NATIONAL GEOGRAPHIC™

8+

WARNING!

Not suitable for children under three years. To be used under the direct supervision of an adult. Choking hazard – small parts can be ingested or inhaled. Cut or stab wounds of the skin by sharp functional edges and points. Instructions for the parents or other responsible persons are included and must be followed. Contains some chemicals that are classified as harmful. Prevent chemicals from coming in contact with the body. Hold small children and animals away while experimenting. Keep Experiment Set out of reach of children under three years. Eye protection for supervising adults is not included. Keep the packaging and manual because they contain important information!

0-3

MANUAL WITH EDUCATIONAL INFORMATION AND EXCITING EXPERIMENTS

CHEMIE 2000
CHEMISTRY 2000

BRESSER®

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General Warnings

- 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 and the final crystal(s) 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 and/or non-reclosable packaging 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.
- Throw away any food used during the experiments.
- Do not apply any substances or solutions to the body.
- Do not grow crystals where food or drink is handled or in bedrooms.
- Take care while handling with hot water and hot solutions.
- Ensure that during growing of the crystal the container with the liquid is out of reach of children under 8 years of age.

General first aid information

- **In case of contact with eyes:** 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.

Declaration of Conformity

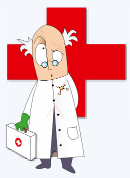
Bresser GmbH has issued a ‚Declaration of Conformity' in accordance with applicable guidelines and corresponding standards. This can be viewed any time upon request.

DISPOSAL

Dispose of the packaging materials properly, according to their type, such as paper or cardboard. Please take the current legal regulations into account when disposing of your device. You can get more information on the proper disposal from your local waste-disposal service or environmental authority.

Write the telephone number of the local poison centre or hospital in the space below. They may be able to provide information on countermeasures in case of poisoning.

In case of emergency dial
Europe 112 | UK 999
USA 911 | Australia 000



Get exclusive new Experiments – only available online!

Media about this product

You can dowload further media (experiments, manuals, etc.) from the BRESSER website* over the following QR code/weblink.

http://www.bresser.de/download/9130600

* Offer subject to the availability of media.

Warranty and warranty term extension

The warranty term is two years from the date of purchase. Please keep your proof of purchase. Register at **www.bresser.de/warranty** and fill out a brief questionnaire to get your warranty term extended to **five years**. Registration must be completed within three months of purchase (date of receipt) to validate the warranty. If you register thereafter, the warranty term will not be extended.

If you have problems with your device, please contact our customer service first. Do not send any products without consulting us first by telephone. Many problems with your device can be solved over the phone. If the problem cannot be resolved by phone, we will take care of transporting your device to be repaired. If the problem occurred after the warranty ended or it is not covered by our warranty terms, you will receive a free estimate of repair costs.

Service Hotline: +49 (0) 2872 - 80 74-210

Important for any returns:
Please make sure to return the device carefully packed in the original packaging to prevent damage during transport. Also, please enclose your receipt for the device (or a copy) and a description of the defect. This warranty does not imply any restriction of your statutory rights.

Your dealer:.. Art. No.: ....

Description of problem:...

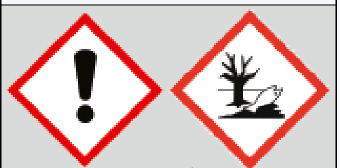
Name:.. Telephone: ....

Street:.. Date of purchase: ....

City/Postcode:.. Signature: ....

Index

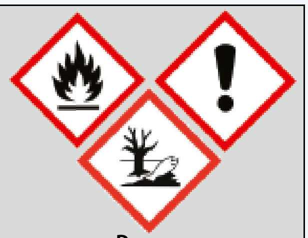
List of chemicals used

Chemical substance	Chemical formula	CAS number	INDEX number	
Copper (II) sulphate	**$CuSO_4 \cdot 5H_2O$**	**7758-99-8**	**053-001-003**	 **Warning**

Hazard Statement:
H302: Harmful if swallowed.
H315: Causes skin irritation.
H319: Causes serious eye irritation.
H410: Very toxic to aquatic life with long lasting effects.
Precautionary Statement — Prevention:
P280: Wear protective gloves/protective clothing/eye protection/face protection.
Precautionary Statement — Response:
P305 + P351 + P338: IF IN EYES: rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P321: Specific treatment (see on label).
P362: Take off contaminated clothing and wash before reuse.
P301 + P312: IF SWALLOWED: call a POISON CENTER or doctor/physician if you feel unwell.
Precautionary Statement — Disposal:
P501: Dispose of contents/container according to local regulations.

Chemical substance	Chemical formula	CAS number	INDEX number	
Hydrogen peroxide 3% (1 mol/l)	H_2O_2	**7722-84-21**	**008-003-00-9**	-
Liquid glycerine (80%)	$C_3H_8O_3$	**56-81-5**	-	-
Litmus red (tournesol) powder	-	**1393-92-6**	**215-739-6**	-
Magnesium sulphate	$MgSO_4$	**7487-88-9**	-	-
Potassium alum	$AlKO_8S_2 . 12H_2O$	**7784-24-9**	-	-
Sodium bicarbonate	$NaHCO_3$	**144-55-8**	-	-
Sodium carbonate	Na_2CO_3	**497-19-8**	**011-005-00-2**	 **Warning**

Hazard Statement:
H319: Causes serious eye irritation.
Precautionary Statement — Prevention:
P260: Do not breathe dust/fume/gas/mist/vapours/spray.
Precautionary Statement — Response:
P305 + P351 + P338: IF IN EYES: rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

Tincture of iodine (0.025 g/ml mass concentration ethanolic solution)	I_2	**7553-56-2**	**053-001-003**	 **Danger**

Hazard Statement:
H226: Flammable liquid and vapour.
Precautionary Statement — Prevention:
P210: Keep away from heat/sparks/open flames/hot surfaces.— No smoking.
P233: Keep container tightly closed.
P280: Wear protective gloves/protective clothing/eye protection/face protection.
Hazard Statement:
H312: Harmful in contact with skin.
H332: Harmful if inhaled.
Precautionary Statement — Prevention:
P280: Wear protective gloves/protective clothing/eye protection/face protection.
P261: Avoid breathing dust/fume/gas/mist/vapours/spray.
P271: Use only outdoors or in a well-ventilated area.
Precautionary Statement — Response:
P302 + P352: IF ON SKIN: wash with plenty of soap and water.
P312: Call a POISON CENTER or doctor/physician if you feel unwell.
P322: Specific measures (see on label).
P304 + P340: IF INHALED: remove victim to fresh air and keep at rest in a position comfortable for breathing.
P312: Call a POISON CENTER or doctor/physician if you feel unwell.
Hazard Statement:
H400: Very toxic to aquatic life.
Precautionary Statement — Prevention:
P273: Avoid release to the environment.
Precautionary Statement — Response:
P391: Collect spillage.
Precautionary Statement – Disposal:
P501: Dispose of contents/container according to local regulations.

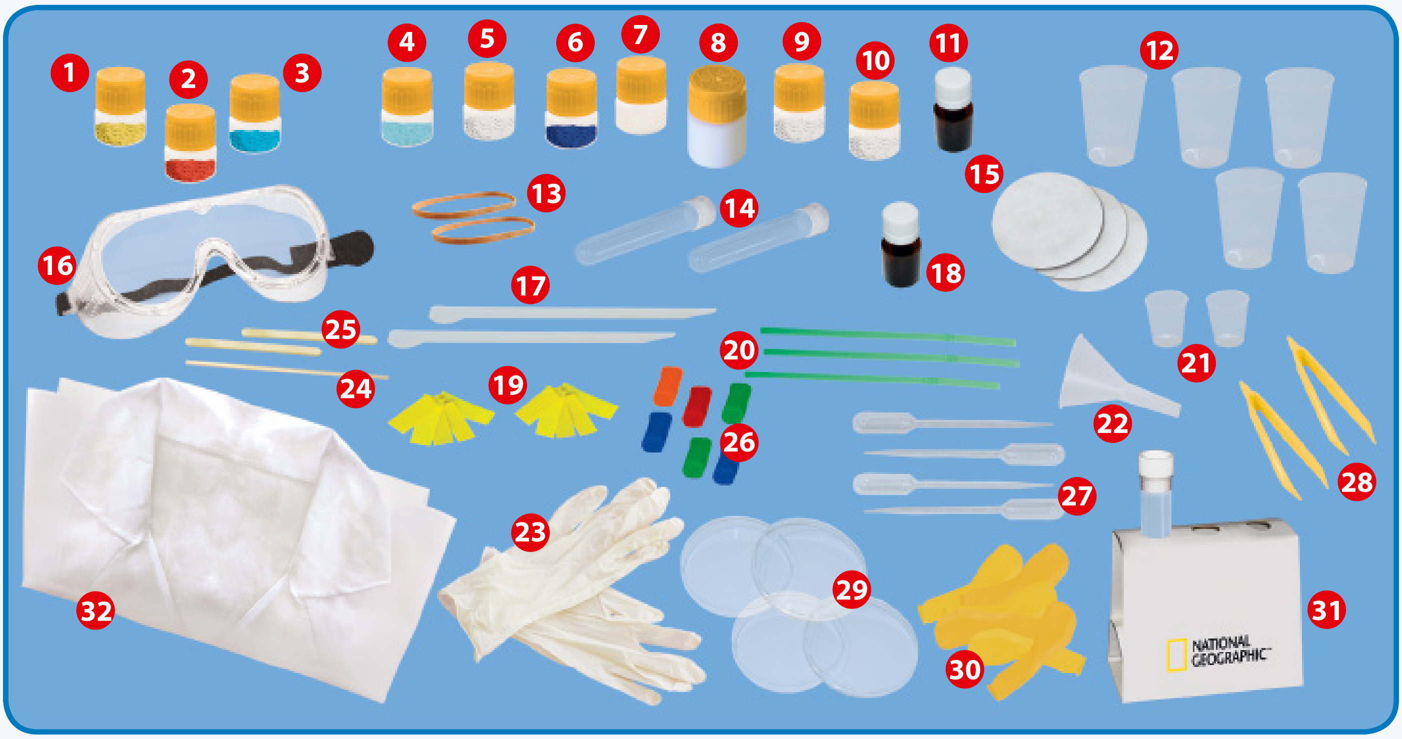
Disposal of used chemicals


When you're disposing chemical substances, please refer to national and/or local regulations. Do not throw chemicals into sewers and garbage. For more details, please refer to a competent authority. For disposal of packaging, make use of specific collection points.

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.

Kit contents



Description:	Quantity:	Description:	Quantity:
1. Yellow food colouring	1	17. Plastic spatulas	2
2. Red food colouring	1	18. Tincture of iodine	1
3. Blue food colouring	1	19. pH test strips	10
4. Copper (II) sulphate	1	20. Straws	3
5. Sodium bicarbonate	1	21. Small measuring cups	2
6. Litmus red (tournesol) powder	1	22. Funnel	1
7. Liquid glycerine	1	23. Protective gloves	2
8. Magnesium sulphate	1	24. Wooden stick	1
9. Sodium carbonate	1	25. Wooden spatulas	2
10. Potassium alum	1	26. Play dough	6
11. Flask for the litmus solution	1	27. Pasteur pipettes	4
12. Large measuring cups	5	28. Tweezers	2
13. Rubber bands	2	29. Petri dish	2
14. Plastic test tubes with lid	3	30. Balloons	6
15. Round filter papers	3	31. Test tube rack	1
16. Protective goggles	1	32. Disposable lab coat	1

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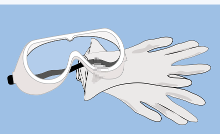
1. Experiments

Note: The reagents and materials included in this kit are labelled with this symbol ★.

Scientist, always put your protective gloves, goggles and lab coat on before conducting any experiment.



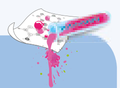
You will need
goggles, gloves and lab coat

Remember to always wash thoroughly the material used, after each experiment! During the experiment, do not use the same materials for different reagents. Otherwise, you may influence the results.

Remember scientist: You must save up your reagents in order to carry out all experiments.

MIXTURES OF SUBSTANCES AND SOLUTIONS

A mixture of substances consists of one or more components. Mixtures can be **homogeneous**, **heterogeneous** or **colloidal**. A homogeneous mixture can also be called solution. A solution consists of, at least, one **solvent** and one **solute**. A solvent is a substance capable of dissolving another, while a solute is a substance that dissolves in another. For example, in a solution of water and sugar, water is the solvent and sugar is the solute.



DID YOU KNOW...
That every time the solvent is water, it is said that the solution is aqueous?

The concentration of a solution corresponds to the amount of solute in a given amount of solution.

Experiment 1
Preparing a solution

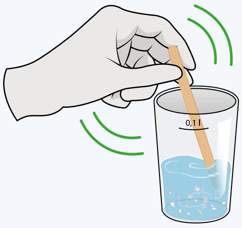
What you will need:
- Water
- Sugar
- Large measuring cup (100 ml) ★
- Plastic spatula ★
- Wooden spatula ★

Steps:

1. Fill half the cup with water.

2. With the plastic spatula, add three spoons of sugar.

3. Stir the mixture with the wooden spatula.



Can you dissolve all the sugar? What type of mixture is this?

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:
You can dissolve all the sugar in water. Water and sugar form a homogenous mixture.

Water dissolves sugar. Water is therefore considered the solvent and sugar the solute.

It's not possible to distinguish a homogenous mixtures components from one another.

Experiment 2
Comparing different mixtures

What you will need:
- Water
- Virgin olive oil
- 96% ethanol or commercial ethanol
- Sand
- 3 Large measuring cups (100 ml) ★
- Wooden spatula ★

Steps:

1. Fill each measuring cup halfway with water.

2. Add olive oil to one of the cups, ethanol to another, and sand to the last one.

What type of mixtures does each cup contain?

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:
Water and ethanol form a homogenous mixture. The intermolecular forces among the water molecules are of the same type as those found among the ethanol molecules. Water molecules can therefore establish interactions with the ethanol molecules. The two substances can mix in all proportions, a property called miscibility. They form a homogenous mixture, also called a solution. The arrangement of ethanol and water molecules is constant throughout the solution and it is not possible to see where the water ends and the ethanol begins, even with a microscope.

By contrast, when water is mixed with olive oil or with sand the result is said to be heterogeneous. The naked eye can easily see where the water ends and the olive oil begins. The intermolecular forces among the water molecules differ from those among the olive oil molecules. These two substances are said to be immiscible. The naked eye can easily see where the water ends and the olive oil begins.

Immiscible liquids can't be mixed.

Experiment 3
Saturated solution – water with sugar

What you will need:
- Sugar
- Water
- Large measuring cup (100 ml)
- Wooden spatula
- Plastic spatula

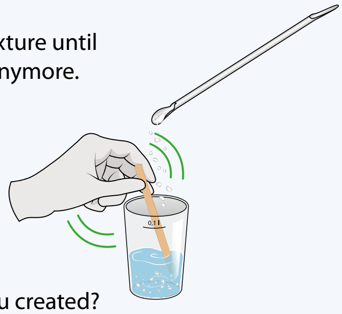
Steps:

1. Fill the cup halfway with water.

2. With the plastic spatula, begin adding spoons of sugar to the cup.

3. Stir the water and sugar mixture with the wooden spatula.

4. Continue adding sugar to the mixture until it becomes impossible to dissolve anymore.



What type of solution have you created?

WARNING. When finished, throw away food used during the experiment.

Explanation:
As you continue to add sugar and stir the solution with the wooden spatula, you'll eventually reach a point when it becomes impossible to dissolve all sugar added. This is called the **saturation point**.

Saturated solution: Solution which contains dissolved the maximum amount of solute in a certain volume of solvent and in a given temperature.

Experiment 4
Preparing a filter

What you will need:
- Funnel
- Round filter papers
- Water
- Pasteur pipette

Steps:

1. Fold the filter as shown in the image below.

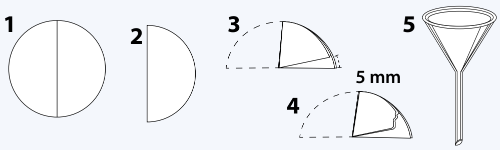


Image 1. Assembling scheme of a filter in a funnel.

2. Place the filter in the funnel.

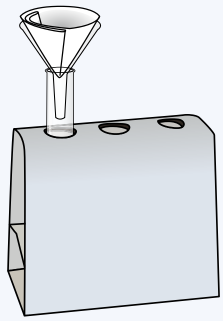
3. Using the Pasteur pipette, add some drops of water allowing for paper filter to more easily attach to the funnel.

Experiment 5
Separating water and sand

What you will need:
- Water
- Sand
- Round filter papers
- Funnel
- Test tube
- Wooden stick
- Large measuring cup (100 ml)
- Test tube rack

Steps:

1. Prepare a mixture of water and sand, by putting sand in a cup of water.

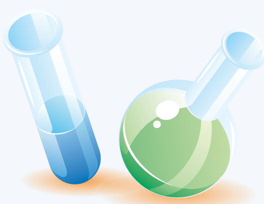


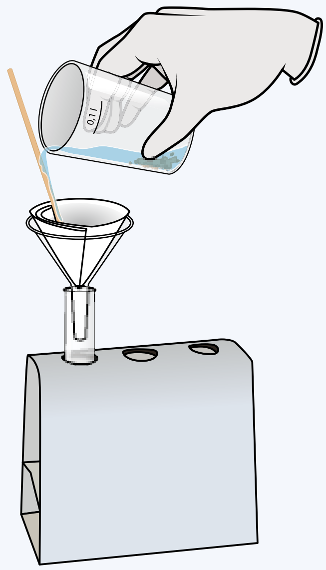
2. Place the funnel whose construction is described in experiment 4 in a test tube. Then place the test tube containing the funnel on the test tube rack.

3. Pour the mixture of water and sand into the funnel and use the wooden stick to guide the liquid.

Can you separate sand from water? What's the name given to the technique you've just used?

Explanation:
Because sand particles are larger than filter holes, the filter retains sand. On the other hand, water passes through the filter freely. Therefore, sand gets stuck in the filter and water lands in the test tube free of sand. This process of separating suspended solid particles from the liquid they are suspended in using a filter is called **filtration**.





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Experiment 6
Homemade filter

What you will need:
- Plastic bottle
- Cotton wool
- Sand
- Small stones
- Scissor
- Two large measuring cups (100 ml) ⭐
- Soil or sand
- Wooden stick ⭐

Steps:

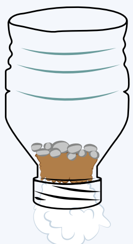
1. Prepare a solution of dirty water: Put water in one of the measuring cups and add a bit of soil or sand. Stir it all, and then save it.

2. With the help of an adult, please use the scissors to carefully cut the bottle into two pieces, making the incision slightly above the point where the bottom half of the bottle ends and the top half begins.

3. Put cotton wool inside the bottleneck.

4. Put the bottleneck upside down.

5. Now, put sand over the cotton wool and over the sand, put the stones.



6. Place the structure you've just made in the empty measuring cup.

7. Pour the dirty water into your homemade filter.

What can you observe?
The water must be less dirty.

Explanation:
When water passes the stones, sand and cotton wool, it is filtered, becoming cleaner.

Experiment 7
Processes of separating mixtures – Decanting

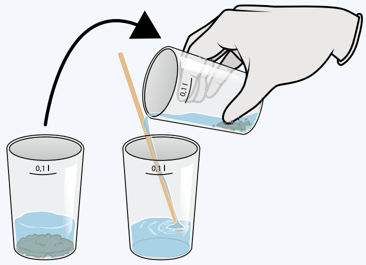
What you will need:
- Water
- Soil or sand
- 2 Large measuring cups (100 ml) ⭐
- Wooden stick ⭐

Steps:

1. Fill a cup halfway with water and add to it soil or sand.

2. Using the wooden stick, stir the mixture. Then wait about five minutes for the mixture to settle.

3. Using the wooden stick, guide the liquid to another cup, as shown in the below image.



Explanation:
Decanting allows for the separation of a liquid from a solid deposited at the bottom of a container.

Processes of separating mixtures:

Decanting is a process used to separate a heterogeneous mixture. It can be used to separate two immiscible liquids as well as non-soluble solids from liquids. This is accomplished by tilting the container holding the heterogeneous mixture towards a second container, ensuring that the first container is only titled far enough that only the less dense substance is poured into the second container.

Sedimentation is a separation process in which a mixture is left at rest until its less dense component is deposited at the bottom of the container.

Crystallization is a process of separating homogeneous mixtures in which the goal is to separate one of its components. The solvent evaporates causing the appearance of solute crystals.

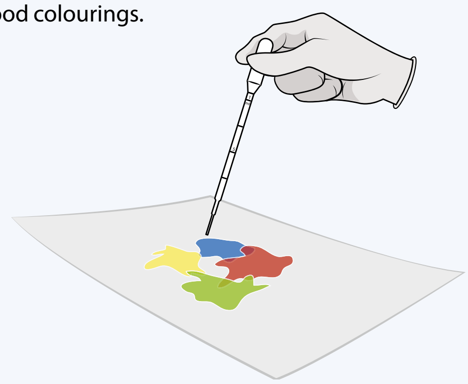
Experiment 8
The art of evaporating

What you will need:
- Tracing paper
- Scissor
- Food colouring ⭐
- Pasteur pipettes ⭐

Steps:

1. With a Pasteur pipette, add some drops of blue food colouring to the tracing paper.

2. With another Pasteur pipette, repeat the previous step using another food colouring. Experiment and create different colours by mixing food colourings.



3. Place the tracing paper in the sun.

4. Set the paper aside until the water evaporates.

5. Using the scissors, cut the paper into a shape you like and hang it on a window for decoration.

Explanation:

When water evaporates, coloured drawings remain on the tracing paper. The food colouring included in your kit consists of water and powder dye, forming a homogeneous mixture. The sun will heat the mixture, causing the water to evaporate. This leaves patches of coloured stains on the tracing paper.

SUPER SCIENTIST: Try this same experiment using other materials like an old sweater or another type of paper.

Experiment 9
How do water molecules move?

What you will need:

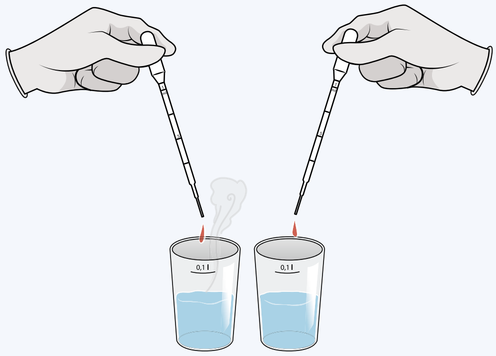
- Two large measuring cups (100 ml) ⭐
- Hot and cold tap water
- Food colouring ⭐
- Two Pasteur pipettes ⭐

Steps:

1. Fill with a large measuring cup with cold tap water.

2. Fill another cup with the same amount of water but this time use hot tap water.

3. Using the Pasteur pipette, add immediately a drop of food colouring to each cup. Ensure that you add the exact same number of drops to both cups and don't stir them.



What do you observe?

Explanation:

The food colouring spreads in the water in both cups, but at different speeds.

When the water is hot the water molecules move more quickly, ensuring that the food colouring spreads faster.

In cold water, the food colouring will take longer to spread because the water molecules' movement isn't as fast as it is in hot water.

SUPER SCIENTIST: Determine the time difference that food colouring takes to become completely mixed in both hot and cold water.

Experiment 10
Diffusion

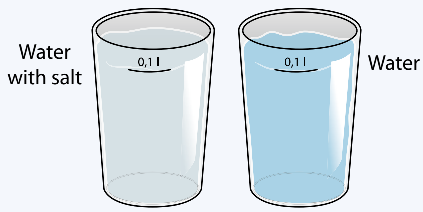
What you will need:

- 1 Tablespoon
- Pasteur pipettes ⭐
- 2 Large measuring cups (100 ml) ⭐
- Wooden spatula ⭐
- Salt
- Water
- Food colouring ⭐

Steps:

1. Fill both cups of water up to the 100 ml mark.

2. In one of the cups, create a saturated solution by adding salt until you can't dissolve it anymore.



3. Add a drop of food colouring to each cup. Do not stir the mixture.

What do you observe?

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:
The food colouring moves faster in the cup only containing water than in the cup containing both water and salt. However, the liquids in both cups after a while become completely coloured.

Even though they are not visible, the water molecules are always in motion. When food colouring is added to the water, the water molecules intermix with the food colouring molecules and both types of molecules move together. Eventually, the food colouring will mix completely with the liquid and it becomes impossible to see where the liquid ends and water begins. The water takes on the colour of the dye.

The faster the molecules move, the faster the food colouring molecules move. Both water and food colouring molecules move more slowly in the water containing salt. The salt adds more molecules to the solution, which take up space. This solution contains more molecules and less space in which the molecules can move, making the movement slower.

SUPER SCIENTIST: Try the same experiment by mixing water with other substances, like sugar or sodium bicarbonate.

The phenomenon taking place in this experiment is called **diffusion**. The rate of the food colouring's diffusion is less in the water containing salt than it is in the water that lacks salt.

Experiment 11
Coloured bottle

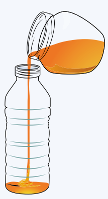
What you will need:
- Small plastic bottle
- Small measuring cup (25 ml)
- Large measuring cup (100 ml)
- Pasteur pipette
- Wooden spatula
- Water
- 96% ethanol or commercial ethanol
- Honey
- Cooking oil
- Food colouring
- Pen

Steps:
1. Using the small measuring cup, add 25 ml of water to plastic bottle.

2. Using the pen, identify and mark the water level.

3. Pour the water from the bottle into the large measuring cup.

4. Add honey to the bottle until reaching the level previously identified.



5. Using the Pasteur pipette, pour two drops of colouring into the cup of water. Stir the mixture using the wooden spatula.

6. Pour the water containing the colouring into the bottle. The water should float atop the honey.

7. Using the small measuring cup, add 25 milliliters of oil to the bottle.

8. Now, using the small measuring cup, measure out 25 ml of ethanol and add to it two drops of food colouring of another colour. Then, carefully and slowly add it to the bottle.

What do you observe?

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:
The substances you've used in this experiment have different densities. The four float separately on top of each other without mixing. At the bottom is **honey**, then comes **water**, followed by **oil**, and **ethanol** sits on top.

Each substance has a different density. Denser substances have more particles per unit of volume than less dense ones. This is why less dense substances float on top of denser ones.

In the case of this experiment, honey is the densest substance, followed by water and oil. Ethanol floats on top because it is the least dense.

SUPER SCIENTIST: Repeat this experiment, but try to pour oil into the bottle before you pour water. What do you think will happen?

Experiment 12
Let go of the drop!

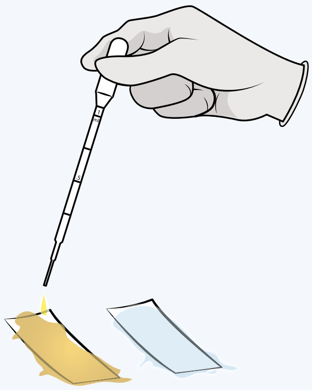
What you will need:
- Two Petri dishes
- Two tablespoons of virgin olive oil
- Two tablespoons of water
- Filter paper
- Paper napkins
- Small measuring cup (25 ml)
- Food colouring
- Pasteur pipette
- Scissors
- Plastic spatula
- Tweezers

Steps:
1. Pour two tablespoons of olive oil in one Petri dish and two tablespoons of water in another Petri dish.

2. Cut two strips of filter paper and dip one in the olive oil and the other in the water.

3. Remove the paper strips with the tweezers and place them over different paper napkins.

4. Choose a food colouring and pour a drop of it over each paper strip.



What does happen with the food colouring drops over each paper strip?

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:
Water and olive oil behave differently. The food colouring drop remains at the surface of the paper anointed with olive oil, while the drop placed on the paper dipped in water spreads.

The food colouring remains as a drop on the paper containing olive oil because its water molecules do not combine with olive oil molecules. Water and olive oil are immiscible liquids. Substances are considered **immiscible** when they do not form a homogenous mixture when added together.

The food colouring drop placed on the wet paper is considered **miscible** with the water. The dye dissolves on the paper strip and spreads across it. Their molecules combine in the same way that molecules in a container holding a solution combine.

Experiment 13
Diving coin

What you will need:
- 2 Equal coins
- 2 Large measuring cups (100 ml)
- Water
- Honey

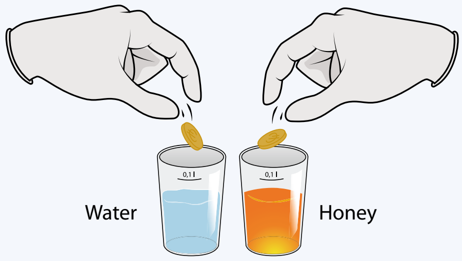
Steps:
1. Fill a cup ¾ of the way full with water.

2. The fill the other cup the same volume with honey.

3. Put one of the coins in the cup holding water.

4. Put the other coin in the cup with honey.

Which coin will reach the bottom of its respective cup first if both are dropped at the same time? And why?



WARNING. When you have finished, throw away any food used during the experiment.

Explanation:
The descent of the coin in water is higher than the descent of the coin in honey. This may be explained by the fact that honey's viscosity is greater than that of water.

Viscosity can be described as the resistance of a fluid (liquid or gas) to its own flow.

Experiment 14
Almost a lava lamp

What you will need:
- Bottle with lid, empty and clean
- Oil
- Food colouring
- Salt
- Water
- Plastic spatula
- Wooden spatula
- Funnel
- Pasteur pipette

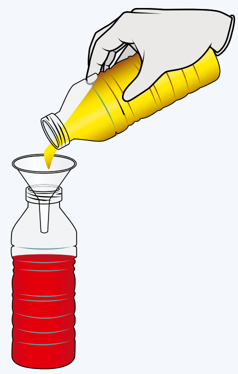
Steps:
1. Pour water into the bottle until 3/4 of its volume is filled.

2. With the Pasteur pipette add some drops of food colouring to the water. Put the lid into the bottle and then shake it a little, mixing the water and food colouring.

3. Fill the bottle almost to the top with oil using a funnel.

4. Let the mixture separate.

5. Now, pour salt into the bottle.



What do you observe?

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:
Oil floats in water because a drop of oil is lighter than a drop of water of the same size. This means that oil is less dense than water.

Density relates the mass of a material with the volume it occupies. Substances less dense than water will float on it. Denser substances than water will sink in it.

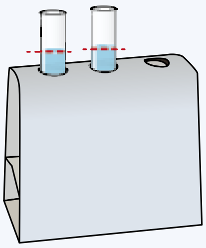
Salt is denser than water and tends to sink to the bottom of the bottle. When you add salt in this experiment, blobs of oil get attached to the salt grains and sink. When the salt dissolves, the oil rises to the top of the bottle, generating a phenomenon similar to what takes place in a lava lamp.

Experiment 15
Hard water and soft water

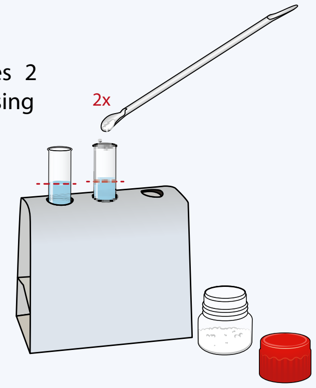
What you will need:
- Plastic spatula ★
- Tepid tap water
- 2 Test tubes with lids ★
- Test tube rack ★
- Magnesium sulphate ★
- Washing-up liquid
- Teaspoon

Steps:

1. Place the test tubes on the test tube rack. Fill in both test tubes with tepid water, up to the second mark.



2. Add to one of the test tubes 2 spoons of magnesium sulphate, using the plastic spatula.



3. Close the test tube containing magnesium sulphate and shake it until the powder is dissolved.

4. Add half a teaspoon of washing-up liquid to each test tube.

5. Put the lids on the tubes and shake each solution. Try to make foam in each of the test tubes.

What happens?
In which tube forms less foam?

Explanation:
Less foam is formed in the test tube with magnesium sulphate. Magnesium sulphate is a compound that hardens water. This is why you cannot form a lot of foam. Tap water often contains calcium and magnesium contents which prevent the soap from making foam. If water contains much mineral content, we say it's 'hard'.

And did the tap water make foam?
Is tap water from your geographic area hard, soft or medium?

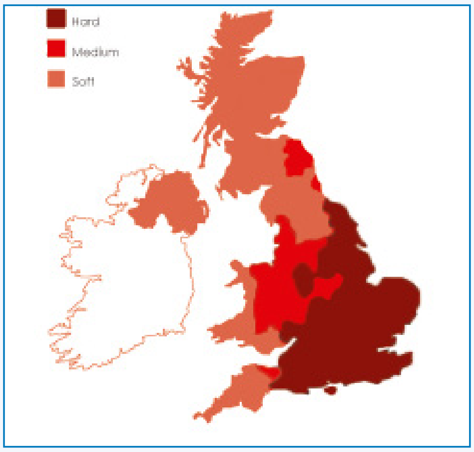


Image 2. UK water hardness map.

DID YOU KNOW…
That the hardness of water can be expressed in mg/l of calcium carbonate ($CaCO_3$), in French degrees (ºfH), in German degrees (°dH), among others? 1°fH = 10 mg/l ($CaCO_3$).

SUPER SCIENTIST: What if you carried this experiment out with sodium bicarbonate? What do you think would happen?

Experiment 16
Super soap bubbles

What you will need:
- Distilled water (tap water can be used, but distilled water forms larger bubbles)
- Washing-up liquid
- Clean container with lid
- Liquid glycerine ★
- Wooden spatula ★
- Small measuring cup (25 ml) ★
- Soap bubble hoop (please note that you can make the hoop with wire)
- Tablespoon

Steps:

1. Measure 150 ml of water into a container.

2. Also with the measuring cup, add 25 ml of washing-up liquid to the same container.

3. Stir it slowly with the wooden spatula. Try to not form bubbles or foam while stirring.

4. Put 1 tablespoon of glycerine in the container.

5. Dip the hoop in the mixture and slowly remove it. Wait a few seconds and then blow against it.

How many soap bubbles can you make with one blow?

Explanation:
The outside of a soap bubble consists of three very thin layers: soap, water and another layer of soap. The 'sandwich' on the outer part of the bubble is called soap film. The bubble bursts when the layer of water stuck between the two soap layers bursts. Glycerine makes the soap layer thicker, preventing the water from evaporating quickly and so bubbles last longer. They also get stronger and that's why you can make larger bubbles.

Soap bubble

Attention: Save the soap bubbles liquid for the next experiment. Keep out of reach of small children and animals and also away from food and drink.

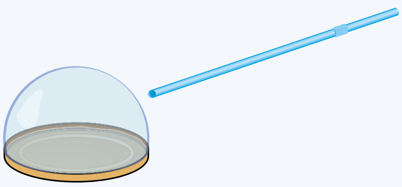
Experiment 17
Bubbles that do not burst

What you will need:
- Mixture of soap bubbles – with at least one each day (Experiment 16)
- Straw
- Scissors

Steps:
1. Remove from the lid from the container holding the mixture.

2. Place the lid upside down and fill it with the super soap bubble liquid.

3. Dip the tip of a straw into the liquid inside the lid. Keep the straw in the lid and blow, through it, to form a soap bubble inside the lid. Slowly, pull the straw out of the lid.



4. Now, dip the tip of the scissors into the container holding the super soap bubbles mixture. Prick the bubble's walls with the scissors.

Observe what happens.

5. Try pricking the soap bubble with other sharp objects (for example a pencil). Remember that you have to dip the tip of all these objects in the super soap bubble solution before they touch the bubble.

6. Try putting your finger inside the bubble too.

Why are these bubbles so resistant?

Explanation:
You must be able to pass the scissors through the bubble layer without it bursting. When something wet touches the bubble, it doesn't make a hole, it only slides and the bubble forms around the object. The super soap bubble solution on the tip of the scissors fills in the hole that would be formed. If you try passing a pair of dry scissors through the bubble, the bubble will burst instantaneously.

Attention: Save the soap bubbles liquid for the next experiment. Keep them out of reach of small children and animals and also away from food and drink.

Experiment 18
Micelles! What are they?

What you will need:
- Camomile tea (4 tea bags)
- Scrapes of natural soap, without colour or scent (4 tablespoons)
- Liquid glycerine (1 + ½ tablespoon)
- Water (1 + ½ cup)

Steps:
1. Make the camomile tea with the help of an adult.

2. Let it boil for 10 minutes and then remove the tea bags.

3. Place the soap scrapes in the tea still hot.

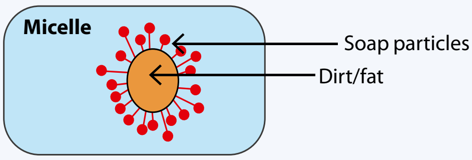
4. Let the scrapes soften.

5. Finally, add glycerine and stir it all well.

Observe what happens to your mixture.

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:
A **micelle** is a complex of surfactant particles that forms around dirt and fat.



The soap scrapes (in this case the surfactants) originate a micelle when added to an aqueous solution. This micelle isolates the fats and dirt in its interior while its ends guarantee its miscibility in water.

The surfactants are organic compounds that when added to an aqueous solution, originate a micelle. Surfactants are used in soaps and shampoos, as they are able to eliminate both fats and dirt.

In this experiment you can look at the chemistry behind a shampoo. The basic composition of a shampoo must include surfactants, preservatives, fragrances and a pH regulator. Here, the surfactants are the soap scrapes, the fragrance is the camomile tea and the glycerine works as a moisturiser and conditioner.

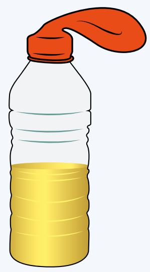
Experiment 19
How to fill up a balloon without blowing

What you will need:
- 0.33 l Plastic bottle
- Sodium bicarbonate
- Vinegar
- Plastic spatula
- Balloon

Steps:

1. Fill up the bottle halfway with vinegar.

2. Using the plastic spatula, put four spoons of sodium bicarbonate inside the balloon.

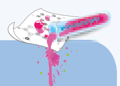


3. Place the balloon on the bottle's neck. Place it carefully, because sodium bicarbonate cannot fall inside the bottle.

4. Lift the balloon so that the sodium bicarbonate falls into the bottle. Try to keep the balloon in the vertical position and see what happens.

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:
Vinegar reacts with sodium bicarbonate and forms the gas carbon dioxide. While the gas is forming the pressure increases and the balloon is filled up.



DID YOU KNOW…
That sodium bicarbonate can be used for personal hygiene, cleaning, cooking and homemade medicines? In cooking it is used as yeast to make bread and cakes.

Experiment 20
Foam column

What you will need:
- Two large measuring cups (100 ml)
- Two small measuring cups (25 ml)
- Vinegar
- Washing-up liquid
- Sodium bicarbonate
- Water
- Food colouring (optional)
- Pasteur pipettes (optional)
- Plastic spatula

Steps:

1. Prepare a solution in the small measuring cup, pouring 25 ml of vinegar and a spoon of washing-up liquid, using the plastic spatula.

2. Put some drops of food colouring in the previous solution if you'd like.

3. In a large measuring cup, prepare a solution of water and sodium bicarbonate, with about 25 ml of water and 2 spoons of sodium bicarbonate, using the plastic spatula.

4. Mix both solutions in the other large measuring cup.

What happens?

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:
It originates foam. Foam is produced by the release of carbon dioxide from the washing-up liquid and vinegar solution, when the vinegar's acetic acid reacts with the sodium bicarbonate.

Sodium bicarbonate is a compound consisting of hydrogen, sodium, oxygen and carbon elements. When it is mixed with vinegar (water and acetic acid) a chemical reaction occurs:

$$H^+ (aq) + HCO_3^- (aq) \rightarrow CO_2 (g) + H_2O (l)$$

Carbon (C) and oxygen (O) elements bond and originate a new gaseous compound, carbon dioxide (CO_2).

Experiment 21
Vinegar and sodium bicarbonate extinguisher

What you will need:
- Large measuring cup (100 ml)
- Candle
- Match
- Vinegar
- Sodium bicarbonate
- Plastic spatula

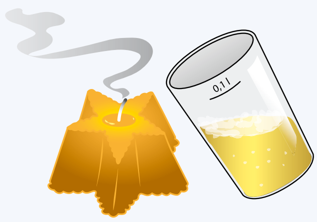
Steps:

1. Fix the candle to a working table and ask an adult to light it.

2. In the cup, with the help of the plastic spatula, put a spoon of sodium bicarbonate.

3. Now, add vinegar (half cup) to the cup.

4. When it starts reacting, approximate the cup towards the candle, without spilling the liquid.



What happens?

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:
Sodium bicarbonate reacts with vinegar and forms carbon dioxide (CO_2) which when getting close to the candle, puts it out.

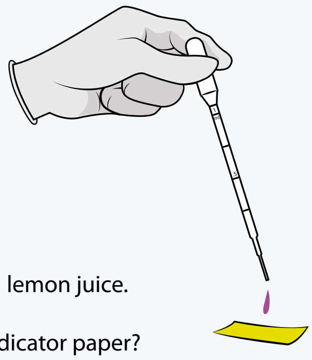
Experiment 22
Test an acid on indicator paper

What you will need:
- pH test strips
- Plastic spatula
- Tweezers
- Pasteur pipette
- Lemon juice
- Grape juice
- Water
- 2 Small measuring cups (25 ml)

Steps:

1. Use the tweezers to hold a pH test strip. Do not touch it with your hands.

2. Put a bit of grape juice into one of the measuring cups. With the Pasteur pipette, put some grape juice over the paper.



Observe what happens.

3. Repeat the procedure with lemon juice.

What happens to the indicator paper?

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:

Grape juice includes in its composition a compound called **tartaric acid** and the lemon juice contains a compound called **citric acid**.

Tartaric and citric acids are, as their names show, acids. Test strips are made to indicate the pH of a substance. The pH is a measure of acidity or alkalinity.

When you put acid on the pH test strip it will change colour to the colour of the pH value of what your are testing.

Solutions with a pH lower than 7 are called acidic and solutions with values greater than 7 are called alkaline (or basic). If the pH value is 7, the solution is neutral. Water, for example, has a pH of about 7.

In case of tartaric acid (grape juice), the colour matches a pH value lower than 7.

Citric acid (lemon juice) is also an acid and therefore also carries the potential to change the colour of the test strip.

SUPER SCIENTIST: Did you notice any differences between the results obtained from using grape or lemon juices?

Compare the colour of each test strip with the pH scale!

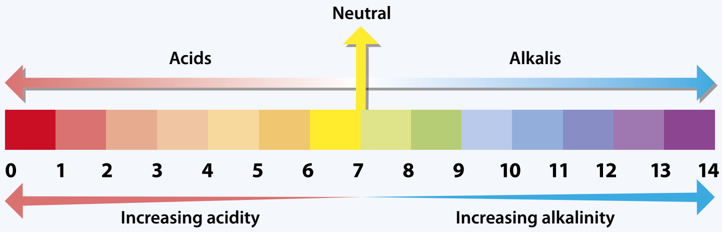


Image 3. pH scale for universal indicator.

Experiment 23
Test a base on the indicator paper

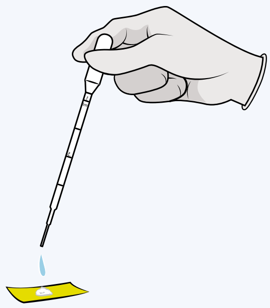
What you will need:
- pH test strips
- Pasteur pipettes
- Tweezers
- Plastic spatula
- Sodium carbonate
- Water

Steps:

1. Use the tweezers to hold a test strip. Do not touch it with your hands.

2. With the plastic spatula, put a little bit of sodium carbonate over the paper.

3. With the Pasteur pipette, add a drop of water.



Observe what happens!

SUPER SCIENTIST: Try repeating this experiment with powder detergent and/or sodium bicarbonate.

Explanation:

Sodium carbonate is a base (alkali). Test strips are made to indicate the pH of a substance. The pH is a measure of acidity or alkalinity.

When you put the base on the test strip and add a drop of water, you create an alkaline solution on the test strip. It will change colour to the colour of the pH value of this solution.

Solutions with a pH lower than 7 are called acidic and solutions with values over 7 are called alkaline (or basic). If the pH value is 7, the solution is neutral.

In the case of sodium carbonate, the colour will match a pH value greater than 7. Compare the colour of your pH test strip with the colours from the pH scale (Image 3).

Detergents that you may find at home also contain bases (alkalis) that will cause the changing in colour of the pH strip to a pH above 7.

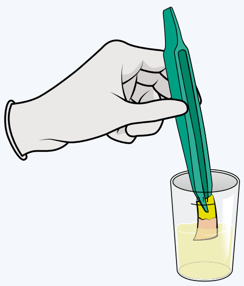
Experiment 24
Acids and alkalis

What you will need:
- 2 Small measuring cups (25 ml)
- Plastic spatula
- Pasteur pipettes
- Tweezers
- pH test strips
- Lemon juice
- Sodium bicarbonate
- Wooden stick

Steps:

1. Pour a bit of lemon juice into one of the measuring cups.

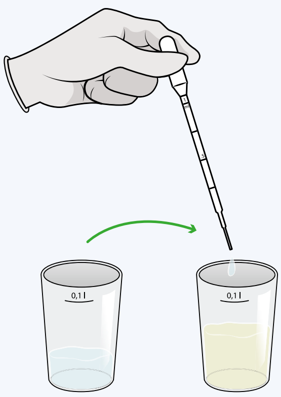
2. Then, dip in the cup, with the help of the tweezers, one of the pH test strips.



Observe and take notes of what happens.

3. Prepare a solution of sodium bicarbonate. Put a little bit of sodium bicarbonate in the other measuring cup and then add a little more of water. Stir the solution well.

4. With the Pasteur pipette add slowly some drops of the solution of sodium bicarbonate to the cup with lemon juice.



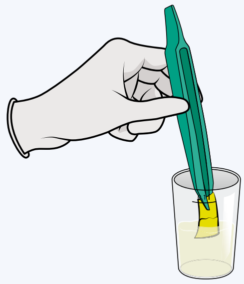
5. Dip, with the tweezers, another pH test strip in the solution you've created.

Observe and take notes!

6. Add the remaining sodium bicarbonate solution to the initial solution.

7. Use another pH test strip in the resulting solution. Observe and take notes.

What happened?



Remember that lemon juice contains a compound called citric acid.

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:

The pH test strip changes colour. When you add a sodium bicarbonate solution to a citric acid solution (lemon juice), the pH changes and as so, the test strip paper will present another colour.

All the more, citric acid, present in the lemon juice, is an acid and sodium bicarbonate is an alkali (base). When adding the base to the acid, you are neutralising the solution, in other words, you are approximating the pH value to 7. However, the balance between acid and alkali that originates pH 7 is difficult to predict and you may not be able to neutralise the solution. Nevertheless you can see a change in colours on the pH test strip that indicate a pH changing.

When you add more base (sodium bicarbonate) the solution becomes more alkaline, which will create a new colour on the test strip.

Compare the colours of the pH test strip paper with the pH scale (Image 3).

Experiment 25
Prepare a natural pH indicator

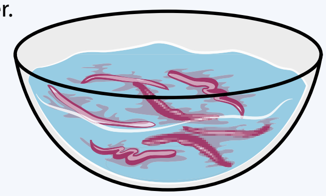
What you will need:
- Red cabbage
- Knife
- Large and wide container
- Wooden spoon
- Hot water
- Container with lid

Steps:

Attention: Ask an adult for help.

1. Put hot water in a large and wide container.

2. Ask an adult to cut with the knife the red cabbage in small parts and put them in hot water.



3. Stir it with the wooden spoon for some minutes, until the water gets purple.

4. Take off the small parts of red cabbage and save this indicator in a container with lid, so that you may use it in the following experiments.

Observe the pH scale for the red cabbage pH indicator!

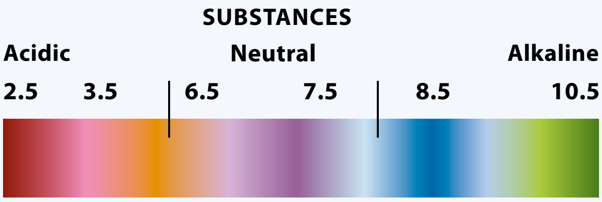


Image 4. pH scale for the red cabbage pH indicator.

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:
Red cabbage has a natural pH meter. It's a pigment called anthocyanin which is soluble in water. When placing red cabbage in hot water we are separating the anthocyanin from the red cabbage and dissolving it in water. Anthocyanin molecules change colour depending on the pH of the environment where placed. This pigment can also be found in apple peels, grapes, corn flakes, poppy flowers and plums.

Attention: save for the next experiment(s). Keep out of reach of small children and animals and also from food and drink.

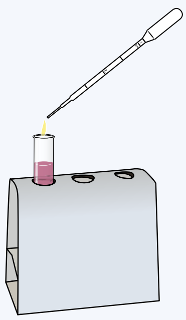
Experiment 26
Test your natural pH indicator with an acid

What you will need:
- Natural pH indicator (Experiment 25)
- Test tube
- Test tube rack
- Small measuring cup (25 ml)
- Vinegar
- Pasteur pipettes

Steps:
1. Put a small volume of the natural pH indicator in a test tube, with the help of the Pasteur pipette.

2. Place the test tube on the test tube rack.

3. Pour a little of vinegar into the small measuring cup. With the Pasteur pipette, add some drops of vinegar into the test tube.



What do you observe scientist? Which is the colour obtained?

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:

The primary constituent of vinegar is acetic acid.

Solutions with a pH lower than 7 are called acidic. Acetic acid is an acid and will therefore change the colour of the natural pH indicator to a hue lying between pink and red, as is shown in image 4.

Experiment 27
Test your natural pH indicator with an alkali

What you will need:
- Natural pH indicator (Experiment 25)
- Test tube
- Test tube rack
- Plastic spatula
- Sodium carbonate
- Pasteur pipettes

Steps:
1. Put a small amount of indicator in a test tube, with the help of the Pasteur pipette.

2. Place the test tube on the test tube rack.

3. With the plastic spatula, add a little of sodium carbonate to the test tube.

What do you observe? What colour becomes the red cabbage indicator?

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:
Solutions with a pH greater than 7 are called alkaline or basic. Sodium carbonate is a base and will therefore change the colour of the natural pH indicator to a hue lying between blue and green, as is shown in image 4.

Experiment 28
Homemade indicator paper

What you will need:
- Round filter paper or absorbent paper
- Natural pH indicator (Experiment 25)
- Scissor
- Pasteur pipettes
- Container with lid

Steps:
1. With the scissor-cut small squares of absorbent paper or filter paper.

2. Pour some drops of the natural pH indicator on each paper square.

3. Save the squares in a closed container, so that you may use them in the following experiments.

WARNING. When you have finished, throw away any food used during the experiment.

Attention: save for the next experiment(s). Keep out of reach of small children and animals and also from food and drink.

Experiment 29
Test an acid with the homemade indicator paper

What you will need:
- Lemon juice
- Small measuring cup (25 ml)
- Pasteur pipettes
- Homemade square paper indicators (Experiment 28)
- Tweezers

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Steps:

1. Pour a bit of lemon juice into the cup.

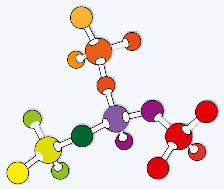
2. Take one of your homemade indicator paper and put it at the table. Add, with a Pasteur pipette, 2 drops of lemon juice to a paper square indicator.

What do you observe, scientist? Take notes of your conclusions in your scientist notebook!

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:

Lemon juice, as you already know, contains a compound called citric acid. As the name indicates, this compound is an acid, and the indicator paper that you've created with the natural pH indicator solution will react indicating the pH of this acid. Compare the colour obtained with the pH scale colours from image 4.



Experiment 30
Test a base with the homemade indicator paper

What you will need:
- Sodium bicarbonate
- Homemade indicator paper (Experiment 28)
- Pasteur pipettes
- Water
- Small measuring cup (25 ml)
- Plastic spatula
- Tweezers

Steps:

1. Put some drops of water in the cup and add a bit of sodium bicarbonate.

2. Take one of your homemade indicator paper and put it at the table. With the Pasteur pipette pour some drops of the solution you've prepared on your homemade indicator paper.

What do you observe, scientist? Take notes about your conclusions in your notebook!

Explanation:

Sodium bicarbonate is a base (alkali). The indicator paper will therefore change to a colour indicating its pH. Using the information on image 4, compare the colour obtained against the the pH scale colours listed for the homemade indicator paper.

Experiment 31
Is water acid, neutral or alkali?

What you will need:
- pH test strips / Natural pH indicator (Experiment 25)/ Homemade indicator paper (Experiment 28)
- Water
- Pasteur pipettes

Steps:

1. Use pH test strips included in your kit or an indicator you've made.

2. Put a drop of water on the indicator paper.

From the colour that appears on the indicator you may determine if the water you used is acidic, alkaline (basic) or neutral.

SUPER SCIENTIST: Try using water from different sources: tap water and water from the bottle, for example. Take notes of the pH differences between them!

Experiment 32
Prepare an indicator using a purple violet

Attention: **Ask an adult for help.**

What you will need:
- Hot water
- 2 Large measuring cups (100 ml)
- Purple violet's petals
- Container with lid
- Strainer

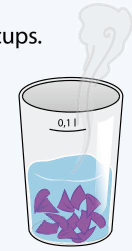
Steps:

1. Collect the purple violet's petals and cut them in small pieces.

2. Place them in one of the cups.

3. Add hot water to the cup.

4. Wait 20 to 30 minutes.



5. Use the strainer to separate the liquid from the petals, passing the solution to another cup.

6. Transfer the solution to a container with lid.

7. Your indicator is done!

Attention: **save for the next experiment(s). Keep out of reach of small children and animals and also from food and drink.**

Experiment 33
Prepare an indicator using a rose

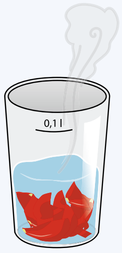
What you will need:
- Hot water
- 2 Large measuring cups (100 ml)
- Rose petals
- Strainer
- Container with lid
- Tweezers

Steps:

1. Collect the rose's petals and cut them in small pieces.

2. Place them in one of the cups.

3. Add hot water to the cup.



4. Wait 20 to 30 minutes.

5. Use the strainer to separate the liquid from the petals, passing the solution to another cup.

6. Transfer the solution to a container with lid.

7. Your indicator is done!

Attention: Store away until you are ready to complete the next experiment. Keep out of reach of small children and animals and also away from food and drink.

Experiment 34
Make the pH scale for the rose's indicator

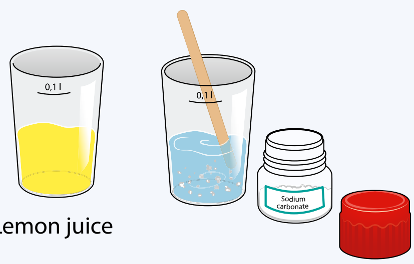
What you will need:
- Rose's indicator (Experiment 33)
- Lemon juice
- Sodium carbonate
- Water
- 3 Test tubes
- Test tube rack
- 2 Large measuring cups (100 ml)
- Plastic spatula
- 3 Pasteur pipettes

Steps:

1. Place 3 test tubes on the test tube rack.

2. Number them from 1 to 3 or write the name of the reagents on each test tube (lemon juice, sodium carbonate, water).

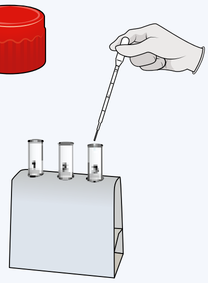
3. Squeeze some lemon juice into one of the cups and, in the other, dissolve a little bit of sodium carbonate with water.



Lemon juice

4. With the Pasteur pipette add to each test tube, 10 drops of your rose indicator.

5. Add 5 drops of lemon juice to tube 1, 5 drops of sodium carbonate solution to tube 2 and 5 drops of water to tube 3.



6. Take note of the colours you see.

7. Now you can use this indicator to test the pH of other substances.

Explanation:

Citric acid (of lemon juice) is an acid, sodium carbonate is a base and water is a substance with neutral pH.

The pH and/or the acidity or alkalinity behaviour of each reagent will vary in the colours that each susbtance will present for this particular indicator, allowing it to generate a colour scale that coordinates with PH values.

SUPER SCIENTIST: Complete your pH scale, repeating this experiment with other acidic and alkaline (basic) substances: vinegar (acid), sodium bicarbonate (alkali), grape juice (acid) or washing powder (alkali).

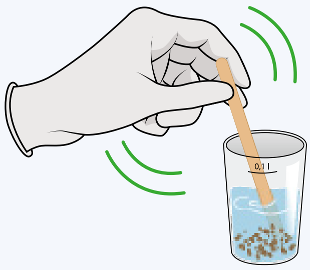
Experiment 35
Measure the pH of the soil using indicator paper.

What you will need:
- Large measuring cup (100 ml)
- Soil
- Pasteur pipettes
- pH test strips
- Distilled water (can be replaced by tap water)

Steps:

1. Put water in a cup.

2. Put a small piece of soil in the cup and stir.



3. Let the soil deposit on the bottom of the cup.

4. After some minutes, please use the Pasteur pipette to apply 2 drops of water to the indicator paper.

What do you observe, scientist? What is the pH of the soil you used?

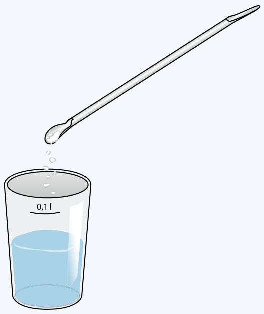
Experiment 36
Salt has pH 7 in water

What you will need:
- Large measuring cup (100 ml) ⭐
- Plastic spatula ⭐
- Salt
- Water
- pH test strip ⭐
- Pasteur pipettes ⭐

Steps:

1. Pour water into the measuring cup.

2. With the help of the plastic spatula, put 1 spoon of salt in the cup.



3. Using the Pasteur pipette, put 2 drops of the solution on the indicator paper.

What is the pH of this mixture?

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:
Salt consists of one positive ion, cation Na^+, and one negative ion, anion Cl^-. When in contact with water, hydrochloric acid, HCl, a strong acid, and sodium hydroxide, NaOH, a strong alkali (base), are formed. The acid and the alkali annul each other and the water has then a neutral pH, which is approximately 7.

Experiment 37
Chemical rainbow

What you will need:
- Wooden spatula ⭐
- Natural pH indicator (Experiment 25)
- 2 Large measuring cups (100 ml) ⭐
- Sodium carbonate ⭐
- Vinegar
- Plastic spatula ⭐
- Pasteur pipettes ⭐
- Small measuring cup (25 ml) ⭐

Steps:

1. Put 50 ml of natural pH indicator in the 100 ml cup. To measure this volume use the small measuring cup and make two measures of 25 ml each.

2. With the help of a Pasteur pipette, add 3 drops of vinegar to the 100 ml cup.

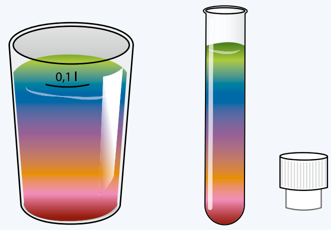
3. In a 25 ml cup, add one teaspoon of sodium bicarbonate to 15 ml of water. Stir it with the wooden spatula until it is dissolved.

4. Fill in a Pasteur pipette with the sodium carbonate solution.

5. Put the content of the Pasteur pipette, immediately in the 100 ml cup and not drop by drop. The solution must change colour immediately and, slowly, sink in the cup.

6. Let the solution stabilise, until you can see all the colours.

7. To prevent the colour from disappearing, pour the 100 ml cup's content into an empty cup.



Note: If a small volume is used, the experiment can be carried out in a test tube.

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:
The indicator changes colour to show the pH value in a substance. In this case, when you mix an acidic solution (vinegar) with a basic solution (sodium carbonate), the indicator produces a coloured spectrum.

Another important concept to obtain this rainbow is density. The sodium carbonate solution is denser than the indicator. That's why it sinks. At the bottom of the cup, vinegar molecules form, creating a new solution which also contributes colours to the chemical rainbow.

SUPER SCIENTIST: Repeat the experiment, but this time change the order in which you add the reagents. Start with the last one and end with the first one. What happens?

Experiment 38
Litmus (tournesol) solution

What you will need:
- 96% ethanol or commercial ethanol
- Pasteur pipette ⭐
- Flask for the litmus solution ⭐
- Water
- Test tube with lid ⭐
- Litmus red (tournesol) powder ⭐
- Plastic spatula ⭐

Steps:

1. Put three plastic spatulas of litmus powder in a test tube and add about three cm of water. Put the lid on the test tube and shake it. Leave it to sit for one day.

2. The next day, gently transfer the solution (that should be dark blue) to the flask for litmus (tournesol) solution. If there is any black residue in the test tube, work to prevent it from entering the solution.

3. Fill a Pasteur pipette halfway and add the ethanol to the flask. This will preserve your solution longer.

4. Lastly, secure the lid tightly to the flask (turn the lid in a clockwise direction).

Preparation of the litmus (tournesol) solution.

Explanation:

You have made a solution by dissolving a solid (litmus powder) in a liquid (water).

Attention: Hang onto the cup so that it will be available when you are ready to complete the next experiment. Keep out of reach of small children and animals and also away from food and drink.

Experiment 39
Changing the colour

What you will need:

- Vinegar
- 2 Pasteur pipettes
- Test tube with lid
- Litmus (tournesol) solution (Experiment 38)
- Water
- Sodium carbonate
- Plastic spatula
- Test tube rack

Steps:

1. Prepare a diluted litmus (tournesol) solution: fill the test tube halfway with water and add, with a Pasteur pipette, five drops of tornesol solution. Place the test tube on the test tube rack.

2. Add, with other Pasteur pipette, 2 drops of vinegar to make the solution turn red.

3. Put a plastic spatula of sodium carbonate in the test tube along with turnesol solution and vinegar. Put the lid on the tube and shake it. Watch the solution turn blue.

4. Now, add two drops of vinegar to the same test tube. Watch the colour become red again.

Explanation:

As you can see from the previous experiments, when the solution has a greater acid concentration it becomes a reddish colour. However, when adding a basic substance like sodium carbonate it will return to a bluish colour. If we increase the acid concentration the solution will return to red.

Therefore, the solution will become blue or red depending on whether the concentration is more basic or more acidic.

Experiment 40
Magic can

Attention: Ask an adult for help.

What you will need:

- Pencil
- Small wire or nail
- Aluminium can
- Copper (II) sulphate
- Large measuring cup (100 ml)
- 2 Teaspoons of table salt
- Table salt
- Wooden spatula
- Plastic spatula
- Pliers

Steps:

1. Ask an adult for help and adapt a piece of wire to one of the pencil's sides. For that, cut a piece of 3 cm of wire and with the help of a pliers, crimp it inside the pencil (the wire must be perpendicular to the pencil's length).

2. Enter the pencil with the tip of the wire, into the can.

3. Lean the wire against the inside of the can wall, at the bottom, and scrap the can making a complete round mark inside.

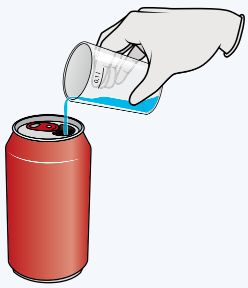
4. Make sure the wire marked the internal part of the can. However, these marks do not need to be deep.

5. Prepare a solution of copper (II) sulphate, using the measuring cup. For this, mix 2.5 g of copper (II) sulphate and 10 ml of water.

Note: One spatula (included in your kit) of copper (II) sulphate corresponds to about 1 g.

6. Add to the copper (II) sulphate solution two teaspoons of table salt and mix it with the wooden spatula until all the salt is dissolved.

7. Pour the solution of copper (II) sulphate with dissolved salt into the can and ensure the solution has covered the marks you've made.



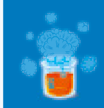
8. Check the can every two minutes. If you see pores on the outside, it means the can is done.

9. Remove the solution from the can to another cup. Be careful with the can, it is now quite fragile.

10. Wash the can with water, in and out, to remove the copper (II) sulphate solution.

11. Now you can pick up the can and rip it as if it was a sheet of paper, pulling each side.

WARNING. When you have finished, throw away any food used during the experiment.



SUPER SCIENTIST: Prepare your can and save it carefully (it is very fragile). Now, get a similar can without going through the experiment and ask a friend or family member to rip it without squashing it. Tell the person you want to test his/her strength. Then, get your can and show how easy it is.

Explanation:
Soda aluminium cans consist of a small aluminium plate. The painting given to the cans protects them from corrosion. When you make a mark inside the can you are exposing that part of the can. Therefore, when you place the can in copper (II) sulphate solution, copper ions are reduced to copper metal, and the aluminium ones are oxidised, passing to the solution. The can gets more fragile on the place where you made the first mark, allowing you to rip it easily.

Salt is used as a catalyser, in other words, it is used to accelerate the chemical reaction.

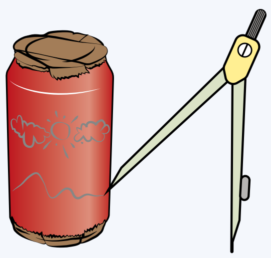
Experiment 41
Can chandelier

Attention: Ask an adult for help.

What you will need:
- Aluminium can
- Adhesive tape
- Copper (II) sulphate ★
- Table salt
- Water
- Compass (or another object with a sharp tip)
- Petri dish ★
- Candle
- Wooden stick ★
- Plastic spatula ★
- Small measuring cup (25 ml) ★
- Paper towel
- File/object with a rough surface

Steps:
1. Put adhesive tape on the upper and lower part of the can.

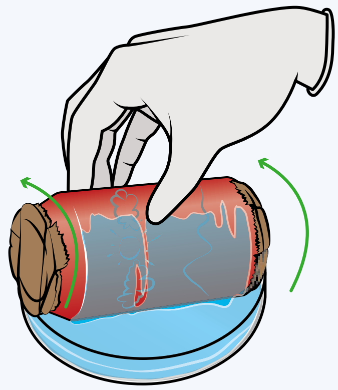
2. With the tip of the compass (or another sharp tip), make drawings along the can, creating a pattern as you like. There's no need for too much strength.



3. Prepare a copper (II) sulphate solution (2.5 g in 10 ml of water) and add half teaspoon of salt.

4. Pour this solution into a Petri dish.

5. Pass the can through the solution, slowly, rotating it so that the whole can passes through the solution. Remember to use gloves!



6. You may stop when you start seeing deposits forming in the areas where you made the drawings.

7. Clean the can with paper towel.

8. Wash the can and your hands well, with water.

9. Let the can dry.

Attention: The next steps should be performed by an adult.

10. On a rough surface or with a file, scrap the upper part of the can, to remove its lid.

11. Also scrap the sides, carefully, so they don't become dangerously sharp.

12. Place a small candle inside the can.

13. Your chandelier is made!

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:
Soda aluminium cans consist of a small aluminium plate.

When we make drawings with a sharp tip of an object, we are exposing the 'skeleton' of the can, making it sensitive to corrosion. When we wet it with the copper (II) sulphate solution, the aluminium parts of the can with the drawings 'let go'. When you place the can in the solution of copper (II), the copper ions are reduced to metal copper, and the aluminium ones are oxidised, passing to the solution.

In this way, the can's metal that is exposed dissolves until the aluminium plate is cut. At the same time, metal copper deposits at the can's surface.

Experiment 42
Coin cleaning

What you will need:
- 2 Old copper coins (you can use 2 pence coins)
- Mustard
- 2 Large measuring cups (100 ml)
- Water
- Paper towel
- 2 Tweezers

Steps:

1. Place a coin in each cup.

2. Pour water into one of the cups, covering the coin.

3. Put mustard in another cup, covering the coin.

4. Set the cups aside for 3 hours.

5. Use the tweezers to remove the coins from the cups.

6. Clean the coins with paper towels.

What happens? Do you see any differences on the coins?

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:
In the cup with water nothing happens, but in the cup with mustard the coin begins to shine.

Mustard has an acid that reacts with the coin's coverage, making it disappear. The coin begins to shine because the metal, which had previously been covered, appears.

Experiment 43
Shining coins

What you will need:
- Large measuring cup (100 ml)
- Copper coins
- Vinegar
- Tweezers
- Soap

Steps:

1. Fill the measuring cup halfway with vinegar.

2. Wash some coins with soap and then put them inside the cup containing vinegar.

3. Wait 10 minutes.

4. Remove them from the vinegar with tweezers.

Are your coins shining?

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:
Over time, copper coins become dark. This happens because the copper from coins is oxidised by atmospheric elements, particularly oxygen. When you put coins in vinegar, the acetic acid reacts chemically with the copper oxide, removing it from the coins surface. Therefore, you can clean the coins.

SUPER SCIENTIST: Try now to make a saturated solution of vinegar with salt. Use it to clean other copper coins that are dark. Is this solution better or worse than one created using only vinegar?

Experiment 44
Diamond mine

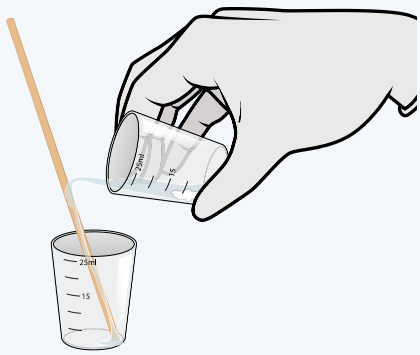
What you will need:
- Potassium alum
- 2 Small measuring cups (25 ml)
- Tepid/hot water
- Plastic spatula
- Wooden spatula
- Wool string or twine
- Pencil
- Magnifying glass

Steps:

1. Pour 10 ml of hot water into a small measuring cup.

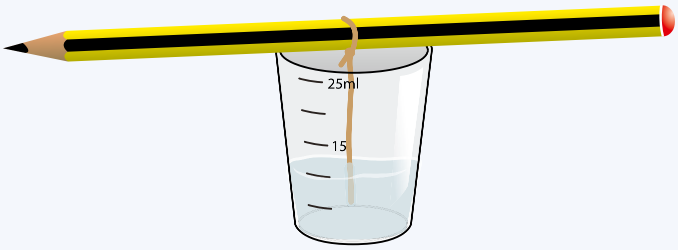
2. Carefully dissolve potassium alum in the cup with water, stirring it while pouring. Add more alum, until it doesn't dissolve any more. (Prepare a saturated solution – you may achieve a saturated solution with 4 g in 10 ml. Remember to save your reagents).

3. Transfer part of the solution to the small measuring cup. Do so carefully so that only liquid is transferred.



4. Tie a piece of wool or twine at the middle of the pencil. Make sure an end is hanging.

5. Place the pencil crossed over the small measuring cup's surface, so that the string swings inside the solution, but doesn't touch the bottom of the cup. Part of the twine must be immersed in the solution.



6. Keep the cup in a covered area for several days.

7. Check the cup once in a while.

8. When your diamonds are large enough, remove them from the cup.

Explanation:
When you prepare a solution with hot water, you can dissolve more salts than if the water was cold. While the solution cools it deposits the salts in excess. In this experiment, when the water cools, crystals deposit around the wool string or twine creating a crystal chain.

SUPER SCIENTIST: You can add some drops of food colouring to the potassium alum solution to make coloured crystals.

Experiment 45
Crystals in eggshell

Attention: Ask an adult for help.

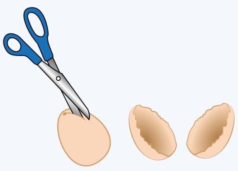
What you will need:
- Potassium alum
- Eggs
- 2 Small measuring cups (25 ml)
- Hot water
- 2 Paintbrushes
- Newspaper sheets
- Scissors
- Food colouring

Steps:
1. Make a hole, carefully, on top and at the bottom of the egg.

2. Place a bowl under the egg and blow into one of the holes you made. The egg white will come out first. Collect to the bowl a portion of the egg white as you will need it to perform this experiment.

Note: You will not need the yolk. After the egg white comes out, place a dish under the egg, so that the two parts of the egg don't get mixed.

3. Using the scissors, cut the egg in half to obtain two separate egg-shells.



4. Wash the eggshell halves with tap water to remove the rest of the eggs content.

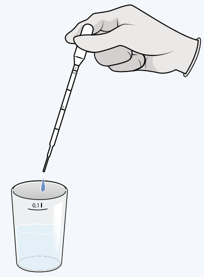
5. Using a paintbrush, paint the eggshell with the egg white (the one you collected in step 2).

Note: The egg white will work as glue.

6. Sprinkle the eggshell with potassium alum.

7. Leave the eggshell to dry (placed on newspaper sheets) for 1 hour.

8. Prepare a saturated solution of potassium alum (4 g in 10 ml), in hot water, using one of the measuring cups.



9. Transfer the solution to a new cup and make sure that only the liquid is transferred to the new cup.

10. Add some food colouring drops.

11. Let the mixture dry at room temperature.

12. Using the other paintbrush, put some of this solution in the eggshell.

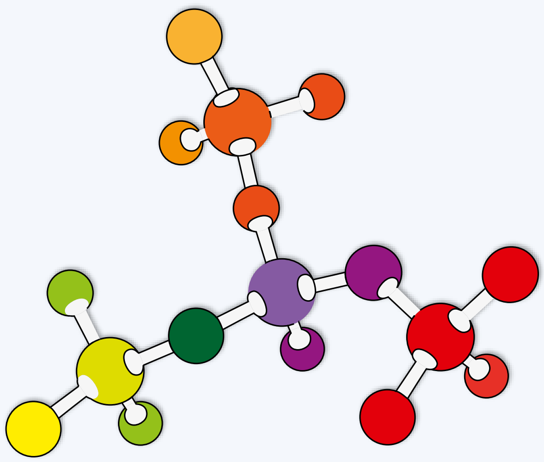
13. Set it aside for 24 hours.

What do you observe scientist?

WARNING. When you have finished, throw away any food used during the experiment.

SUPER SCIENTIST: If you want to make crystals in different colours, on step 9, after the solution is made, ask an adult for help and separate the solution into different cups. Now you can use different dyes in each cup.

Explanation:
When you prepare a solution with hot water, you can dissolve more salts than if the water was cold. While the solution cools it deposits the salts in excess. In this experiment, salts will meet inside the eggshells, where they will deposit and form crystal eggs.



Experiment 46
Stalagmites and stalactites

What you will need:
- Hot water
- 2 Large measuring cups (100 ml)
- Small cloth
- Sodium bicarbonate
- Wool string or twine
- Dish

Steps:

1. Fill in both cups with hot water.

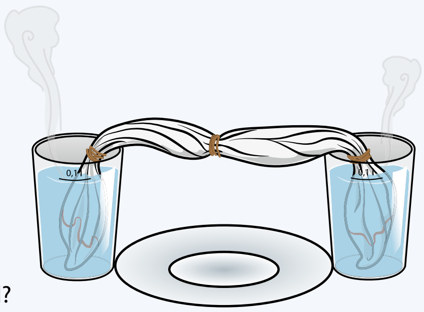
2. Add sodium bicarbonate to both cups until you make saturated solutions. You can obtain saturated solutions with 3 g of sodium bicarbonate and 20 ml of water.

3. Twist the small cloth. Tie its ends with twine, and also the middle of the cloth.

4. Place the cloth's ends inside the cups. The ends have to reach the bottom of the cups. If necessary, put the cups closer together.

5. Place the dish under the tissue in between the cups.

6. Wait a few days.



What happened?

Explanation:

The saturated solution of sodium bicarbonate rises through the cloth and drops from the centre. The drops transform into hard pillars of sodium. One is formed from bottom to top (stalagmite) and the other from top to bottom (stalactite).

Water moves through the rope created with the small cloth, as it fills in the air spaces from the cloth. This process is called capillary action. Sodium bicarbonate is dragged by water. While water evaporates, it deposits in the centre and crystallises.

Experiment 47
Bowl with fast crystals

What you will need:
- Magnesium sulphate
- 2 Small measuring cups (25 ml)
- Food colouring
- Plastic spatula

Steps:

1. In the cup, mix 10 g of magnesium sulphate in 10 ml of hot water. Stir for at least one minute. Create a saturated solution.

2. Add a little bit of food colouring if you want coloured crystals.

3. Transfer the solution to a new measuring cup, assuring that only the liquid passes to the new cup.

4. Place the cup in the fridge.

After some hours observe your crystals!

5. Throw away the remnant solution in order to observe better the crystals.

Explanation:

The water's temperature determines the amount of magnesium sulphate that can be dissolved. The hotter the water, more magnesium it dissolves. Cooling the solution quickly, benefits the fast growth of crystals, since there's few space for the dissolved salt in the denser and colder solution. While the solution cools, the magnesium sulphate atoms gather in a crystalline structure. Crystals formed through this process are smaller and more numerous.

Experiment 48
Mega crystal

What you will need:
- Water
- Copper (II) sulphate
- 4 Large or small measuring cups (100 ml or 25 ml)
- Tweezers
- Wooden spatula
- Plastic spatula
- Wooden stick

Steps:

1. Prepare a saturated solution of copper (II) sulphate. Use the plastic spatula to remove the copper (II) sulphate from the recipient (you must achieve a saturated solution with 8 – 10 spoons in 25 ml of water).

2. Pour the solution into another cup and leave the reagent in excess in the first cup. Use the wooden stick to help you.

3. Set the solution aside for a day, covered.

4. Use the remaining solution to carry out Experiment 49.

Note: If you want larger crystals, set the solution aside for a longer period of about four days.

5. After this period, remove the liquid from the cup and observe what remains at the bottom of the cup.

6. Using the wooden spatula, remove the crystals from the bottom of the cup.

7. Choose one of the crystals and save it.

8. Prepare another saturated solution of copper (II) sulphate. You may use the crystals that you haven't chosen and dissolve them in hot water, in order to prepare this saturated solution.

9. Transfer the solution to another measuring cup.

10. Place the crystal you've chosen at the bottom of the cup that has the new saturated solution, using the tweezers.

11. Set this solution aside, for at least one week.

12. Remove your mega crystal with the help of the tweezers.

Explanation:

When you prepare a solution with hot water, you can dissolve more salts than if the water was cold. While the solution cools it deposits salts that are in excess. In this experiment, you form an initial crystal that you then put again in the solution. The crystals from the new solution will deposit and crystallise around that crystal. This way, you'll obtain a mega crystal at the end of this experiment.

Image 6. Copper (II) sulphate crystal.

Attention: save for the next experiment(s). Keep out of reach of small children and animals and also from food and drink.

Experiment 49
Shining writing

What you will need:

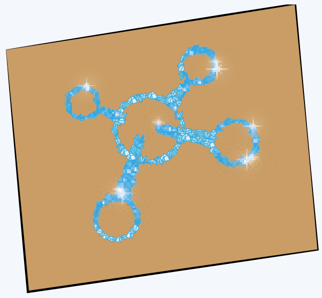
- Saturated solution of copper (II) sulphate (use the solution you prepared in Experiment 48)
- 1 Paintbrush
- 1 Piece of card or black cardboard

Steps:

1. Dip the brush in the cooper sulphate solution and then use it to make drawings on the cardboard.

2. Let the cardboard dry near a window.

3. The drawing will appear with small blue crystals.



Explanation:

When the water is hot, substances dissolve faster. More so, it is possible to dissolve more copper (II) sulphate in hot water than in cold water. When a substance doesn't dissolve anymore, a saturated solution is formed.

In this experiment, when it's no longer possible to dissolve more solute (copper (II) sulphate) in hot water, a saturated solution is formed. If you set aside a saturated solution, crystals are formed when the water evaporates. As the paint you used to draw on the cardboard was a saturated solution, when you set it aside blue crystals formed on the places where you draw with the brush, because water has evaporate.

SUPER SCIENTIST: Carry out this experiment with other solutes, such as salt or sugar.

Experiment 50
Vinegar crystals

What you will need:

- Vinegar
- Large measuring cup (100 ml) ⭐
- Small crushed stones

Steps:

1. Half fill the cup with vinegar.

2. Place the stones in the cup with vinegar.

3. Wait 24 hours.

4. Remove all the stones from the cup, less one.

5. Set the cup aside, until the vinegar evaporates. Scientist, you must be patient, as this rest time may take one month or even more.

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:

Vinegar (acetic acid) corrodes stones, releasing carbon dioxide and leaving minerals in the solution. Over time and while water and vinegar evaporate, the minerals crystallise.

Experiment 51
Sugar crystals

Attention: **Ask an adult for help.**

What you will need:
- Pan
- Wooden spoon
- Glass jar
- Sugar
- Water
- Food colouring ⭐
- Wooden skewers
- Pasteur pipette ⭐
- Plate

Steps:

1. Pour one glass of water and two spoons of sugar into the pan.

2. Ask an adult to put the pan on the stove until the water boils. Stir constantly so that nothing sticks to the bottom.

3. Remove the pan from the stove and add more sugar, spoon by spoon, until it cannot dissolve in the water.

4. If you want, add with the Pasteur pipette, some food colouring and stir.

5. Pour the liquid in the glass jars, dip the skewers in the liquid and afterwards, sprinkle them with some more sugar. Leave the skewers to dry.

6. When the skewers are dry, place them in the jar again.

7. Place the jar in a dark place to set for about a week, or until the crystals have formed.

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:
As the water evaporates, dissolved substances precipitate. Once the process occurs, crystals begin to form. Their colour is determined by the food colouring used.

Experiment 52
Looking for starch

Attention: **Ask an adult for help.**

Starch (cornflour) is a substance that can be found in plants and that gives us energy. It is a compound made of carbon (C), oxygen (O) and hydrogen (H) atoms.

What you will need:
- Empty plastic bottle (0,5 l)
- Starch (cornflour)
- Plastic spatula ⭐
- Tincture of iodine ⭐
- Pasteur pipette ⭐

Iodine is a toxic chemical product. Ask an adult for help and throw away carefully the resulting products of your chemical experiments when finished. Wash thoroughly any object you would like to save.

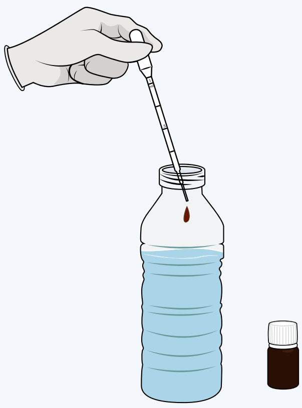
Steps:

1. Fill in ¾ of the bottle with water.

2. With the plastic spatula, put about 4 spoons of cornflour inside the bottle.

3. With the Pasteur pipette, add to the water 20 drops of tincture of iodine.

4. Shake the bottle and set it with the solution aside for some minutes.



What happens?

WARNING. When you have finished, throw away any food used during the experiment.

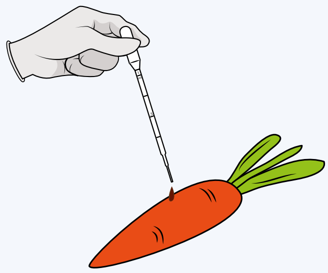
Explanation:
Iodine combines chemically with starch, present in cornflour. When this happens, the colour of the tincture of iodine changes from brown to dark blue, almost black.

DID YOU KNOW...
That the alcoholic solution of iodine is the antiseptic and disinfectant most used among people?

Experiment 53
Looking for starch II

Attention: **Ask an adult for help.**

What you will need:
- Tincture of iodine ⭐
- Pasteur pipette ⭐
- Food products chosen by you



Steps:

1. With the help of the Pasteur pipette, add some drops of tincture of iodine to a food sample, on which you want to identify the presence of starch.

Attention: **Do not ingest the foods used during the experiments.**

What do you observe?

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:
Tincture of iodine is a mixture of molecular iodine, I_2, with a salt containing iodide ion, I^- which stimulates its dissolution.

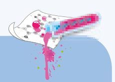
$$I_2 + I^- \rightarrow I_3^-$$

When the tincture of iodine is added to starch, the previous reaction occurs in the reverse direction, releasing I_2:

$$I^{3-} \rightarrow I_3 + I^-$$

I_2 has low solubility in water but in the presence of I^- a reaction occurs, in which I_2 reacts with starch, resulting in an intense blue colour.

SUPER SCIENTIST: Look for iodine in the Periodic Table of chemical elements.



DID YOU KNOW...
That plants produce their own food through the Sun's energy in a process called photosynthesis? In this process water and carbon dioxide (CO_2) are transformed in glucose and oxygen. Glucose is a type of sugar that is then transformed in starch. This way, sugar and starch help plants to live.

Experiment 54
Invisible paint

What you will need:
- Starch (cornflour)
- Tincture of iodine ⭐
- 2 Paintbrushes
- Large measuring cup (100 ml) ⭐
- Water
- Piece of paper
- Pasteur pipette ⭐
- Pan

Steps:

Attention: **Ask an adult for help.**

1. In a pan, mix a spoon of cornflour for each cup of water. Stir it, until it's boiling and transparent.

2. Remove the pan from the heat source.

3. Dip the brush in this mixture and write a message on the dark paper.

4. Let it dry in a dark place for about 1 hour.

5. In the cup, add half finger of water and add, with the Pasteur pipette, 20 drops of tincture of iodine.

6. Dip a clean brush in this new solution and pass it over your message.

What happens?

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:
Tincture of iodine is an excellent indicator of starch. When you brush the tincture solution on the message, you can decode it, because the tincture detects the presence of starch, present in cornflour.

When iodine is added with starch, a molecular complex with an intense blue colour is formed.

Experiment 55
Does bread have starch?

What you will need:
- Slice of bread
- Tincture of iodine ⭐
- Pasteur pipette ⭐

Steps:

1. With the Pasteur pipette, put some drops of tincture of iodine on the bread.

Observe! What happens? Which colour is formed?

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:
Tincture of iodine is an excellent starch indicator. When iodine is added with starch, a molecular complex with an intense blue colour is formed. Bread is a great source of carbohydrates and has a great amount of starch, as so when adding tincture of iodine drops you'll see that a blue colour will form on the slice of bread.

Experiment 56
The action of saliva

Attention: Ask an adult for help.

What you will need:
- 2 Test tubes with lid ⭐
- Water
- Pasteur pipettes ⭐
- Tincture of iodine ⭐
- Starch (cornflour)
- Straw ⭐
- Plastic spatula ⭐
- Test tube rack ⭐

Steps:

1. Fill half a test tube with water.

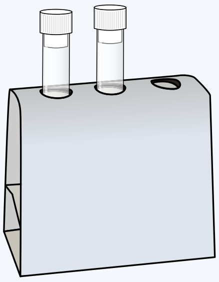
2. With the help of a straw, put a bit of your saliva in the second test tube.

3. Add water to the second test tube, so that it has the same volume as the first one.

4. Put, with the help of the plastic spatula, a spoon of cornflour in each test tube.

5. Cover the test tubes and shake them.

6. Place the tubes on the test tube rack and set them aside for 30 minutes.



7. With the Pasteur pipette, put 3 drops of tincture of iodine in each test tube.

8. Cover the tubes again and shake them.

What do you observe?

WARNING. When you have finished, throw away any food used during the experiment.

Explanation:

You must have observed that in the tube with saliva there wasn't a change in colour, while in the other an intense blue colour appeared.

In the previous experiments, you could verify that iodine is a great indicator of the presence of starch. For this reason, the tube that only contains starch and water has an intense blue colour. However the tube with your saliva didn't change its colour. Saliva is responsible for initiating chemical digestion in your mouth. It contains an enzyme, called amylase, which breaks down starch. When we put iodine in the test tube with saliva, it won't detect the starch because it has already been broken down by amylase.

Experiment 57
Homemade play dough

What you will need:
- Food colouring ⭐
- Tablespoon
- Teaspoon
- Large measuring cup (100 ml) ⭐
- Small measuring cup (25 ml) ⭐
- Flour
- Salt
- Water
- Cooking oil
- Large bowl

Steps:

1. Put in the bowl 10 tablespoons of flour.

2. Add a teaspoon of salt to the flour and stir it.

3. Fill in the large measuring cup with water and add a pinch of food colouring, with the colour you want your play dough to become. Remember that you can mix colours to make different colours!

4. Add the cup with water and food colouring to the mixture.

5. Stir it all and add, with the small measuring cup, 20 ml of cooking oil.

6. Finally, store your play dough in a plastic bag properly closed or in a recipient well covered.

Remember scientist: You must save your play dough in a box or container properly closed. You must avoid placing it in damp areas. This way, you guarantee your play dough can be reused and that it keeps its characteristics.

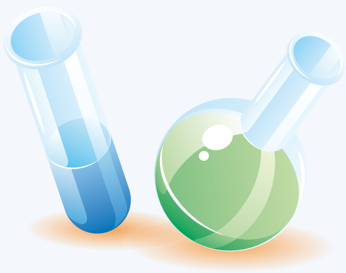
WARNING. When you have finished, throw away any food used during the experiment.

2. Making molecules

What you will need:
- Play dough in several colours ⭐
- Toothpicks

Steps:

1. Get play dough pieces and make small balls. These balls will represent atoms while the toothpicks will work as chemical bonds.



There are several types of chemical bonds; these bonds join together the atoms of a given molecule. Chemical bonding can be covalent, ionic or metal. Covalent bondings are formed by sharing electrons and can be single (or simple) bonds (1 pair of electrons establish the bonding), double bonds (2 pairs of electrons establish the bonding) and triple bonds (3 pairs of electrons establish the bonding).

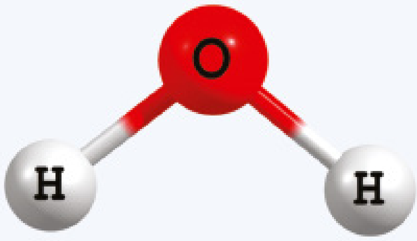
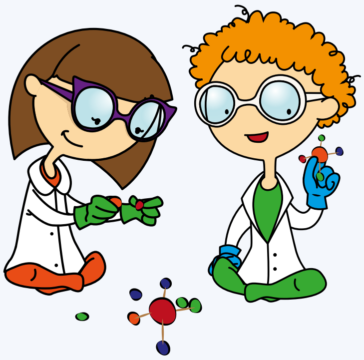


Image 8. Water molecule model. Hydrogen is represented in white and oxygen in red.

You may represent a simple bond with a toothpick, a double bond with two toothpicks and a triple bond with three toothpicks.



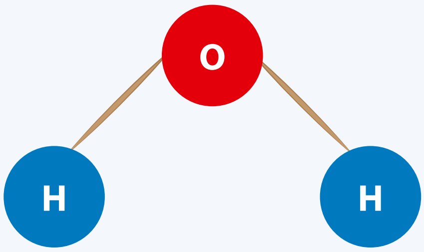


Image 9. Representation of how you must make your water molecule.

The molecules we are going to make have hydrogen (H), oxygen (O), carbon (C) and/or nitrogen (N) atoms. These atoms are represented by the letters you see on their side: H, O, C and N. This is how they will be identified along the experiments.

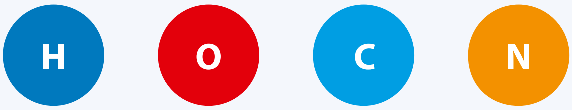


Image 7. Representation of hydrogen (H), oxygen (O), carbon (C) and nitrogen (N) atoms.

Link a colour to each atom. For example, the colour red may represent oxygen (O).

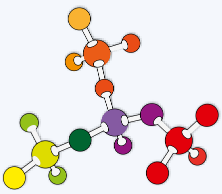
When all atoms are made, move on to the experiments.
Look carefully to the drawings of each molecule and make one at the time.

We'll show you a molecular model for each molecule and a scheme of how you should make each one.

Experiment 58
Water (H_2O)

Water is a natural resource, vital for life in our planet. It's an essential element for the survival of ecosystems and our own survival as well. We must take care and harness water in the best way posible. Water molecules consist of 2 hydrogen atoms and 1 of oxygen.

What you will need:
- 2 Atoms of H
- 1 Atom of O
- 2 Simple bonds



Experiment 59
Oxygen (O_2)

Oxygen is a molecule that consists of two oxygen atoms bonded by a double bond. It's a colourless and unscented gas, at room temperature, and is one of the main components of the terrestrial atmosphere.

It is a very reactive compound, which can react with several elements, oxidising them.

This molecule is vital for many living beings, namely us, humans, who need oxygen to breathe.

Oxygen is transformed in ozone (O_3), molecule consisting of 3 oxygen atoms, in the stratosphere. Ozone protects planet Earth from ultraviolet rays, produced by the Sun.

What you will need:
- 2 Atoms of O
- 1 Double bond

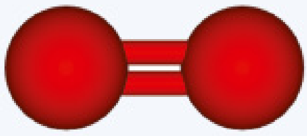


Image 10. Oxygen molecule model. Oxygen atoms are represented in red.

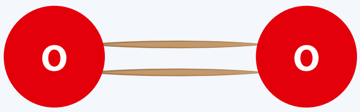


Image 11. Representation of how you must make your oxygen molecule.

Experiment 60
Nitrogen (N_2)

Nitrogen is the most abundant gas in the atmosphere of our planet (more than 70%). Nitrogen molecule consists of 2 nitrogen atoms bonded by a triple bond. It's an inert gas (non reactive), colourless and unscented.

Plants need nitrogen in great amounts. This molecule is essential for plants growth.

This compound is used in basic chemistry processes and refineries (production, cooling, and packaging), in agro-food (freezing, cooling, packaging), in analysis and laboratories, in health and even in the treatment of tyres and metals, among others.

What you will need:
- 2 Atoms of N
- 1 Triple bond

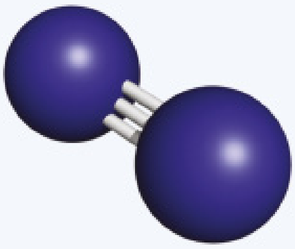


Image 12. Nitrogen molecule model. Nitrogen atoms are represented in blue.

Image 13. Representation of how you must make your nitrogen molecule.

Experiment 61
Carbon dioxide (CO_2)

Carbon dioxide is, at room temperature, colourless and unscented gas. It consists of 2 oxygen atoms and one carbon atom.

This compound is very important for plants and vegetables as it's an essential part of the photosynthesis process.

It's from photosynthesis that plants obtain their food.

This gas is released by human beings breathing and also burning fossil fuels (gasoline, for example).

Carbon dioxide is one of the gases that contribute for the green-house effect. The excess production of carbon dioxide, mainly caused by human beings, increases the greenhouse effect.

The greenhouse effect happens when the gases from the terrestrial atmosphere absorb radiation emitted by its surface. As so, part of the heat released from Earth, isn't released into space, accumulating and increasing the global temperature of the planet.

What you will need:
- 1 Atom of C
- 2 Atoms of O
- 2 Double bonds

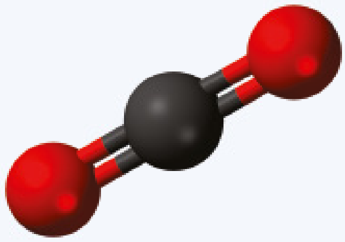


Image 14. Carbon dioxide molecule model. Oxygen is represented in red and carbon in black.

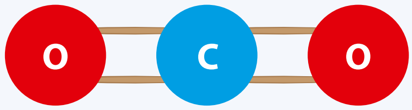


Image 15. Representation of how you must make your carbon dioxide molecule.

DID YOU KNOW...
That carbon dioxide is used in some drinks (sparkling drinks) and also in extinguishers?

Experiment 62
Methane (CH_4)

Methane is a colourless, unscented and very flammable gas.

Methane is produced through the following natural processes: organic waste decay, digestion of herbivorous animals, metabolism of some bacteria, fuel extraction (for example, oil), among others.

It is the simpler amongst hydrocarbons.

A hydrocarbon is a chemical compound that consists of only carbon and hydrogen atoms.

What you will need:
- 1 Atom of C
- 4 Atoms of H
- 4 Simple bonds

Image 16. Methane molecule model. Hydrogen is represented in white and carbon in black.

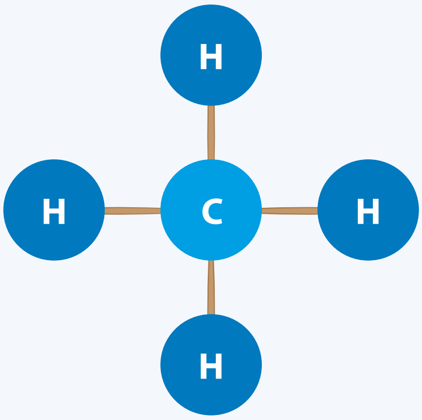


Image 17. Representation of how you must make your methane molecule.

DID YOU KNOW…
That methane gas is one of the gases that cause the greenhouse effect?

Experiment 63
Ethane (C_2H_6)

Ethane is a colourless, unscented and flammable gas. It can be found in oil and natural gas.

Just like methane, it is a hydrocarbon and it is also an alkane.

An alkane is a hydrocarbon of open chain that only has simple bonds.

What you will need:
- 2 Atoms of C
- 6 Atoms of H
- 7 Simple bonds

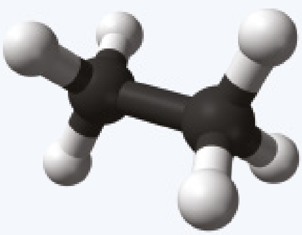


Image 18. Ethane molecule model. Hydrogen is represented in white and carbon in black.

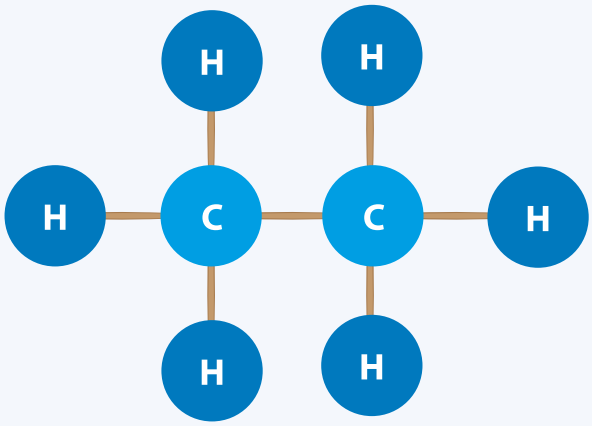


Image 19. Representation of how you must make your ethane molecule.

Experiment 64
Propane (C_3H_8)

Propane is an alkane that consists of three carbon atoms and eight hydrogen atoms.

Mixed with other specific substances, this gas may be harnessed as automobile fuel called liquefied petroleum gas (LPG).

What you will need:
- 3 Atoms of C
- 8 Atoms of H
- 10 Simple bonds

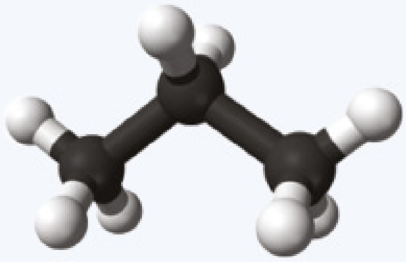


Image 20. Propane molecule model. Hydrogen is represented in white and carbon in black.

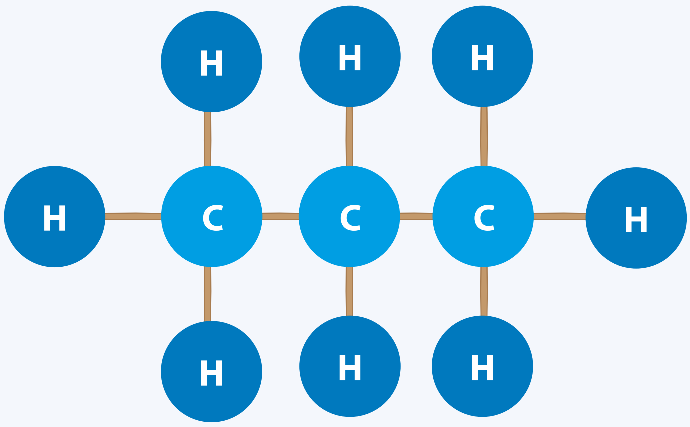


Image 21. Representation of how you must make your propane molecule.

Experiment 65
Butane (C_4H_{10})

Butane is a colourless, unscented and flammable gas, which comes from oil.

It is used as a fuel for lighters, flashlights and some camping stoves. Aerosols can also use this gas as propellant. Even though butane is less expensive than propane, many devices aren't made to work with butane tanks.

What you will need:
- 4 Atoms of C
- 10 Atoms of H
- 13 Simple bonds

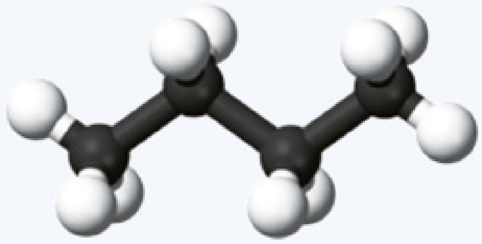


Image 22. Butane molecule model. Hydrogen is represented in white and carbon in black.

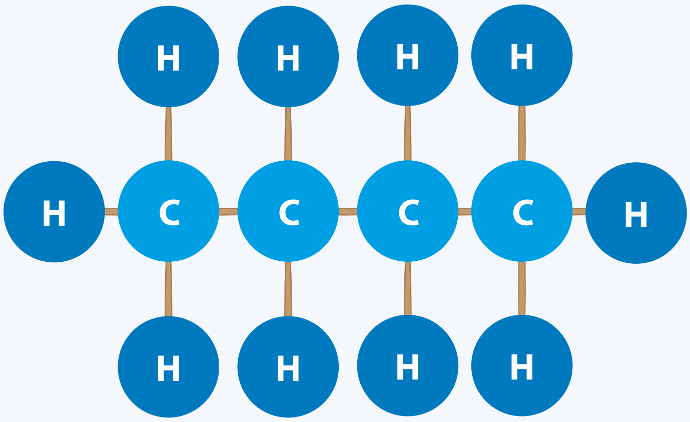


Image 23. Representation of how you must make your butane molecule.

DID YOU KNOW…
That contrary to most of gases, butane's density is near twice the density of atmospheric air? For this reason, butane deposits at the bottom of containers where it's stored.

Propane and butane are similar gases and both are used to heat and as fuels. However, each one of them burns at different temperatures due to their chemical structures.

Experiment 66
Cyclohexane (C_6H_{12})

Cyclohexane is a colourless and flammable liquid. Its odour is similar to the one of detergents. This molecule is a cyclic hydrocarbon saturated, in other words, a cyclic alkane.

What you will need:
- 6 Atoms of C
- 12 Atoms of H
- 18 Simple bonds

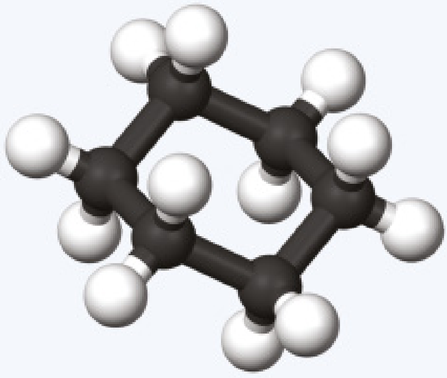


Image 24. Cyclohexane molecule model. Hydrogen is represented in white and carbon in black.

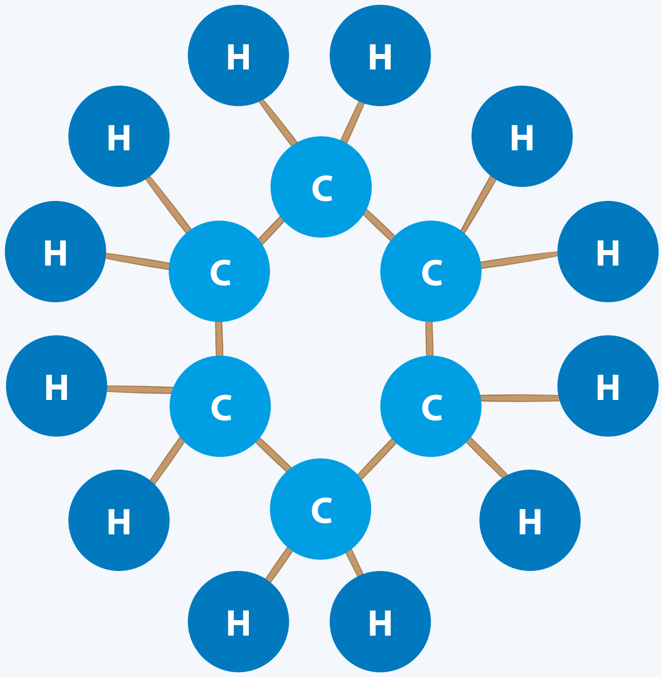
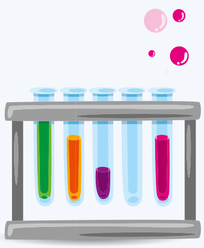


Image 25. Representation of how you must make your cyclohexane molecule.



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Experiment 67
Benzene (C_6H_6)

Benzene is a chemical liquid, at room temperature, flammable and with a sweet odour. It evaporates fast when exposed to air.

Benzene is formed in natural processes such as volcanic eruptions or forests fires, but also produced by human activities. This compound is also a natural part of crude oil and gasoline.

This chemical is used as a raw material in the production of plastics, lubricants, rubbers, paints, detergents, pesticides and others.

Benzene presents in its chemical structure 3 double bonds.

What you will need:
- 6 Atoms of C
- 6 Atoms of H
- 9 Simple bonds
- 3 Double bonds

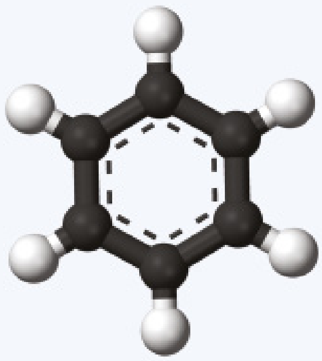


Image 26. Benzene molecule model. Hydrogen is represented in white and carbon in black.

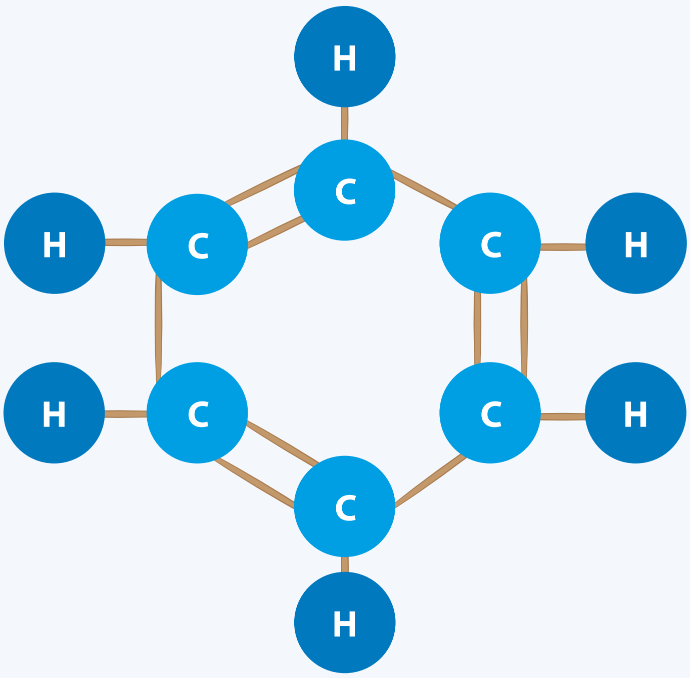


Image 27. Representation of how you must make your benzene molecule.

Experiment 68
Ammonia (NH_3)

At room temperature, ammonia is a toxic colourless gas. It's a dangerous compound in case of inhalation and has a specific and irritating odour.

It dissolves easily in water.

This compound is very important in industry. It is used as raw material to produce fertilisers, dyes, cleansing products, polymers and refrigerating systems, among others.

What you will need:
- 3 Atoms of H
- 1 Atom of N
- 3 Simple bonds

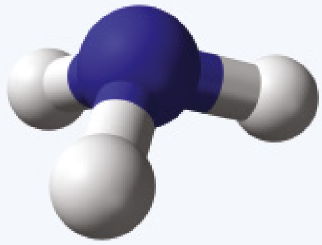


Image 28. Ammonia molecule model. Hydrogen is represented in white and nitrogen in blue.

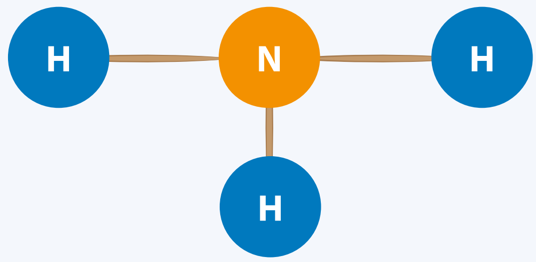
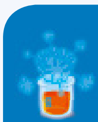


Image 29. Representation of how you must make your ammonia molecule.

DID YOU KNOW…
That the manufacture of ammonia is made by a process called Haber-Bosch?



SUPER SCIENTIST: Ask an adult for help and look for cleansing products labels that you may have at home. Try to find out if any of them has ammonia. If you have fertilisers at home analyse their composition too.

Experiment 69
Ethanol (C_2H_6O)

Ethanol is what we call alcohol. This molecule is responsible for alcohol content of beverages such as wine or beer. It is also used as a disinfection agent.

Over the last years, ethanol has been explored as a possible renewable fuel, produced from vegetal material.

It's a volatile liquid (evaporates easily), flammable and colourless. In its chemical structure we may find hydrogen, carbon and oxygen atoms.

What you will need:
- 2 Atoms of C
- 1 Atom of O
- 6 Atoms of H
- 8 Simple bonds

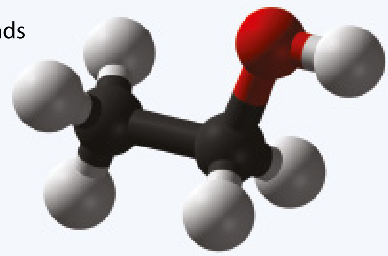


Image 30. Ethanol molecule model. Hydrogen is represented in white, carbon in black and oxygen in red.

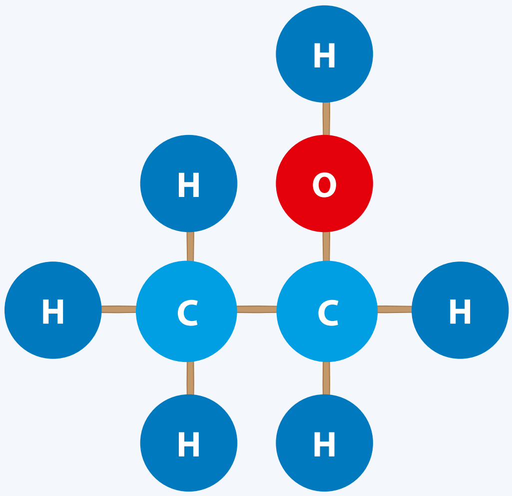


Image 31. Representation of how you must make your ethanol molecule.

Experiment 70
Isopropyl alcohol (C_3H_8O)

Isopropyl alcohol is a transparent liquid at room temperature. This compound is also quite volatile and flammable. Contrarily to ethanol, which is used in common beverages, isopropyl alcohol can't be consumed.

Isopropyl alcohol is used as a chemical solvent and for example, in disinfecting and cleaning solutions.

What you will need:
- 3 Atoms of C
- 1 Atom of O
- 8 Atoms of H
- 11 Simple bonds

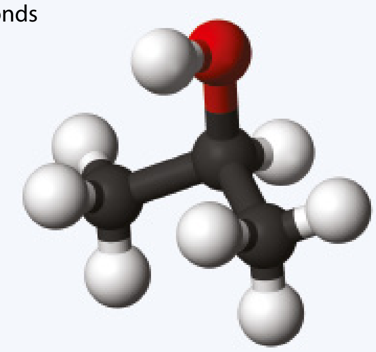


Image 32. Isopropyl alcohol molecule model. Hydrogen is represented in white, carbon in black and oxygen in red.

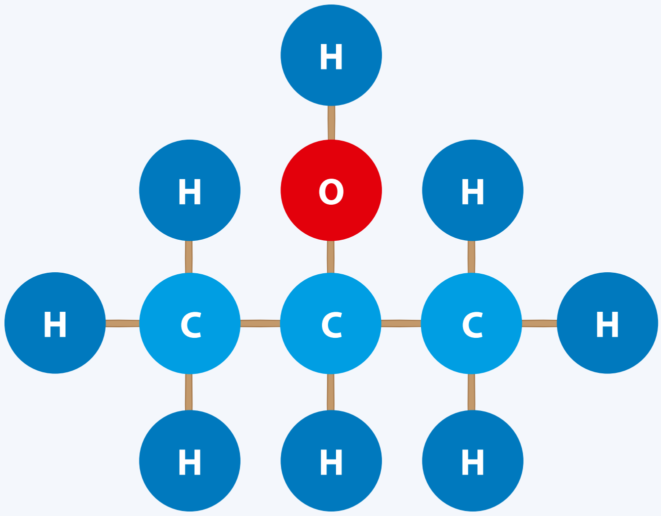


Image 33. Representation of how you must make your isopropyl alcohol molecule.

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