sheet inside it and wet the plastic sleeve with the solution.

3) Wet the end of the straw in the bubble solution, take the straw out of the liquid and blow it near the surface so the bubble rests on it.

OBSERVE THE FOLLOWING: you will see coloured bands on the transparent part of the half bubble when sunlight hits it at a certain angle. They don't last long.



4) At the end of the experiment wash the straw well under running water.