CHAPTER 4

CHAPTER 4

Acids and Bases in the Home

Heating and Heat Transfer

Magnetism

Matter and Measurement

More about Electricity

Variety of Lives

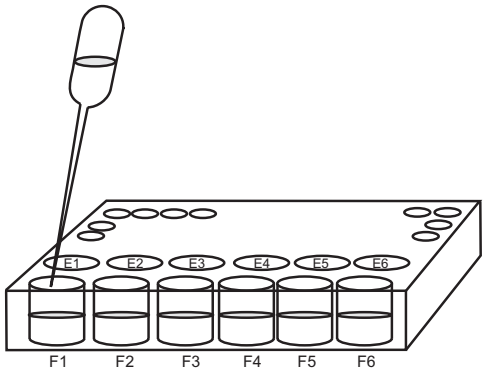
Activity 4.1 USING SENSES OF TASTE AND TOUCH TO CLASSIFY HOUSEHOLD SUBSTANCES

Focus question: Are our senses reliable and safe measuring instruments?

You will need:

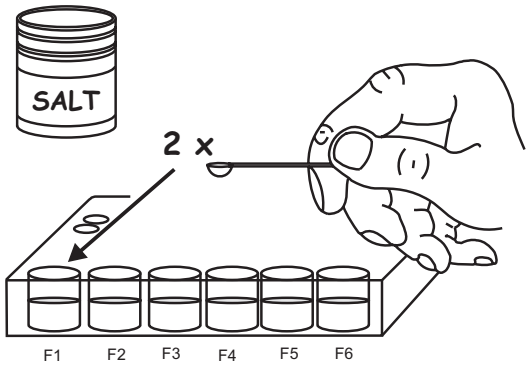
•1 comboplate •1 microspatula •5 x propettes •vinegar •dish washing liquid
•bicarbonate of soda •orange squash •toothpaste •cream of tartar
•universal indicator(dye) •lemon juice •salt •powdered milk •sugar •water

STEP 1



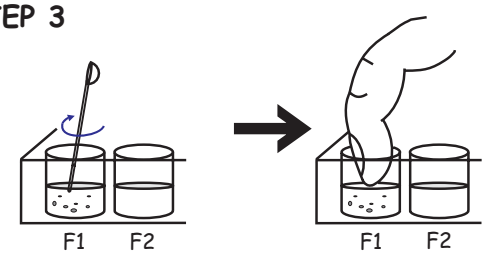
Use a propette to half fill all the large wells of the comboplate with tap water.

STEP 2



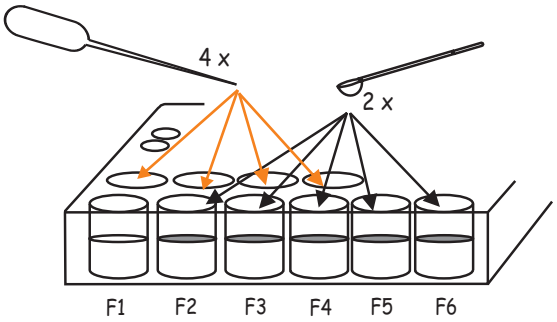
Dissolve 2 microspatulas of salt in well F1.

STEP 3



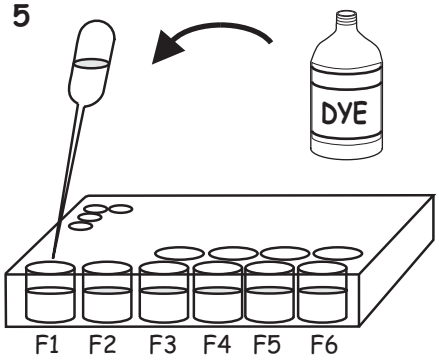
Stir with the end of the microspatula and use your finger to taste and feel.

STEP 4



Rinse the microspatula with water and then repeat the procedure with the remaining solid substances. For liquids, use a propette to add 4 drops of the liquid. (N.B. do not taste dishwashing liquid).

STEP 5



Put 1 drop of the dye provided in the first well and record the colour in the last column of table (a).

STEP 6

Repeat the procedure with the remaining solutions and answer the questions that follow.

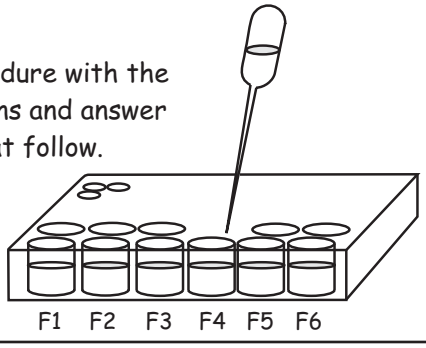


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Table (a)

SOLUTION	TASTE sour/bitter	ORIGINAL COLOUR	FEEL like water/slippery	COLOUR WITH DYE
Lemon juice				
Toothpaste				
Salt				
Vinegar				
Powdered milk				
Dishwashing liquid				
Bicarbonate of soda				
Cream of tartar				
Orange squash				
Water				
Sugar				

1.1 Compare and discuss your results with your team mates.

1.2 Decide together as to which substances you think are acids because they taste sour and feel like water; and which are basic because they taste bitter and feel like soap (slippery).

Table (b)

..... is an acid because it tastes sour and feels like water.	**..... is a base because it tastes bitter and feels slippery.**

1.3 Orange squash tastes sweet but feels like water. In which group do you think it belongs?

1.4 If you were provided with DOOM or Baygon Green, would you agree to taste them?

1.5 Are our senses of taste and feel always reliable and safe to use to find out if a substance is acidic or basic? Why ?

1.6 Is water basic, acidic or neutral ?

1.7 Divide your list into two groups, based on the colour of the solution when the dye was added.

Colour A	**Colour B**

1.8 Discuss the connection if there is any, between taste and feel of the solution, and the colour the dye went with them.

1.9 What do you think can be the best way of finding out if substances are acidic or basic?

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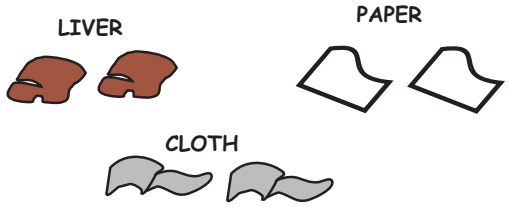
Activity 4.2 SOME LIQUIDS WHICH LOOK LIKE WATER CAN KILL YOU

Focus Question: If you are given three unknown liquids which look just like water, is it wise to taste or even touch them to check if they are water or not?

You will need:

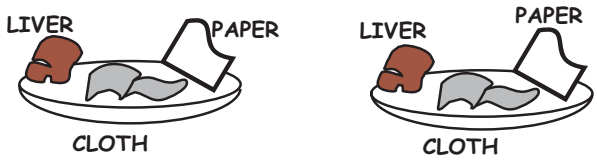
- 2 x propettes
- 1 petri dish
- car battery acid
- a piece of cloth
- a piece of raw liver
- a piece of paper
- water

STEP 1



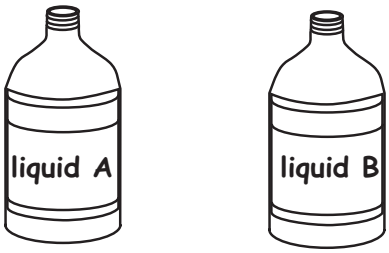
Cut out 2 pieces of liver, 2 pieces of cloth and 2 pieces of paper.

STEP 2



Put one set of a piece of liver, a piece of cloth and a piece of paper on a petri dish and another set on the lid.

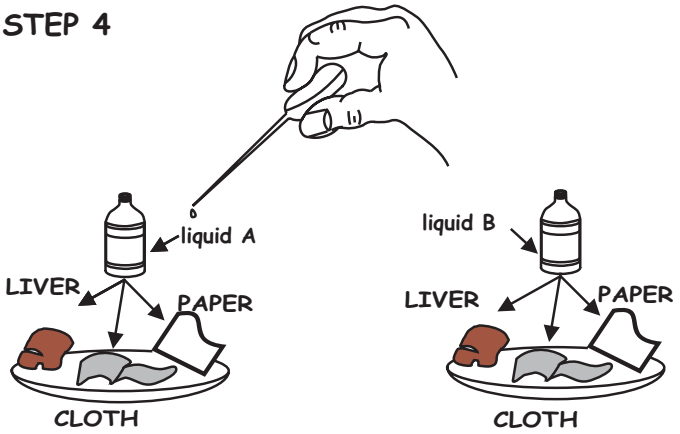
STEP 3



One of these two liquids is an acid and the other is water.

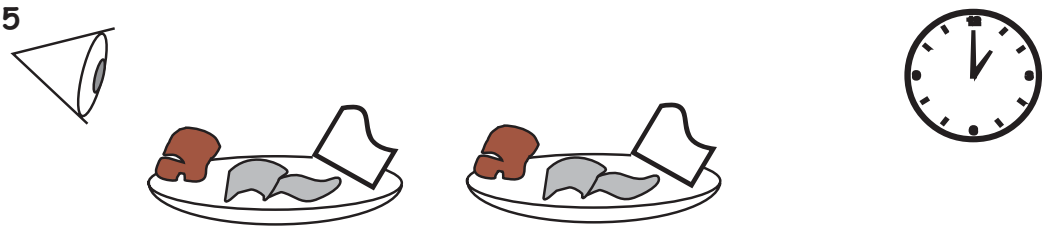
Q1 Can you tell from just looking at the two which liquid is water and which is an acid?

STEP 4



Use a propette to put a few drops of liquid A on the pieces in the dish and liquid B on those in the

STEP 5



Wait a few minutes and observe what happens.

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Q2 Describe what you have seen.

Q3 Which of the two liquids is an acid and which is water?

Q4 Do you think the acid liquid is safe even to touch?

Q5 What do you think can happen if you drink that liquid?

Q6 Do you think it will be a good idea to go around tasting unknown liquids?

Q7 Suggest the best way to find out whether the liquid is acidic or basic.

Q8 Do you think the dye used in the first activity could be of some help in classifying substances?

Q9 If you are given three unknown liquids which look just like water, is it wise to taste or touch them to check if they are water or not?

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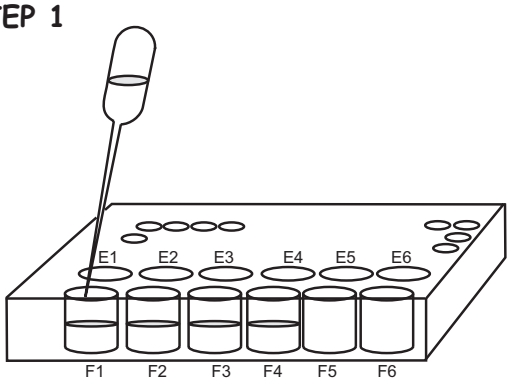
Activity 4.3 CHEMICAL INDICATORS

Focus question: Since some substances are dangerous to taste or even touch, what is the best way to determine whether a substance is basic or acidic?

You will need:

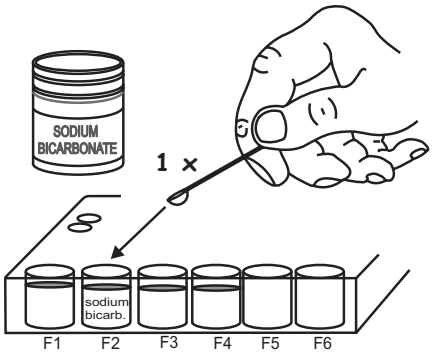
- 1 comboplate®
- 3 x microspatulas
- 3 propettes
- red and blue litmus strips
- bromothymol blue
- tartaric acid
- sodium bicarbonate
- dilute hydrochloric acid
- dilute sodium hydroxide solution
- sugar
- water

STEP 1



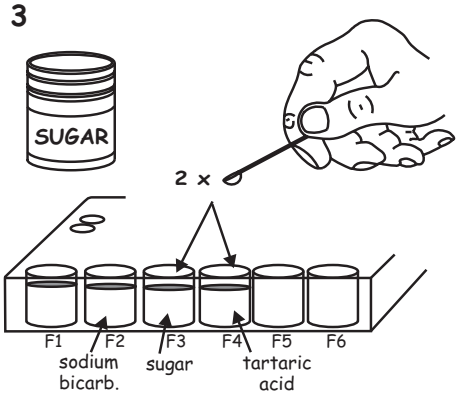
Use a propette to half fill wells F1, F2, F3 and F4 of the comboplate with tap water.

STEP 2



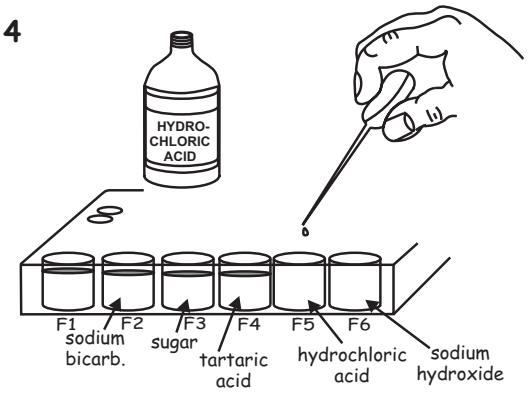
Do not add anything in well F1, but dissolve 1 microspatula of sodium bicarbonate in well F2.

STEP 3



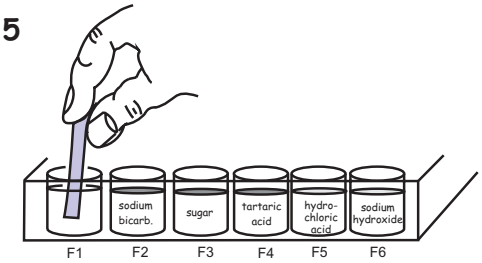
Repeat step 2 using a clean microspatula for sugar in well F3 and tartaric acid in well F4.

STEP 4



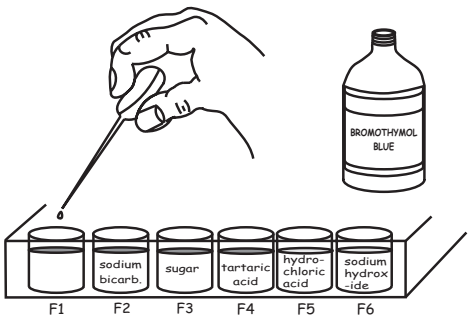
Use a propette to add 20 drops of dilute hydrochloric acid into well F5 and dilute sodium hydroxide into well F6.

STEP 5



Dip a strip of blue litmus paper and then a strip of red litmus paper into well F1. Record your findings in the table below and repeat the procedure for the other wells using new strips each time.

STEP 6



Add three drops of bromothymol blue to well F1 and note the colour in the table. Repeat the procedure for the other wells.

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SOLUTION	BLUE LITMUS PAPER PAPER	RED LITMUS PAPER PAPER	BROMOTHYMOL BLUE
water			
tartaric acid			
sodium bicarbonate			
sugar			
hydrochloric acid			
sodium hydroxide			

Answer the following questions :

3.1 What is the colour of bromothymol blue in
- (a) an acidic solution?
- (b) a basic solution?
- (c) a neutral solution?

3.2 An acidic solution will turn ..... litmus paper .....

3.3 A basic solution will turn ..... litmus paper .....

3.4 Is sugar acidic or basic? How did you find out?

3.5 Give the answer to the focus question.

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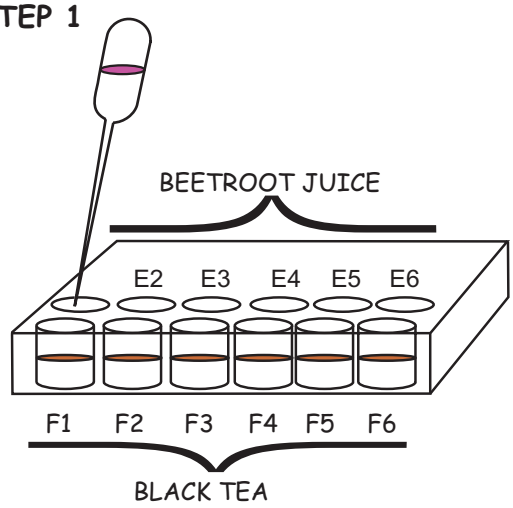
Activity 4.4 MAKING YOUR OWN INDICATORS

Focus question: When you are at home and you do not have access to any of the indicators used in activity 4.3, what can you use instead?

You will need:

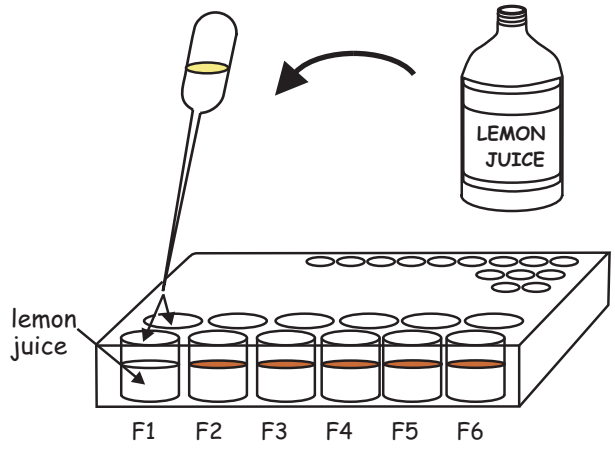
•1 comboplate®	•3 propettes	•cream of tartar	•sugar
•1 microspatula	•beetroot juice	•powdered milk	•salt
•2 sample vials	•black tea	•sodium bicarbonate	•lemon juice

STEP 1



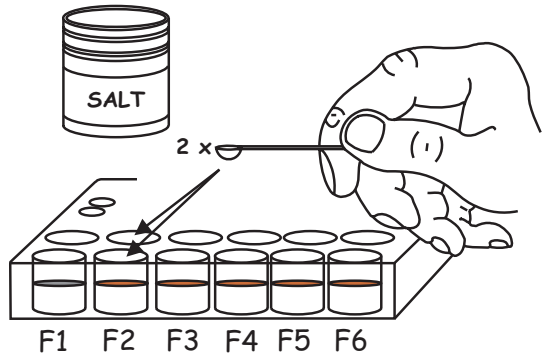
Half fill each of the F wells of the comboplate with black tea, and each of the E wells with beetroot juice.

STEP 2



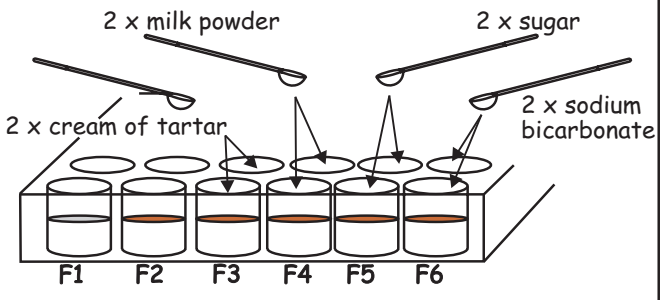
Use a propette to add 3 drops of lemon juice into wells F1 and E1. Record your findings in the table provided.

STEP 3



Add two microspatulas full of salt in wells F2 and E2. Record your findings and rinse the microspatula.

STEP 4



Repeat step 3 using cream of tartar in wells F3 and E3, powdered milk in F4 and E4, sugar in F5 and E5, and sodium bicarbonate in wells F6 and E6.

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Table 4.4

SUBSTANCE	COLOUR CHANGE IN BEETROOT	COLOUR CHANGE IN BLACK TEA	Is it ACID/ BASE or NEUTRAL?
lemon juice			
salt			
cream of tartar			
milk			
sugar			
sodium bicarbonate			

Work in groups of three to answer the following questions:

Q1 What colour does beetroot juice change to when an acid is added to it?

Q2 What is the difference between the use of a commercial indicator and that of a self made indicator?

Q3 What do you think will happen if you add Handy Andy to tea? Give a reason for your answer.

Q4 If beetroot juice and tea do not change colour when the substance is added, what can you say about the substance?

Q5 If you are at home and do not have access to any of the indicators used in activity 4.3, what can you use to find out whether a liquid is acidic or basic?

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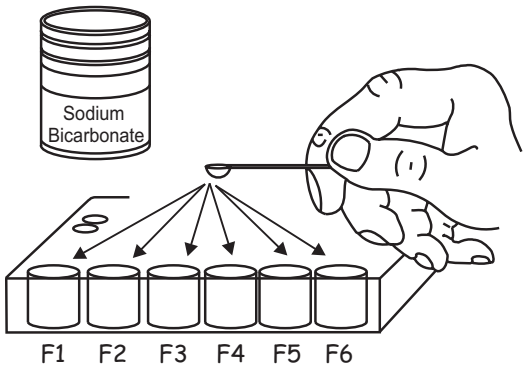
Activity 4.5 ACIDIC LIQUID AND DRY SODIUM BICARBONATE

Focus question: Which liquids (acidic or basic) fizz when put on sodium bicarbonate?

You will need:

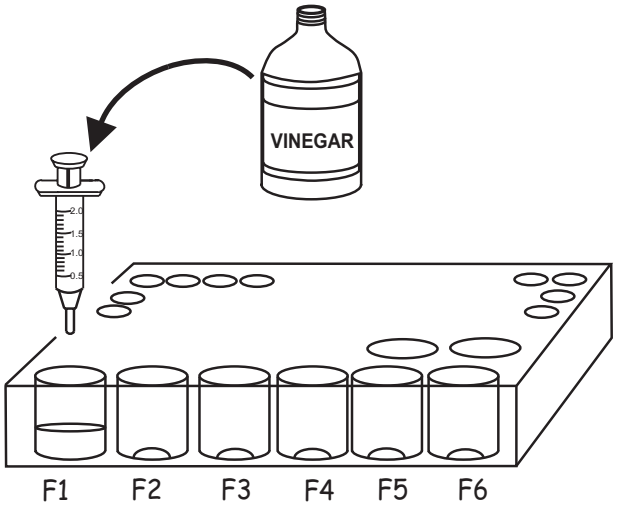
- 1 comboplate®
- 1 microspatula
- 1 syringe
- vinegar
- dilute sodium hydroxide
- lemon juice
- ammonia solution
- milk of magnesia
- dilute hydrochloric acid
- sodium bicarbonate
- water

STEP 1



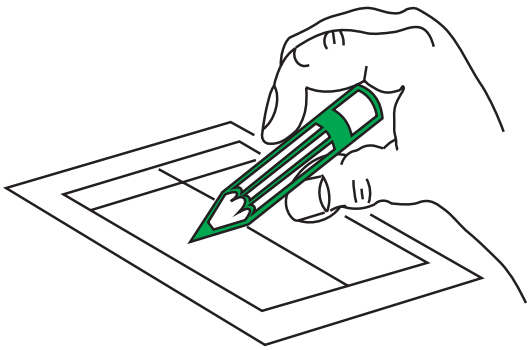
Put 1 microspatula full of sodium bicarbonate into wells F1 to F6.

STEP 2



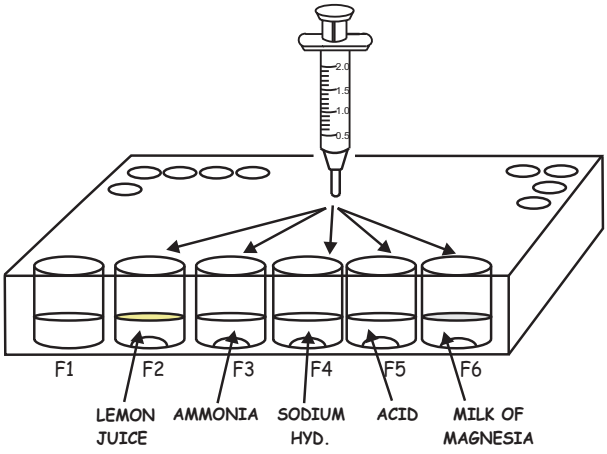
With a syringe put 1 ml of vinegar into well F1 and note what happens.

STEP 3



Record your observations on the table provided and then rinse the syringe thoroughly with water.

STEP 4



Repeat steps 2 and 3 for all the remaining liquids.

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SUBSTANCES WHICH FIZZ	SUBSTANCES WHICH DO NOT FIZZ

Q1 Identify which substances are acidic and which are basic.

Q2 What does the bubbling tell you about the substance produced?

Q3 What do you think actually happens when sodium bicarbonate fizzes?

Q4 Is it the same fizzing you get when you first shake a bottle of Coke and then open it?

Q5 Which liquids (acidic or basic) make sodium bicarbonate fizz?

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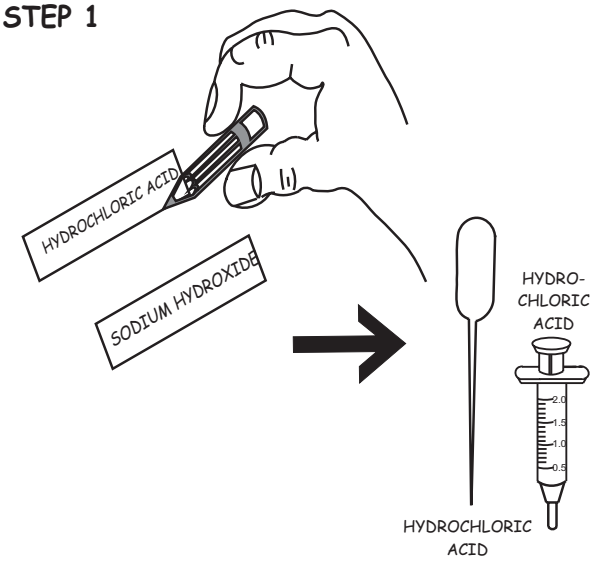
Activity 4.6 NEUTRALISATION

Focus Question: What happens when you put an acidic substance and a basic substance together?

You will need:

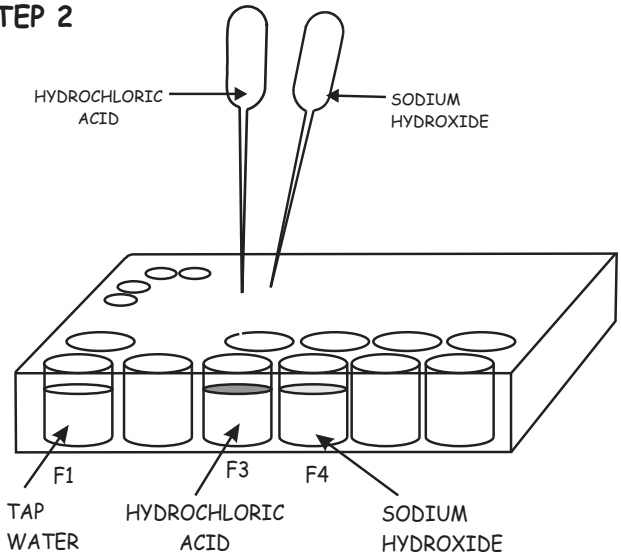
- 1 comboplate®
- 3 x propettes
- 2 x syringes
- 2 x microspatulas
- 0.1 M hydrochloric acid
- 0.1 M sodium hydroxide
- Universal indicator
- water

STEP 1



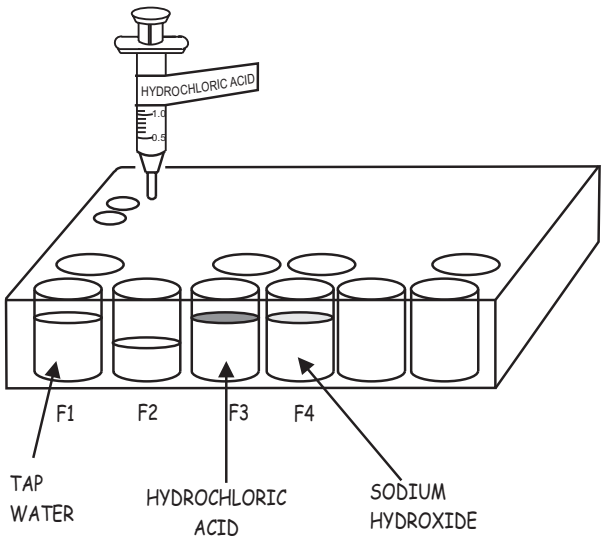
Put a label of hydrochloric acid on a syringe and a propette, and a sodium hydroxide label on another set.

STEP 2



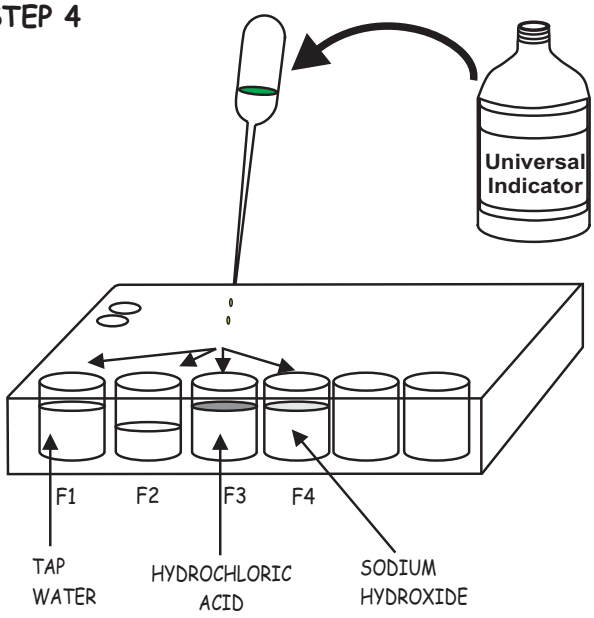
Fill well F1 to 2/3 with tap water, well F3 to 2/3 with hydrochloric acid and well F4 to 2/3 with sodium hydroxide solution.

STEP 3



Use the appropriate syringe to put 1 ml of acid into well F2.

STEP 4



Add 2 drops of Universal Indicator into wells F1, F2, F3 and F4 and record the colours.

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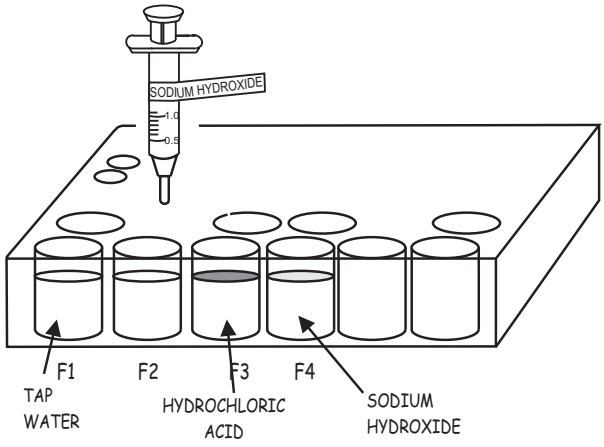
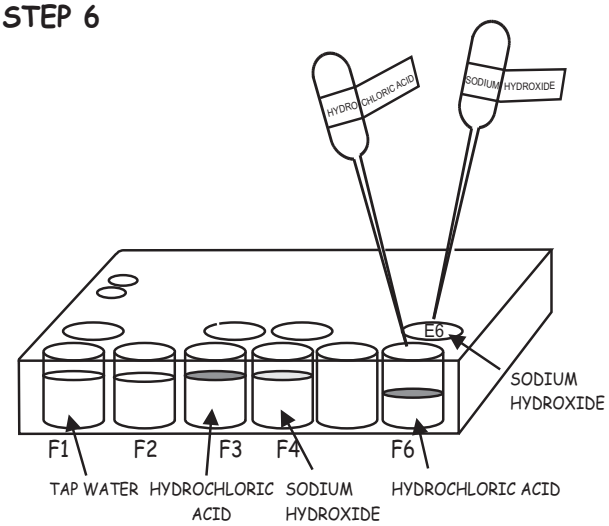
STEP 5



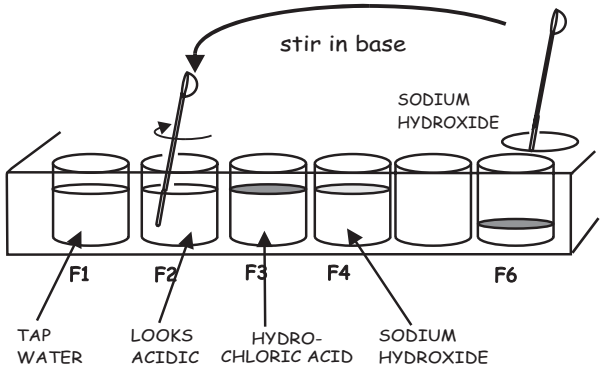
Now use a syringe to add 1 ml of sodium hydroxide to well F2. Stir and note the colour change.

STEP 6



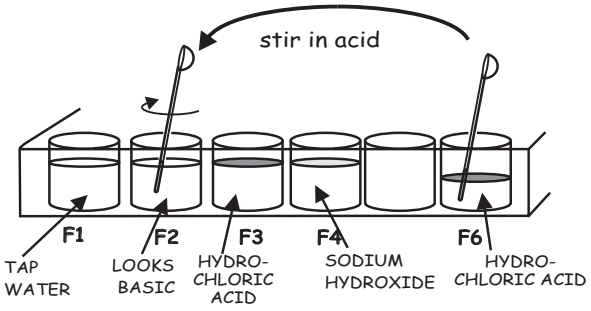
Fill half of well F6 with hydrochloric acid and half of well E6 with sodium hydroxide.

STEP 7



If the colour of the solution in well F2 looks more like the solution in well F3, dip the end of a microspatula into the sodium hydroxide in well E6. Stir the solution in F2 with the microspatula and repeat the process until the colour in F2 resembles the colour of the water in well F1.

STEP 8



If the colour of the solution in well F2 looks more like the colour of the solution in well F4, repeat step 7, but dip the end of the microspatula into the acid in well F6.

Q1 Identify which substance is acidic, basic or neutral.

Q2 Compare the colours in the 4 wells. What can you say about the changed colour in well F2 and the colour in well F1?

Q3 What does this tell you about the solution in F2? Is it acidic, basic or neutral?

Q4 What happens when you put an acidic substance and a basic substance together?

Q5 What will the colour of the universal indicator be if dipped into the solution in well F2?

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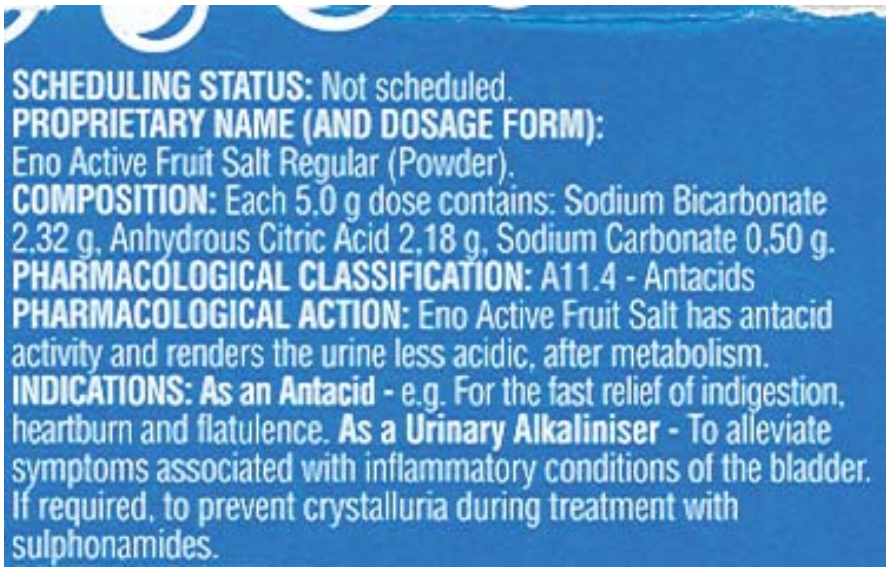
Activity 4.7 Treating Indigestion

Focus Question: ENO is a commercial fruit salt used as an antacid. Explain how ENO serves as an antacid.

You will need:

- 1 comboplate
- 1 propette
- 1 microspatula
- milk of magnesia
- universal indicator
- ENO
- vinegar
- water

Study the piece from the label of ENO below and answer the questions that follow:



Q1 Identify the ingredients of ENO and their quantity from the label.

Q2 From the contents of ENO can you explain why ENO exhibits effervescence when added to water?

Q3 Why do we 'burb' after swallowing a solution of ENO?

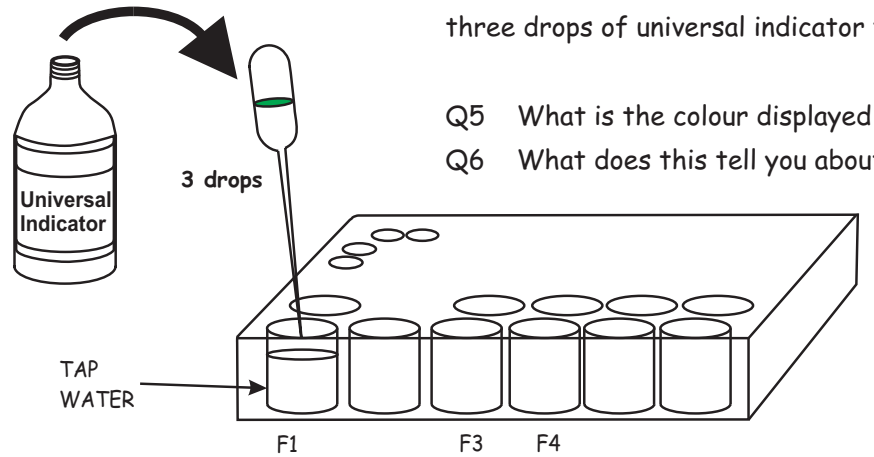
Q4 Explain how ENO alleviates acid indigestion and heartburn.

STEP 1

Use a propette to fill well F1 to 2/3 with water. Add three drops of universal indicator to the water in the well.

Q5 What is the colour displayed by the universal indicator?

Q6 What does this tell you about the pH of water?



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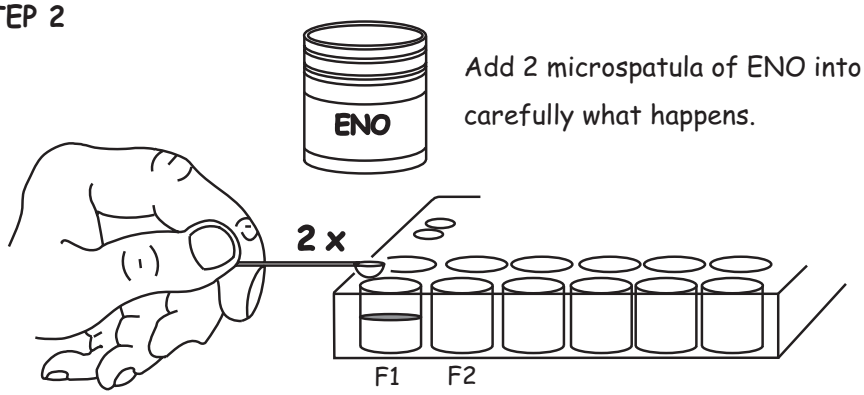
STEP 2

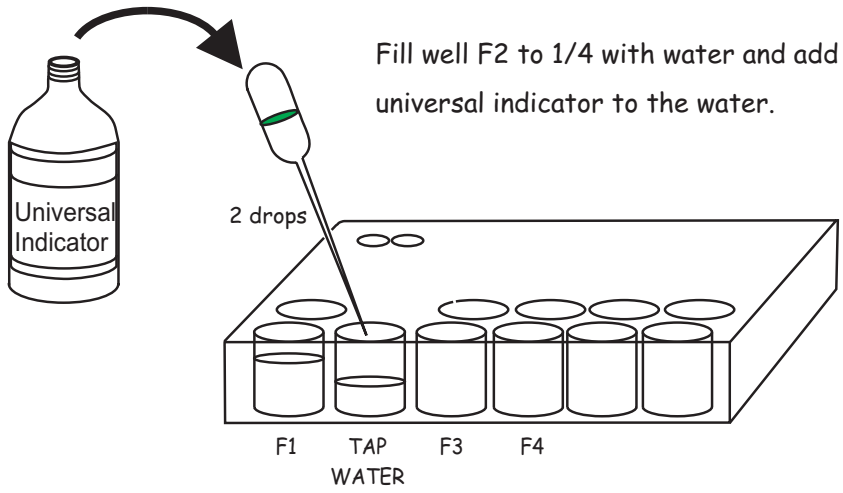


Add 2 microspatula of ENO into well F1 and observe carefully what happens.

Q7 Describe your observations.

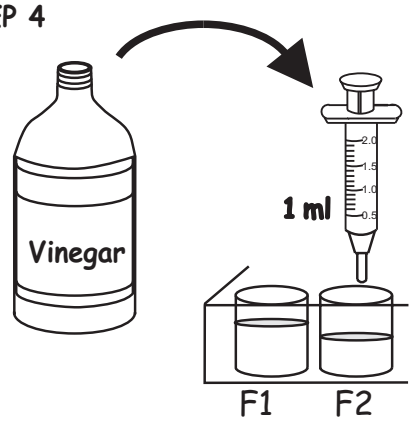
Q8 Why does ENO first appear acidic and then later becomes basic?

STEP 3



Fill well F2 to 1/4 with water and add two drops of universal indicator to the water.

STEP 4

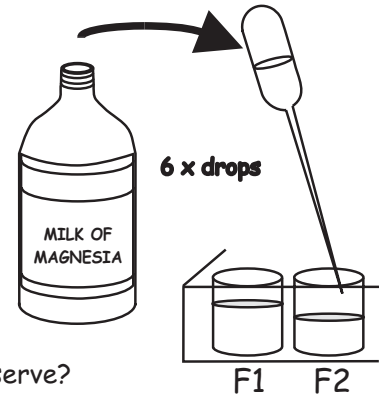


Add 1 ml of vinegar to the mixture in well F2.

Q9 What do you observe?

STEP 5

Add 6 drops of milk of magnesia to the mixture in well F2.



Q10 What do you observe?

Q11 Explain your observations.

Q12 Is milk of magnesia an antacid or not? Explain your answer.

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Activity 4.8 ACIDS AND BASES IN OUR DAILY LIVES

Study the items below and answer the following questions. Use the letter corresponding to the item. Try out the questions practically.

Q1 Which substances do you think are neutral?

Q2 If you have problems with ulcers, which substances should you avoid eating? Why?

Q3 What do you think will happen if you add substance L to substance N?

Q4 What will you observe if you dip item R in a solution of item O?

Q5 Identify substances in the chart which are basic.

Q6 Explain what happens when you add substance J to substance C.

Q7 Identify substances which can be used to find out if a substance is acidic, basic or neutral.

Q8 Identify antacids in the chart. What are they used for?

Q9 Which are natural and which are commercial indicators?

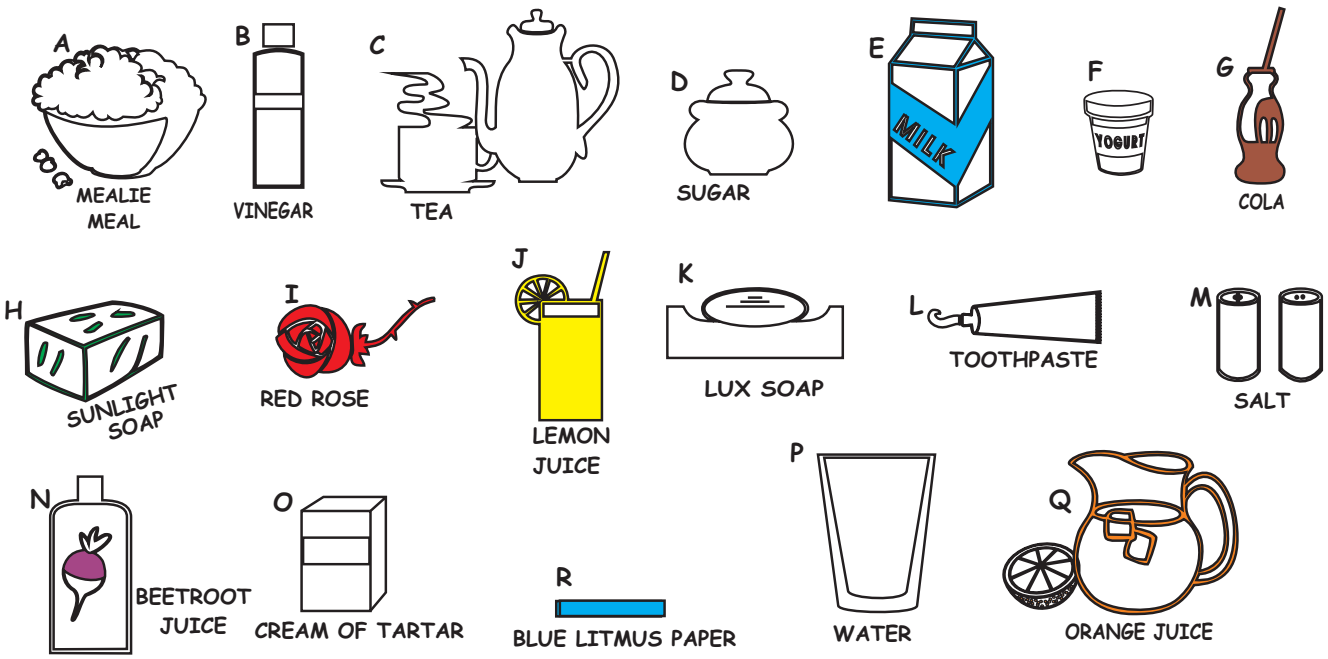
Q10 Which two items can you mix to produce a gas which is responsible for the fizzing in substance G?

Q11 M is a product of a reaction between an acid and a base. What are the names of the acid and the base?

Q12 Explain what happens when J is mixed with P.

Q13 A bee sting is painful because it contains acid. Which substance can you use to soothe a bee sting? Why?

Q14 A wasp sting is painful because it contains an alkali. Which substance can you use to soothe a wasp sting? Why?



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Activity 4.9 The secret message (Ice breaker activity)

Focus Question: Why are the letters of the message in different colours?

(Work in groups of 4 to prepare the materials you will need for this activity.)

You will need:

- comboplate
- 3 propettes
- 4 x cotton wool
- 4 pieces of chart paper
- ear buds
- ammonia
- Water
- cabbage juice
- Vinegar

Step 1

Use a propette to add 1/3 of water into well F1 and well F4.

Step 2

Fill well F1 to 2/3 with vinegar and well F4 to 2/3 with ammonia solution using different propettes.

Step 3

On the plastic rod of each ear bud, mark one end V and the other end A when a marker.

Now work as individuals.

It is good to recognise the good qualities in other people. It is even better to compliment people close to us about their admirable qualities. This can serve as an encouragement and a motivation to become an even better person.

Step 4

Within your group, choose a partner and think about a positive quality you admire (or like) about your partner. No flattery allowed! Be genuine. Think of a message you can write to your partner to acknowledge his or her good quality.

Step 5

Dip the end of an ear bud marked V into the vinegar solution and start writing the first word of your message on the piece of chart paper.

Step 6

Dip the end of an ear bud marked A in the ammonia solution and write the second word of your message. Continue to write the rest of the message by exchanging the two solutions that way.

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Step 7

Allow the message to dry completely and then present it to your partner.

Step 8

After receiving your message, read it by misting it lightly with the spray bottle filled with the red cabbage solution.

Q1 Why are the words on your message different colours?

Q2 Which words were written with an acid?

Q3 How can you tell?

Q4 What is the indicator in this activity?

Q5 Write the chemical formula of vinegar and that of ammonia.

Share your message with the whole class. Do you agree that, that is your positive quality?

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Activity 4.10 USING WHAT YOU KNOW ABOUT INDICATORS

Use the indicator chart provided and your knowledge of the different household substances, to predict the answers to the questions:

Q1 Explain what will happen if you add bromothymol blue to a sugar solution.

Q2 What colour will tea turn to if you add hydrochloric acid to it? Give reasons for your answer.

Q3 What colour is phenolphthalein likely to go if added to a substance with a bitter taste?

Q4 What will be the colour of beetroot juice if you add milk to it?

Q5 If a solution turns Universal Indicator purple, is it an acid or a base?

Q6 What colour will methyl orange be in car battery acid?

Q7 If substance A tastes sour, what colour is litmus likely to go if added to it?

Q8 What colour is thymol blue likely to be if added to a mixture of equal volumes of an acid and a base?

Q9 If solution A turns Universal Indicator yellow and solution B turns it red, which is likely to be lemon juice?

Q10 Why does Universal Indicator show three different colours for acids?

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COMMERCIAL INDICATORS			
Name of indicator	**Original colour**	**colour in ACIDIC solution?**	**colour in BASIC solution?**
Bromothymol blue	blue	yellow	blue
Litmus	blue	red	blue
Methyl orange	orange	red	orange
Phenolphthalein	colourless	colourless\milky	red
Thymol blue	blue	red	yellow
Methyl red	red	red	yellow
Alizarin yellow	yellow	yellow	red
Universal indicator		red/orange/yellow	blue/purple
NATURAL INDICATORS			
Beetroot	purple	red	purple-brown
Red cabbage	red	red-purple blue	blue-green
Radish	red	orange-pink	purple-brown
Tea	brown	yellow	dark brown

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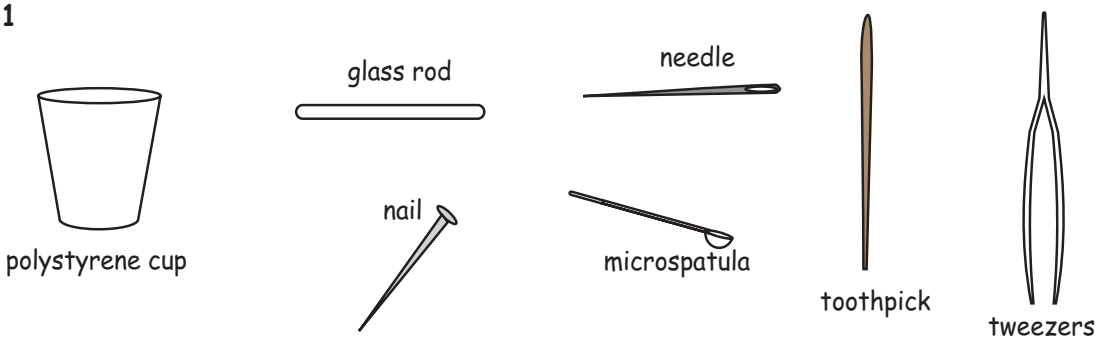
Activity 4.11 IS IT A GOOD OR BAD CONDUCTOR OF HEAT?

Focus question: Why does the handle of a metal mug with hot tea burn your fingers, while a glass cup with the same hot tea does not burn your fingers?

You will need:

- 1 comboplate®
- 1 microspatula
- 1 needle
- 1 polystyrene piece
- 1 toothpick
- 1 glass rod
- a pair of tweezers
- 1 nail

STEP 1



Think about each one of the items provided and decide whether it is a good conductor or a bad conductor of heat.

STEP 2

Table (a)

ITEM	DECISION good/bad	REASON FOR YOUR DECISION
glass rod		
needle		
microspatula		
nail		
toothpick		
tweezers		
comboplate		
polystyrene (piece)		

Record your decision on the table above and state the reason for your decision in the last column of the table.

STEP 3

Compare your results with those of your team mates and discuss your results especially where you do not agree with each other.

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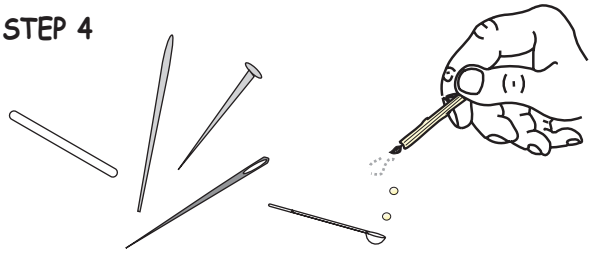
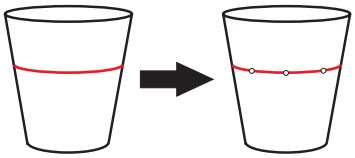
STEP 4

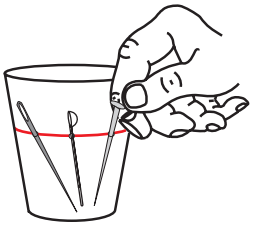


Drop molten wax from a lit candle on a microspatula and repeat the step with a tooth pick, a glass rod, a nail and a needle.

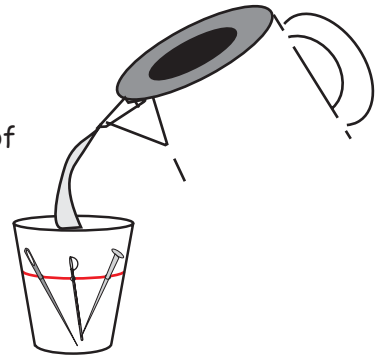
STEP 5



Draw a line around the cup about 3 cm from its bottom. Make 5 small holes along the line.



Insert the microspatula pointing downwards into one of the holes. Repeat the step with a tooth pick, a glass rod, a nail and a needle in the remaining holes.
Then pour hot water into the cup making sure that it does not leak through the holes.



Observe what happens to the wax on each item when they are immersed in the water.
Feel the wax and note your observations in the table below:

Table (b)

The wax melts when the item is a **good conductor** of heat.	The wax does not melt when an item is a **bad conductor** of heat.

Q1 What is common about the items which are good conductors of heat (feel hot)?

Q2 Explain how you think heat travels from the parts which are in contact with hot water to the wax which is on the other end?

Q3 Why does a handle of a metal mug with hot tea burn your fingers, while that of a glass cup with the same tea does not burn your fingers?

Q4 If you were asked to improve the mug, what would you do to make it a good container for drinking hot tea?

Q5 What is an insulator?

Q6 Give examples of materials which can serve as good insulators.

Q7 Why are houses with no ceilings normally colder in winter than houses with ceilings?

Q8 Explain what you would use and how you would try to keep the hot water in a plastic bottle hot for a few more hours when you have access to only these materials: a plastic bag, aluminium foil, microburner, a sponge, cotton wool, a piece of string, a pair of scissors, cold water, a piece of blanket.

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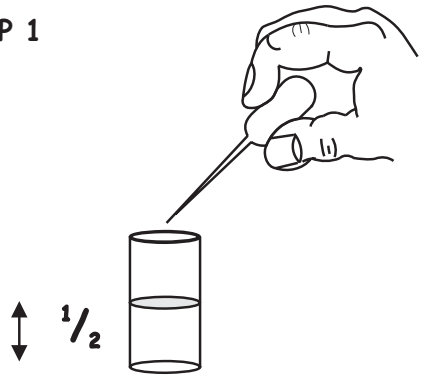
Activity 4.12 MOVING IN CIRCLES

Focus question: How does the domestic hot water system work?

You will need:

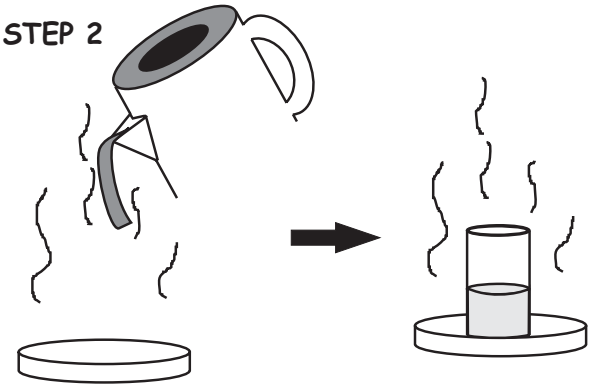
- 1 large sample vial
- 1 propette
- 1 Petri dish
- food colouring
- boiling water
- tap water

STEP 1



Use a propette to half fill the sample vial with cold tap water.

STEP 2



Pour boiling water in a petri dish, and stand the vial in it.

STEP 3

Put a drop of food colouring at the bottom of the vial with cold water, using a propette. Observe immediately what happens to the food colouring.

Q1 Describe your observations.

Q2 Give a simple explanation for what happens.

Q3 Why is it that the element of an electric kettle is always at the bottom?

Q4 What happens to a liquid when it is heated and when it is cooled?

Q5 What actually happens to the particles of a liquid when the liquid is heated and then expands?

Q6 In the domestic water system, the pipe which is sourcing cold water into the tank is at the bottom, while the pipe which leads to the hot water tap is at the top. Explain why this is so.

Q7 What happens to the particles of a liquid when it is cooled?

Q8 Why do your feet often feel cold when the rest of your body is warm?

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Activity 4.13 (work in pairs)

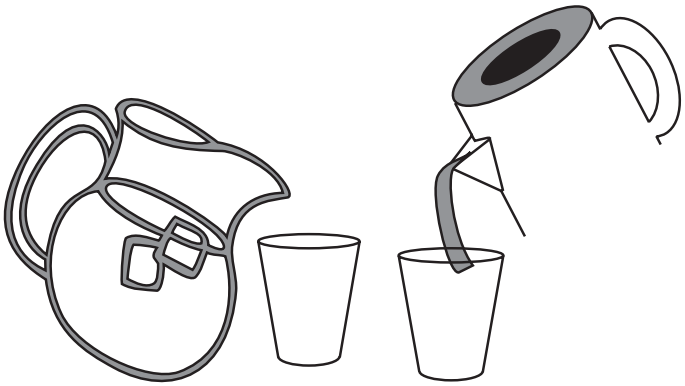
WHICH IS THE HEAVY WEIGHT: THE COLD OR THE HOT LIQUID?

Focus question: How does the temperature affect the movement of water molecules?

You will need:

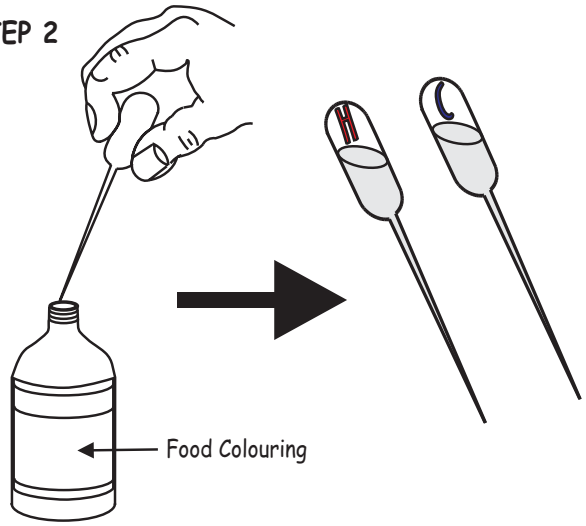
- 1 comboplate®
- 1 microstand
- 2 x polystyrene cups
- 3 x propette
- 2 x microfunnels
- 2 x small vials
- 2 paper clips
- food colouring
- cold water
- hot water

STEP 1



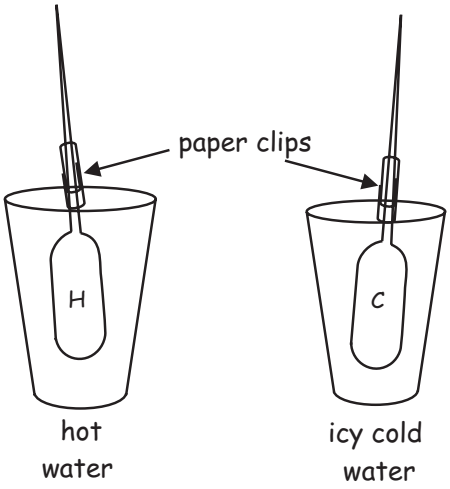
Half fill one polystyrene cup with ice cold water and the other with hot water.

STEP 2



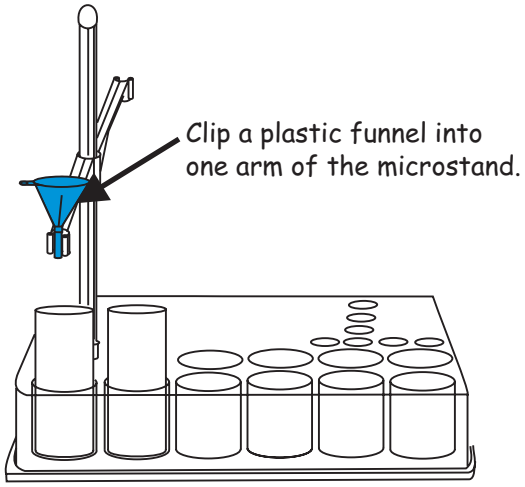
Use a pen to label one propette **H** and the other ***C***. Draw some food colouring into each propette.

STEP 3



Insert the propette labelled '***C***' into the icy cold water and clip it to the wall of the cup with a paper clip. Do the same with propette **H** in hot water.

STEP 4



Insert the microstand into well D2, one small vial into well F1 and the other vial into well F2.

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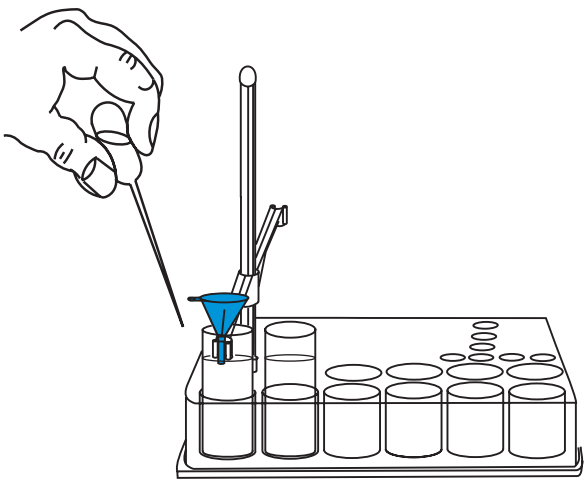
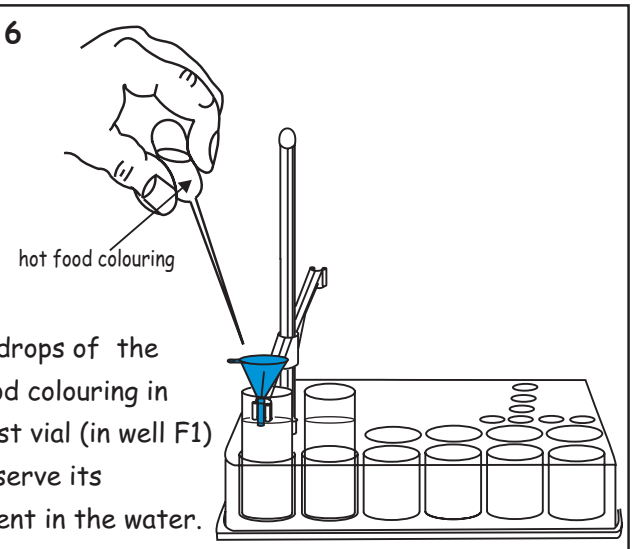
STEP 5



Fill the vials to 2/3 with tap water. Lower the microstand arm so that the stem of the funnel is immersed in the water.

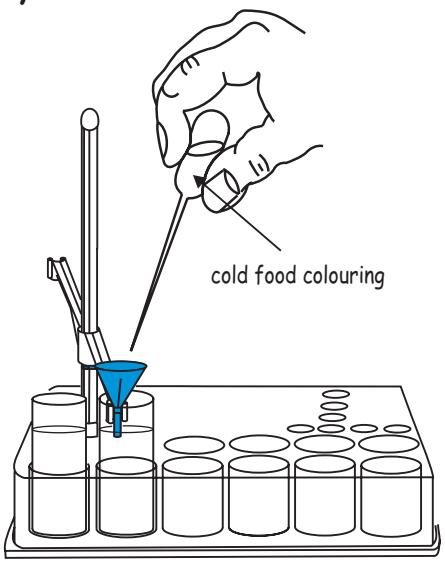
STEP 6



Add 5 drops of the hot food colouring in the first vial (in well F1) and observe its movement in the water.

Q1 Describe the movement of the food colouring in the water.

STEP 7



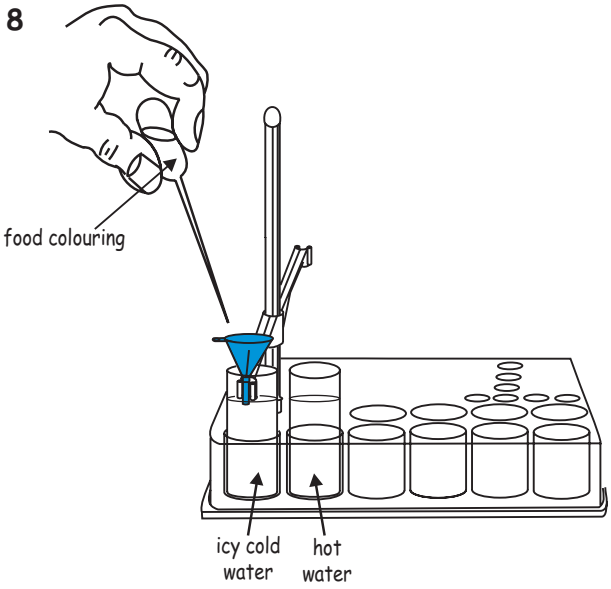
Add 5 drops of the cold food colouring in the second vial (in well F2) and observe its movement in the water.

Q2 Describe the movement of the food colouring in the water.

Q3 What is the difference in the movement of the food colouring in the first vial and that in the second vial?

Q4 Explain your observations in terms of what the liquid particles do.

STEP 8



Fill the vial in well F1 with icy cold water and that in well F2 with hot water. Then repeat steps 6 and 7.

Q5 Describe in detail what happened.

Q6 How does the temperature affect the movement of liquid particles (molecules)?

Q7 What happens to a liquid when it is heated and when it is cooled?

Q8 Which is heavier: the cold or the hot food colouring?

Q9 In your own words, explain what the term convection currents means.

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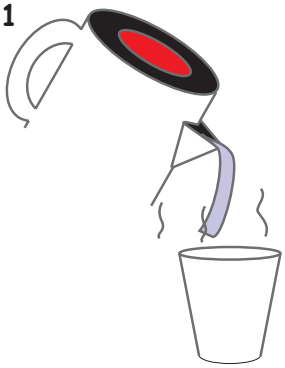
Activity 4.14 CONVECTION, CONDUCTION AND RADIATION

Focus question: If you put your hand directly above a cup with boiling hot tea without touching the cup, does your hand receive the heat through convection or conduction or radiation?

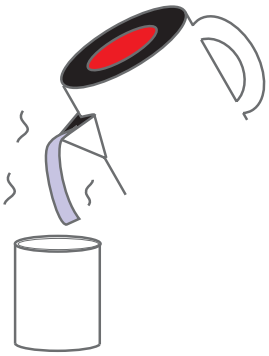
You will need:

•1 microburner •1 polystyrene cup •1 can •hot water •1 metal rod

STEP 1



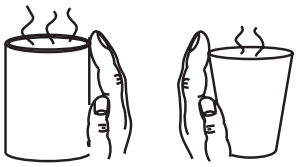
Fill a polystyrene cup and a can with hot water.



STEP 2

State whether your fingers or your hand receive heat through conduction or convection or radiation in each of the following situations and how:

Q1

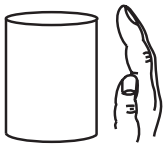


When you touch the sides of the two containers.

Q2

When you insert your finger directly into the liquid.

Q3



When you place your hand near the side of the can without touching it.

Q4

Placing your hand above the flame of a microburner.

Q5

Placing your hand directly above the hot liquid without touching it.

Q6

Inserting the metal rod into the hot water and then touching its end.

Q7 Consider how a thermos flask is made. Explain which type of heat transfer is prevented in each case and how.

Q8 Why are the walls of the flask silvered?

Q9 To prevent heat transfer by conduction, the flask is made of poor conductors. Name the poor conductor used for making the container and keeping it sealed.

Q10 What do you think the vacuum between the two glass walls is used for?

Q11 Use the following words/phrases to show the difference between conduction, convection and radiation: energy; transferred; solids; liquids; gases; vacuum; particles; closely packed; movement; fluids.

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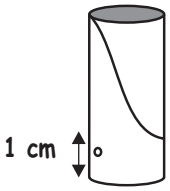
Activity 4.15 HOT AIR BALLOONS

Focus question: What moves the hot air balloons off the ground?

You will need:

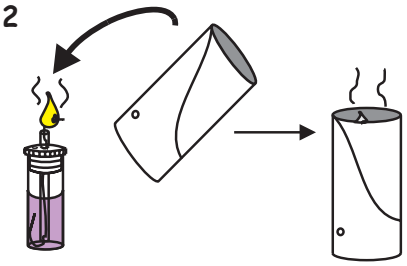
- 1 light weight paper bag
- 1 microburner
- 1 toilet roll tube
- 1 wooden skewer

STEP 1



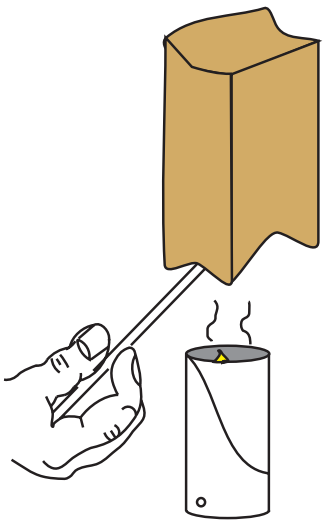
Make a vent hole about 1 cm above the bottom of one end of a toilet roll tube.

STEP 2



Place the tube around a burning microburner with the vent hole at the bottom.

STEP 3



Hold a light paper bag with a wooden skewer directly above the tube until the air inside heats up.

STEP 4

Observe what happens to the paper bag.

Answer the following questions:

Q1 Describe what happens to the paper bag.

Q2 What causes this to happen?

Q3 Explain what you see in terms of "rising air".

Q4 What is the vent hole, made in step 1, for?

Q5 What moves the hot air balloons off the ground?

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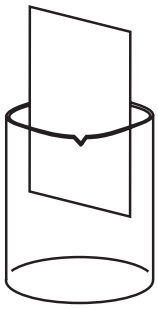
Activity 4.16 VENTILATION SYSTEM (Teacher's demo)

Focus question: How do convection currents cause winds?

You will need: (be very careful not to burn yourself)

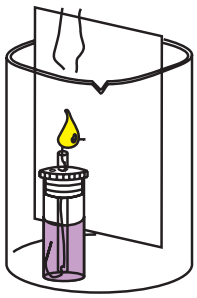
•1 microburner •1 glass beaker •a piece of cardboard •smouldering cloth

STEP 1



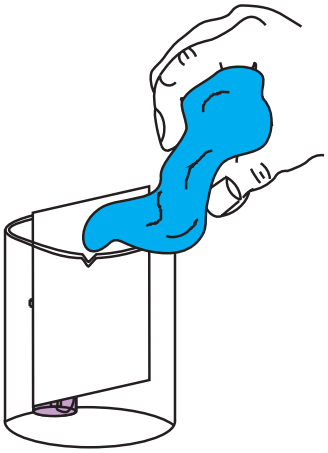
Insert a piece of cardboard into the glass beaker so that it partitions the beaker into two parts.

STEP 2



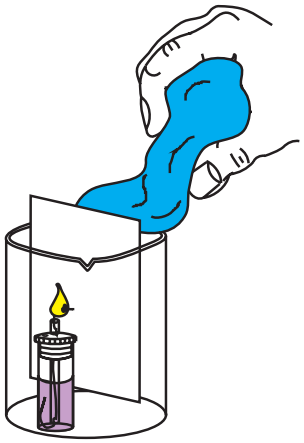
Place a burning microburner inside one part.

STEP 3



Hold a smouldering cloth at the mouth of the other part.

STEP 4



Observe what happens to the smoke.

Q1 Describe what you see.

Q2 The smoke is moving in a certain direction. Can you explain why this is so?

Q3 What do you think causes the smoke not to go straight up above the smouldering cloth, but to go down and under the partition and to the other side?

Q4 Why is it safe to swim in the sea during the day, but dangerous to do so at night?

Q5 If you suddenly open the door of a room where there is a fire in the fireplace, cold air rushes in. Why is this so?

Q6 How do convection currents cause winds?

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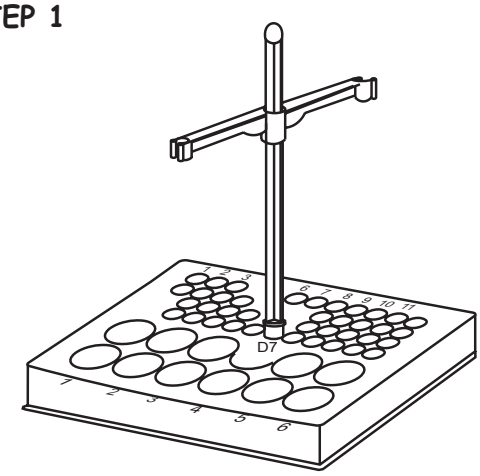
Activity 4.17 RADIATION AND ABSORPTION OF HEAT BY BLACK AND WHITE SURFACES

Focus question: Why is it not comfortable to wear a black outfit during hot days?

You will need:

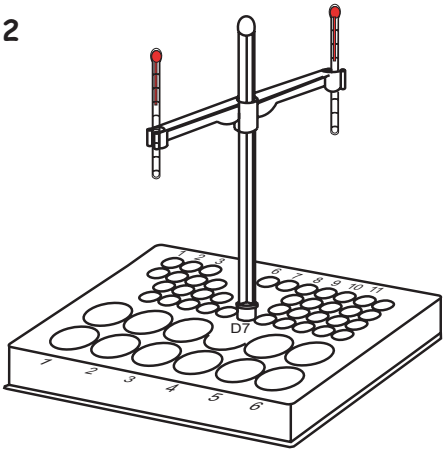
•1 comboplate •1 microstand •1 black sample vial •2 x thermometers
•1 clear sample vial

STEP 1



Fit the microstand into one of the small wells.

STEP 2

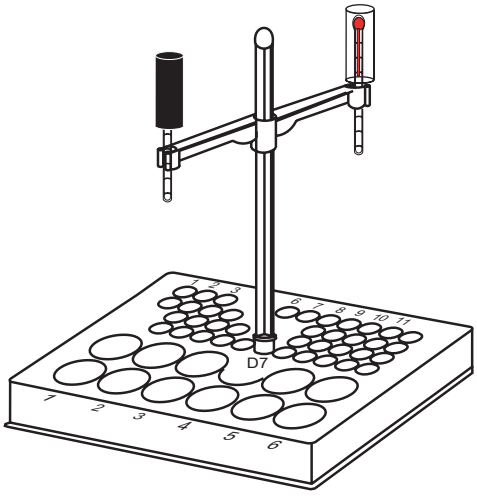


Fit one thermometer in an inverted (upside down) position in one of the arms of the microstand and the other thermometer in the other arm.

STEP 3

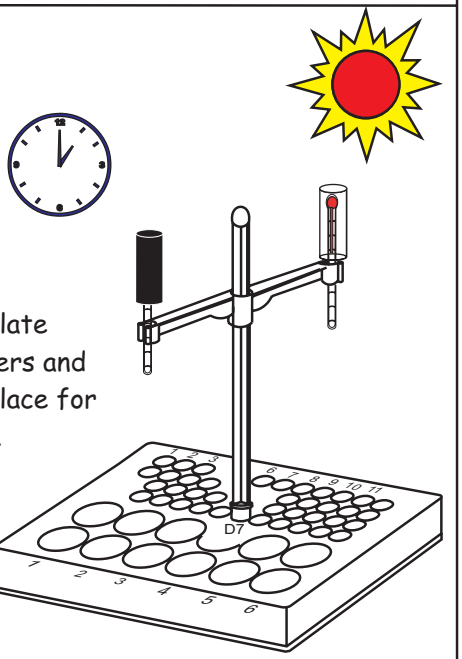
Turn the thermometers in such a way that the markings can be read. Note readings on the two thermometers and record under initial temperature on the table below.

STEP 4



Place a clear vial over one thermometer and the black tinted vial over the other thermometer.

STEP 5



Place the comboplate (with thermometers and vials) in a sunny place for about 10 minutes.

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STEP 6

Observe the reading of each thermometer at 2 minute intervals and record your findings on the table (a) below.

Table (a)

Time/min	tinted vial Temperature/°C	clear vial Temperature/°C
initial temp		
2		
4		
6		
8		
10		

Table (b)

Time/min	tinted vial Temperature/°C	clear vial Temperature/°C
initial temp		
2		
4		
6		
8		
10		

Repeat step 3 and 5 in a shady place and observe the temperature drop. Record your findings on the table (b) above.

Q1 Which surface, (the black or the white), absorbs heat better?

Q2 Which saucepan a shiny one or a black one will cook food faster?

Q3 ..... objects absorb much energy from radiation that hits them and therefore are ..... radiators.

Q4 Which surface, (the silver or the black), radiates heat better?

Q5 ..... objects reflect much energy from radiation that hits them and therefore are ..... heat absorbers.

Q6 Why is it not comfortable to wear a black outfit during hot days?

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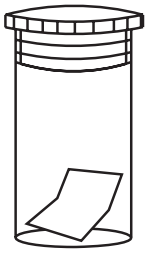
Activity 4.18 THE MAGIC BURNING OF PAPER (do the activity at 12 noon)

Focus question: Why does the plastic used in microwave cooking not melt?

You will need:

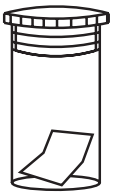
•1 magnifying glass •a piece of paper •1 glass sample vial with lid •sunlight

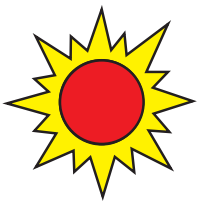
STEP 1



Insert a piece of paper at the bottom of a vial and close the vial with the lid.

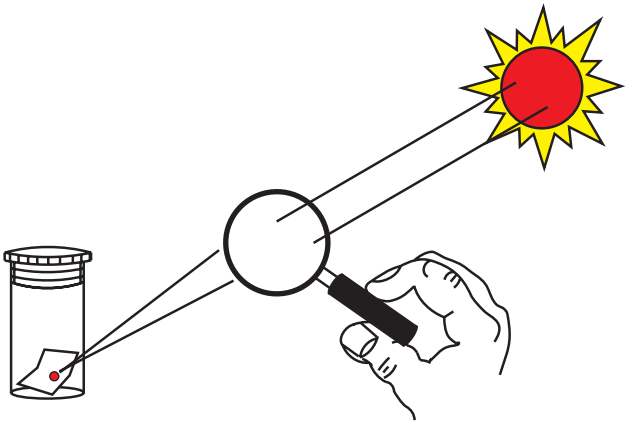
STEP 2





Place the vial in direct sunlight.

STEP 3



Use the magnifying glass to focus the sunlight on the paper, and hold it in one position until you see something happening to the paper.

Q1 Describe what you see and explain what this is a sign of.

Q2 What caused the smoke from the paper?

Q3 What is the source of energy in this case?

Q4 How was energy transferred from this source to the paper?

Q5 Why is the glass of the vial not acting like a barrier of energy transfer in this case?

Extension Questions:

Q6 In the microwave oven we use plastic cookware. Explain how the food in the plastic cookware receives the energy without the plastic melting.

Q7 How do plants receive their energy from the sun?

Q8 Explain how the greenhouse effect works.

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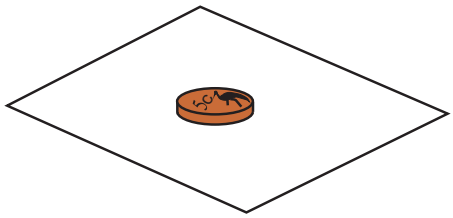
Activity 4.19 FIRE PROOF MATERIALS (Teacher's demo)

Focus question: Why is the paper and the cloth not catching fire?

You will need: (be very careful not to burn yourself)

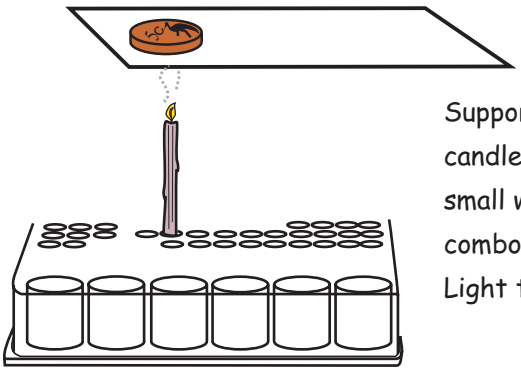
- 1 comboplate®
- 1 birthday candle
- a piece of paper
- a piece of nonsynthetic cloth
- a coin
- prestik

STEP 1



Place a coin on a piece of paper.

STEP 2



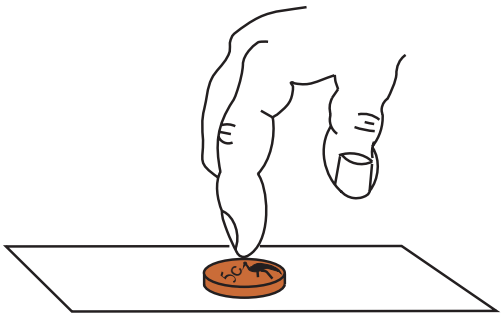
Support a birthday candle in one of the small wells of the comboplate with prestik. Light the candle.

Hold the paper above the flame for about one minute with the coin directly above the flame.

STEP 3

Observe what happens and remove the paper and the coin.

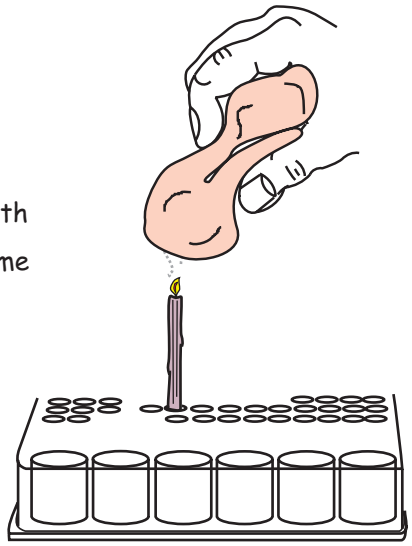
STEP 4



Touch the coin to feel the temperature.

STEP 5

Wrap the coin in the cloth and expose it to the flame for some time.



STEP 6

Observe what happens and remove the cloth from the flame.

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Answer the following questions:

Q1 Describe your observations.

Q2 Why is this happening?

Q3 Explain how the heat is transferred from the flame to the paper, then to the coin and then to the surroundings.

Q4 Why is the cloth not burning?

Q5 Where is the heat of the coin transferred to?

Q6 How is heat transferred away from the coin?

Q7 Which coin, a black painted one or a shiny, silver one, will be more suitable in this activity and why?

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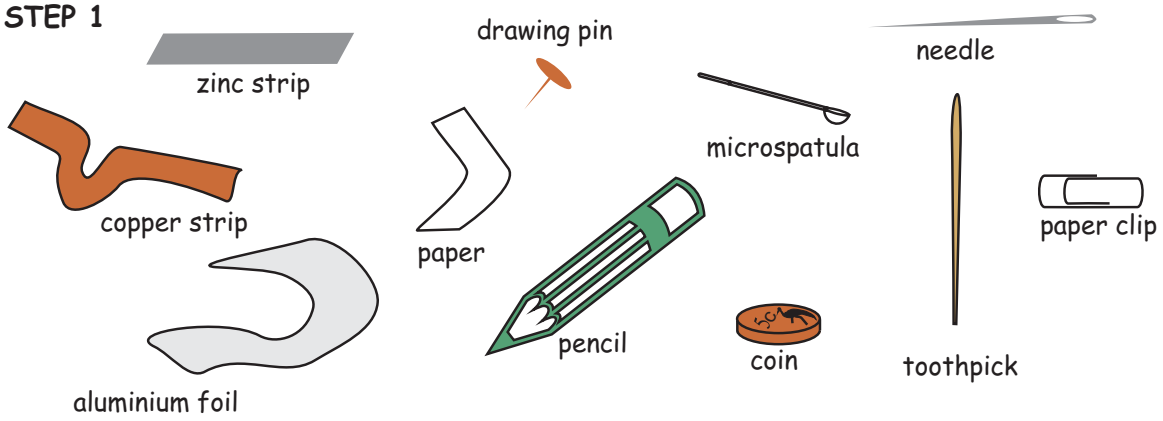
Activity 4.20 MAGNETS HAVE STRANGE POWERS OVER SOME THINGS

Focus question: Is magnetism a property of all metals?

You will need:

- 1 microspatula
- an aluminium foil piece
- a pencil (carbon)
- a copper strip
- 1 magnet
- a coin
- a piece of paper
- a zinc strip
- a paper clip
- a toothpick
- 1 drawing pin
- a needle

STEP 1



Think about each one of the items provided and decide whether it will be attracted by a magnet or not.

STEP 2

OBJECT	Do you think it will be attracted: yes/no	Observation Attracted? Yes/No	Magnetic? Yes/No	Metal? Yes/No
toothpick				
microspatula				
needle				
drawing pin				
paper clip				
copper strip				
coin				
aluminium foil				
zinc strip				
piece of paper				
pencil (carbon)				

Record your decision in the second column of the above table and compare your decision with those of your team mates. Discuss the differences.

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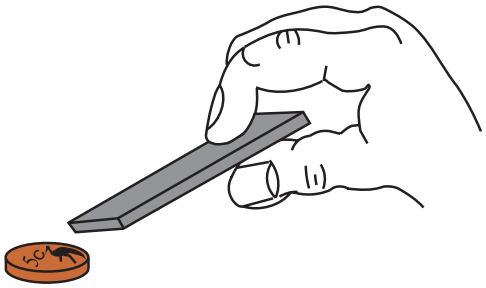
STEP 3



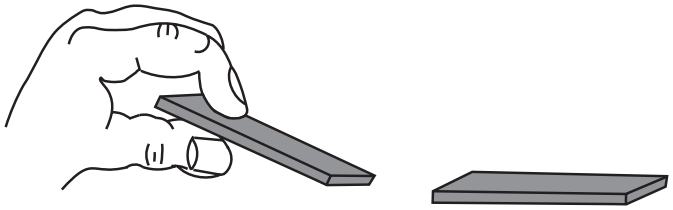
Test your decisions by bringing a magnet close to each of the objects and record your findings in the third column of the table.

STEP 4

Borrow the magnet of your partner and bring one of its ends close to the end of your magnet.

Q1 What happens?

Test the same end on the other end of your magnet.



Q2 What happens?

Q3 Explain what you see.

Q4 Are the two ends of your magnet the same?

Q5 How do you know whether an object is magnetic or not?

Q6 Does a magnet attract all metals? Give reasons for your answer.

Q7 Identify non-metals amongst the objects you have used for this activity.

Q8 What are non-metals?

Q9 From your findings do you think that magnetism is a property of all metals?

Extension Questions:

Q10 If you can cut your magnet into two, will you get two magnets, one with south poles and the other with north poles, or will the magnets each have two different poles?

Q11 Name the non-magnetic metals used in this activity.

Q12 How can a magnet be demagnetised?

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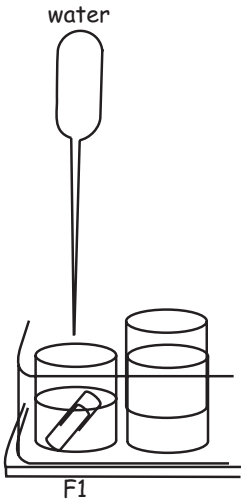
Activity 4.21 THE MAGIC OF MAGNETS

Focus question: In what way can magnets be used?

You will need:

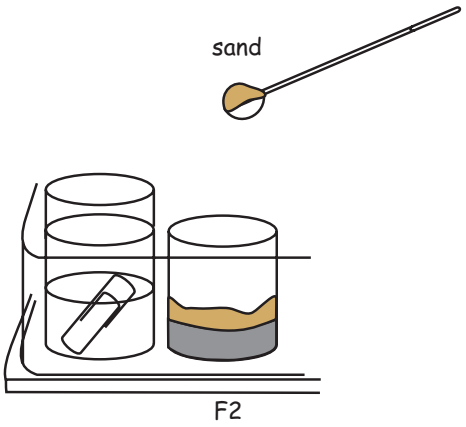
- 1 comboplate
- 1 propette
- a piece of string
- 1 microstand
- sand
- a paper clip
- 1 magnet
- iron filings
- 1 microspatula
- water

STEP 1



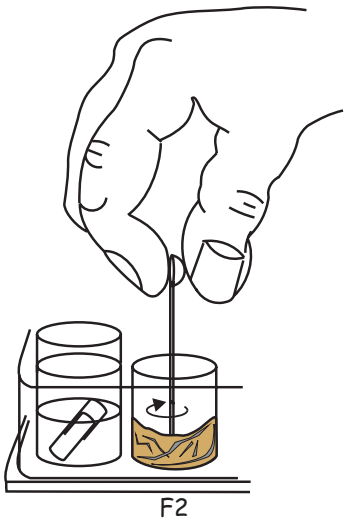
Put a paper clip in well F1 and add water.

STEP 2



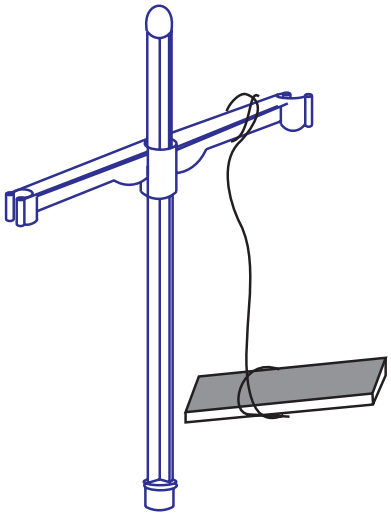
Put a thin layer of iron filings at the bottom of well F2 and fill to one quarter with sand.

STEP 3



Mix the iron filings and the sand in well F2 using a microspatula.

STEP 4



Tie one end of a string to the magnet and another to the microstand side arm.

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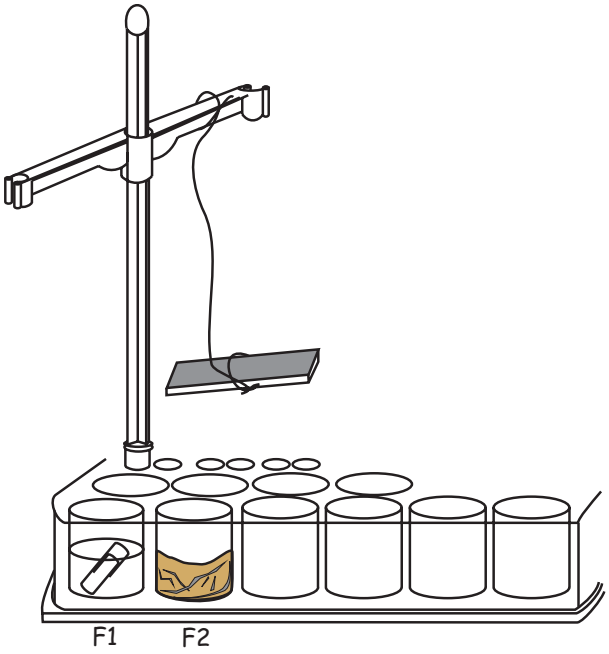
STEP 5



Push the microstand into one of the small wells of the comboplate.

Q1 In which direction is the swinging magnet pointing?
Q2 Find out whether the magnet will always point in this direction by repeating step 4 and 5 several times. What happened?
Q3 Can we use a magnet to find our direction?

Use only the materials indicated to remove the paper clip in well F1 without spilling the contents of the well.

STEP 6

Separate the sand and iron filings in well F2.

Q4 Describe how you managed to remove the paper clip in F1 without spilling the water.

Q5 Can the magnet attract the paper clips in the well through the plastic material of the comboplate®?

Q6 If it is possible explain why.

Q7 Describe how you managed to separate the sand and the iron filings in well F2.

Q8 From the above questions, what do you think magnets can be used for in our everyday lives?

Q9 Explain how magnets can be used for decorations in the kitchen.

Q10 If the comboplate® was made of iron, do you think it would be possible for the magnet to attract the paper clip through it? Why?

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Activity 4.22 MAKING A COMPASS

Focus question: In which direction does a free swinging magnet always come to rest?

You will need:

•1 comboplate •2 needles •a compass •a piece of paper •water
•1 microstand •1 magnet •1 Petri dish •a piece of string

STEP 1

Fill the Petri dish with water and then float the rectangular piece of paper on the water.

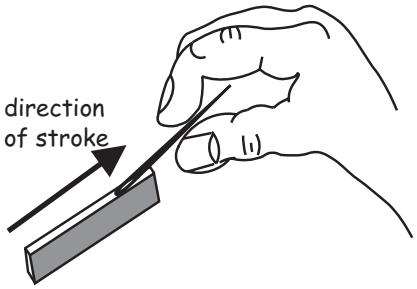
STEP 2

Lay the needle on top of the paper floating on the water.

Q1 What happens?

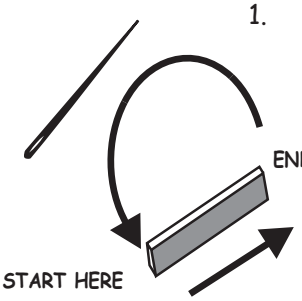
STEP 3

Take the needle off the paper.



Hold the needle firmly and stroke it against the magnet, starting at one end of the magnet and ending at the other end of the magnet.

STEP 4



1. Lift needle in a circular motion.
2. Stroke in the same direction as before.

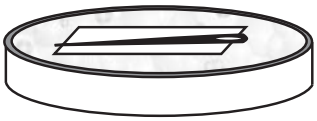
When you reach the other end of the magnet, lift the needle up in a circular motion. Stroke the needle again in the same direction as before, from the end you first started at. Repeat the stroking twenty times.

STEP 5

Lay the needle again on top of the piece of paper floating on the water and note what happens.(Make sure that the paper is in the centre of the Petri dish so that it is not obstructed by the walls of the Petri dish.)

Q2 What happens?

Q3 What are you actually doing when you stroke the needle with the magnet?



STEP 6

Take a compass and put it next to the Petri dish. Compare the direction of the compass needle with that of the needle floating on the water.

Q4 What can you say about the direction of the magnetised needle and the compass needle?

Q5 What causes the direction of the needles?

Q6 In which direction do the needles point?

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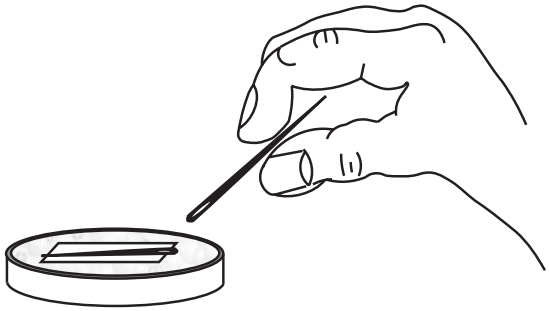
STEP 7



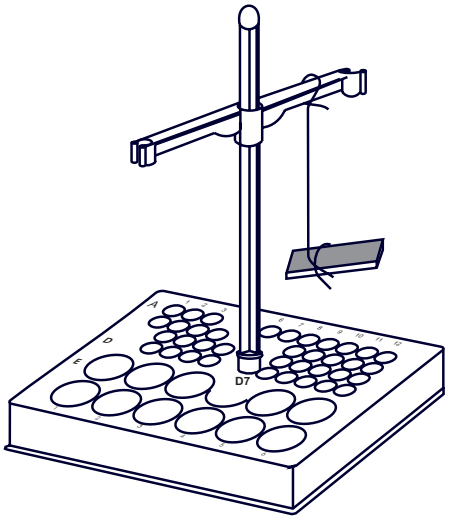
Take another needle and bring one end to the needle in the dish so that it is closest to the end which was stroked with the magnet.

Q7 What happens?

STEP 8

Tie one end of a piece of string to the magnet and the other end to the side arm of the microstand. Insert the microstand into a small well of the comboplate so that the magnet swings freely.

Note the direction at which the magnet is pointing at rest.



Q8 Where do the two ends of the free swinging magnet point? Is this in the same direction as the needle?

Q9 Is the needle of the compass a magnet or not?

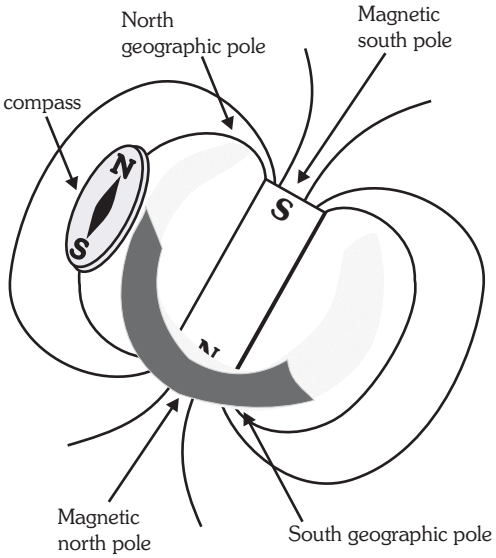
Q10 In which direction does a free swinging magnet point when it comes to rest? Why?

Q11 Is the needle in the Petri dish a magnet or not?

Q12 How can we make a magnet using a piece of metal?

Q13 Is it possible to turn a piece of aluminium into a magnet? Why?

Q14 The diagram on the right represents the Earth's magnetic field. Explain this diagram in detail.



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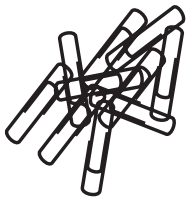
Activity 4.23 JUST HOW STRONG IS YOUR MAGNET?

Focus question: Can a magnet attract objects from a distance?

You will need:

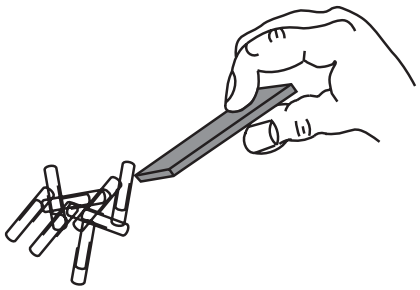
- 1 glass vial
- 1 petri dish
- 10 paper clips
- 1 magnet
- iron filings
- a piece of paper

STEP 1



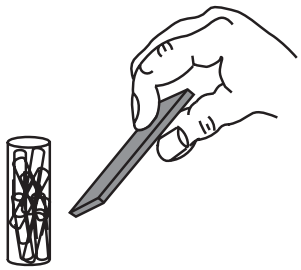
Put paper clips in a little pile.

STEP 2



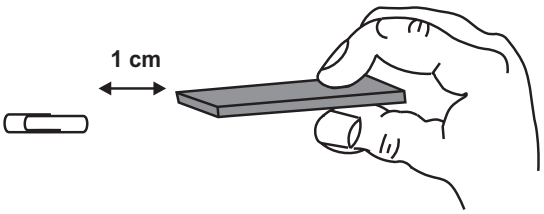
Bring the magnet near the paper clips and pick up as many of the clips as the magnet can possibly carry.

STEP 3



Put the paper clips into the sample vial and bring the magnet to the outside of the vial. Note what happens.

STEP 4

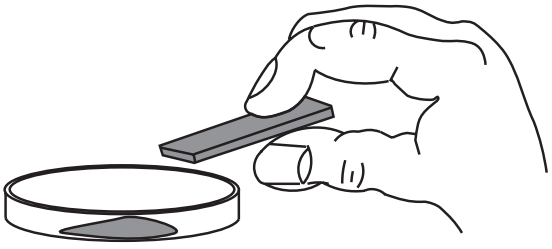


Bring the magnet to a distance of about 1 cm from one paper clip and see what happens.

STEP 5

Pour some iron filings into the Petri dish and close it.

STEP 6



Move the magnet over the top of the lid of the Petri dish and observe what happens.

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Q1 Can a magnet attract a paper clip if it is 1cm away?
Q2 Can a magnet attract a paper clip through the glass of the vial?
Q3 Why is it possible for a magnet to attract through another material?
Q4 Why is it possible for a magnet to attract a paper clip from a distance of 1cm?
Q5 What is a magnetic field?

Step 7

Put a piece of white paper on top of a magnet. Sprinkle the iron filings on the paper.
Q6 Explain what happens.
Q7 What can we use to indicate the direction of a magnetic field line?

Step 8

Use a plotting compass to show the direction of a magnetic field.
Q8 Why is it that the lines of a magnetic field never cross?
Q9 Diagram a, shows the electric field around two point charges. Diagram b, shows the magnetic field around a bar magnet. Compare the fields shown in diagrams a and b below.

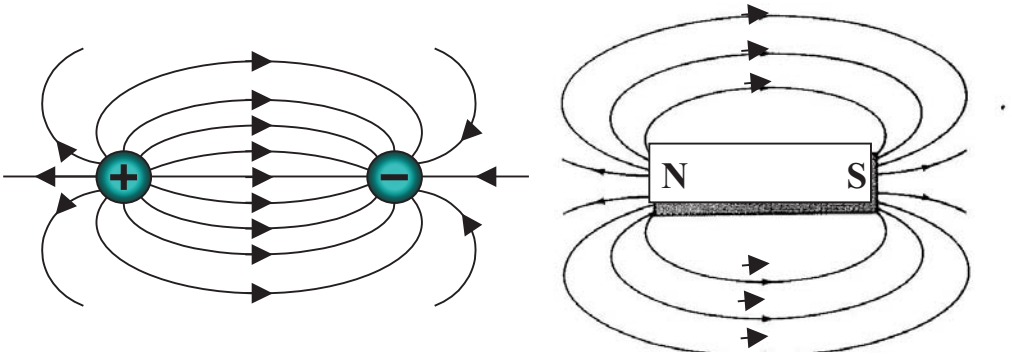

Diagram a Diagram b

a) Make a list of any similarities between the two fields.
b) Make a list of any differences between the two fields.
c) Say that you bring a positive electric charge near the north pole of the bar magnet in diagram b). What will happen to the charge? Explain.
d) Where will a compass needle point to, if you place it in between the two point charges in diagram a? Explain.

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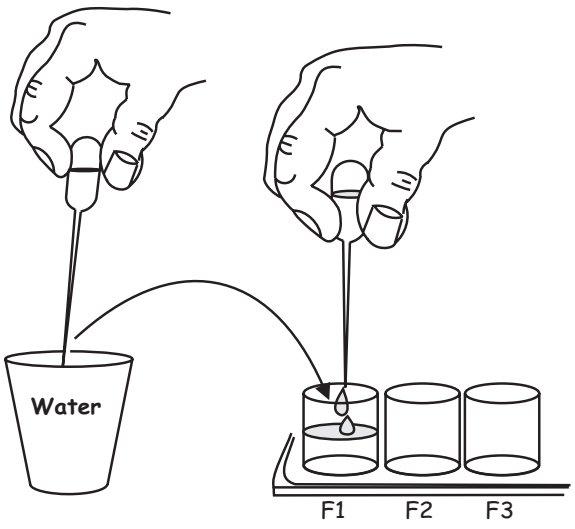
Activity 4.24 HOW MUCH WATER CAN THE LARGE WELL OF MY COMBOPLATE HOLD?

Focus question: What are the capacities of some of the items in my kit?

You will need:

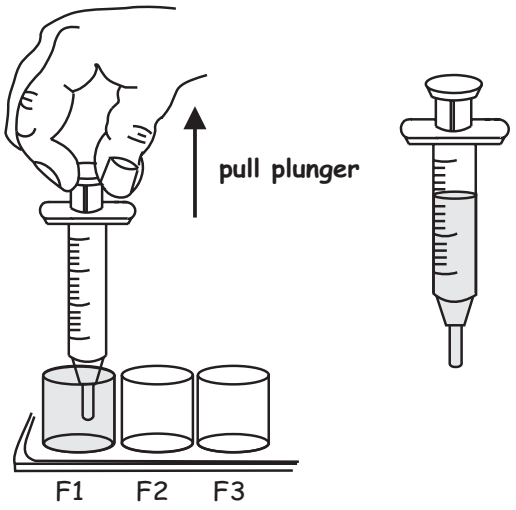
- 1 comboplate
- 1 propette
- 1 gas collecting tube
- 1 syringe
- 1 small sample vial
- water

STEP 1



Use a propette to fill one of the large wells with water to the brim.

STEP 2



Use the syringe to draw all the water from the well.

Q1 What is the volume of the water?

Q2 What is the capacity of the large well?

Q3 What can you say about the capacity of the large well and that of the syringe?

Q4 Describe how you would find the capacity (Volume) of the small well.

STEP 3

Measure the volume of the small well and record your findings on the table below.

Q5 Find out what the volume of the small vial and the gas collecting tube is.

ITEMS	CAPACITY (VOLUME)/ ml
syringe	
large well	
small well	
small vial	
gas collecting tube	

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Activity 4.25 ESTIMATING VOLUMES USING ITEMS WITH DEFINITE KNOWN VOLUMES

Focus question: Can you estimate the volume of a large sample vial using the small sample vial?

You will need:

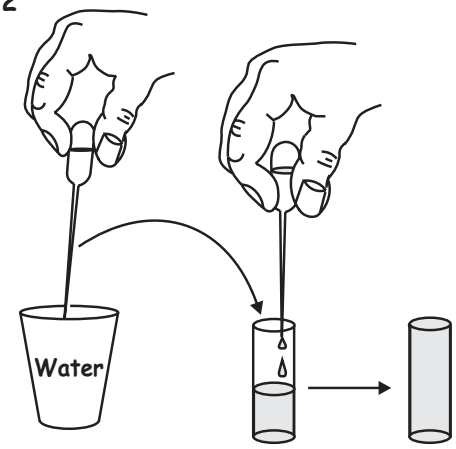
•1 small sample vial •1 propette •1 large sample vial •water

STEP 1

Check the volume of the small vial used in activity 4.24

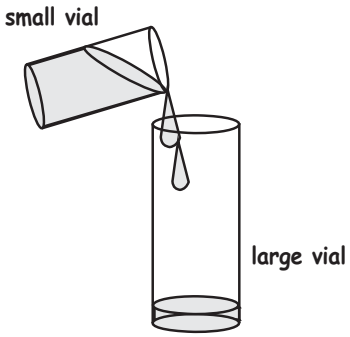
Q1 What is the volume of the small sample vial?

STEP 2



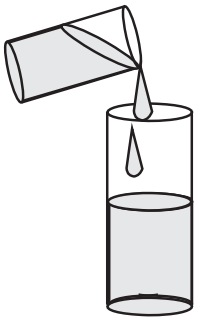
Use a propette to fill the small sample vial with water to the brim.

STEP 3



Transfer the water in the small sample vial into the large sample vial.

STEP 4



Repeat steps 2 and 3 until the large vial is full.

Q2 Estimate the volume of water left in the small sample vial.

Q3 What is the capacity of the large sample vial?

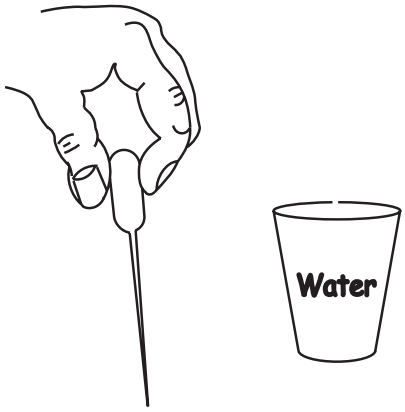
Q4 The volume of the large vial is _____ times the volume of the small vial.

Q5 Answer the focus question.

Q6 What are propettes used for?

Q7 Is it possible to fill up the whole bulb of a propette with water? Why?

STEP 5



Prove your answer to Q7 using a propette and water.

Q8 How much of the liquid can the propette hold?

Q9 What is the volume of the whole bulb?

Q10 What is the capacity of the bulb?

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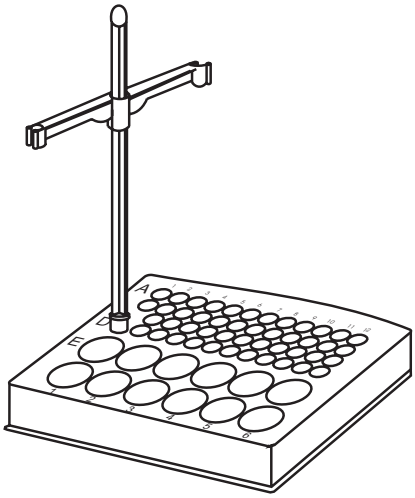
Activity 4.26 WHAT IS THE VOLUME OF THE SPRING IN MY KIT?

Focus question: How can we measure the volume of an irregular object?

You will need:

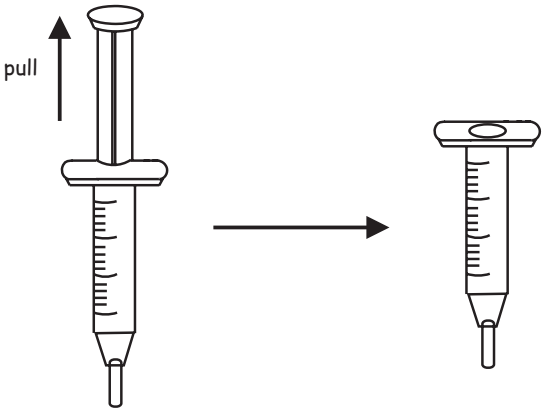
- 1 comboplate
- 1 microstand
- 1 propette
- 1 syringe
- 1 spring
- prestik
- 1 paper clip
- water

STEP 1



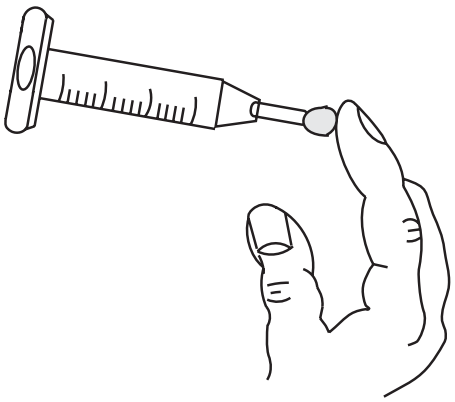
Insert a microstand into a small well of a comboplate.

STEP 2



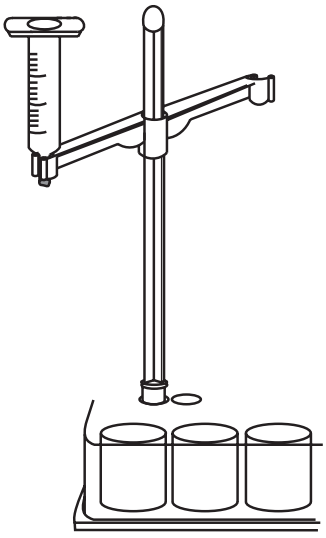
Remove the plunger of the syringe.

STEP 3



Use a piece of prestik to seal (block) the opening of the syringe nozzle.

STEP 4



Clip the nozzle of the syringe into the side arm of the microstand.

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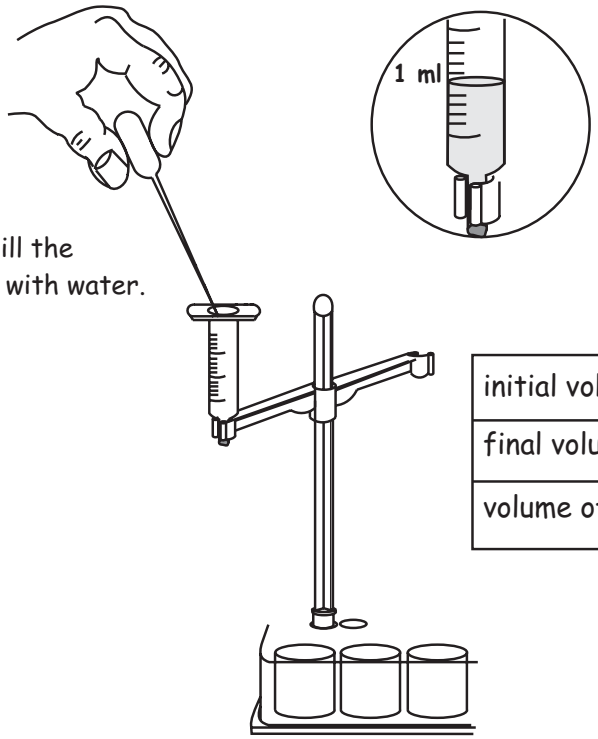
STEP 5

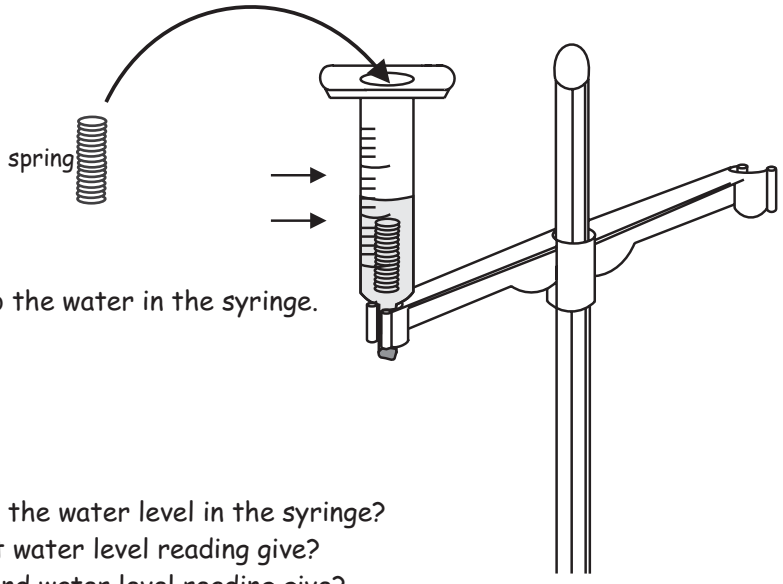


Use a propette to fill the syringe up to 1.0 ml with water.

initial volume on the syringe	
final volume on the syringe	
volume of the spring	

Q1 What is the initial volume of water in the syringe? Record that on the table above.

STEP 6



Carefully insert the spring into the water in the syringe.

Q2 What is the new reading of the water level in the syringe?
Q3 What volume does the first water level reading give?
Q4 What volume does the second water level reading give?
Q5 What is the volume of the spring?
Q6 How can we measure the volume of an irregular object?

STEP 7

Repeat steps 5 -6 to find the volume of a paper clip using 2 ml of water in step 5.

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ACTIVITY 4.27 THE CURRENT IN A SERIES CIRCUIT

Focus Question: Is the strength of the current the same anywhere in a series circuit?

What you need

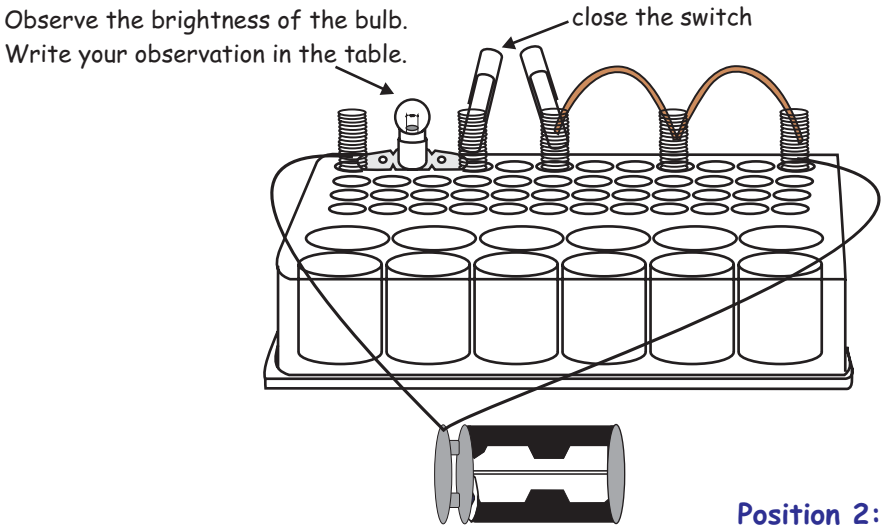
•a comboplate •3 x bulbs •3 x bulb holders •5 x springs •2 x paper clips
•2 x copper strips

What to do

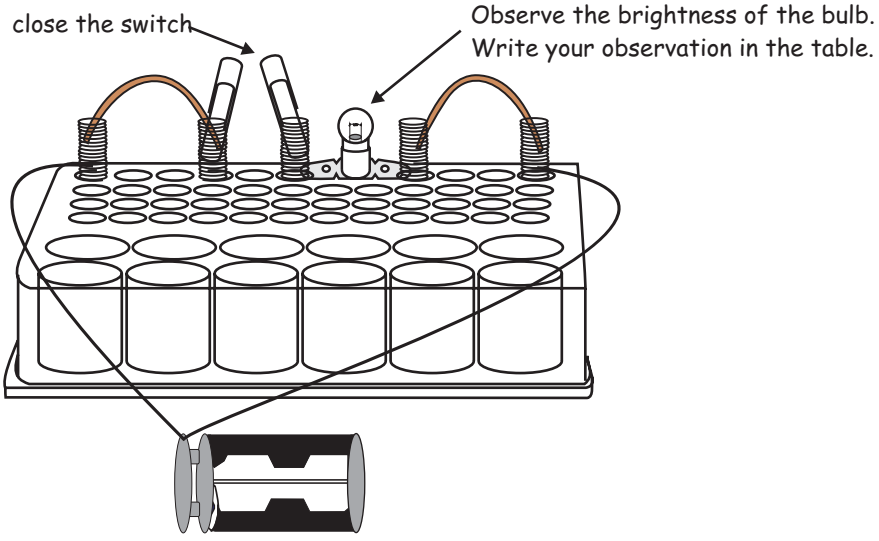
Work in pairs or groups of three. Use the micro-electricity kit to construct the series circuits given in the figures below. Complete the given table. Remember to predict the brightness of the bulb before you close the switch.

Bulb's position	Brightness Prediction	Bulb brightness
Before switch		
After switch		
Before battery		

Position 1: Before the switch



Position 2: After the switch



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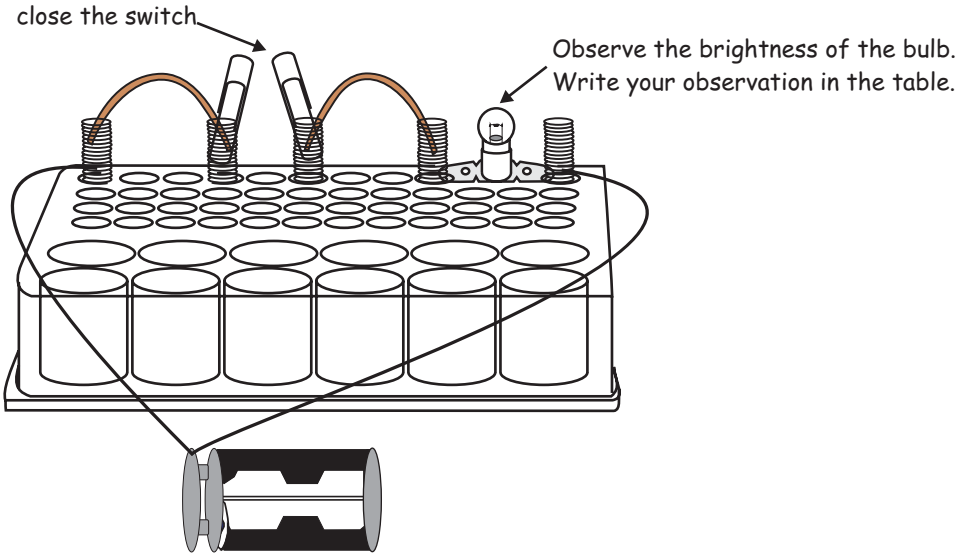
Position 3: Before the battery



What to discuss

1 Thando is a Grade 8 learner. When he was asked by his teacher to describe the current in a series circuit he said the following:

> **"The strength of the current before the light bulb is bigger. This is because the current goes through the light bulb and gets used up."**

Discuss Thando's statement.

2 In your micro-electricity kit is a part called a **resistor**.

A resistor is a specially designed device to reduce the current in a circuit. Some parts of a circuit cannot work properly if they have large currents in them. If you ever get the chance, look inside a radio or TV. You will see many, many resistors.

3 Predict the brightness of the light bulb in your series circuit if you were to replace one of the copper strips with a resistor. Set up such a circuit and test your prediction. (You may need to add an LED to your series circuit.)

4 How accurate was your prediction? Discuss.

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ACTIVITY 4.28 LIGHT BULBS IN SERIES

Focus Question: What are the advantages and disadvantages of connecting bulbs in series ?

What you need

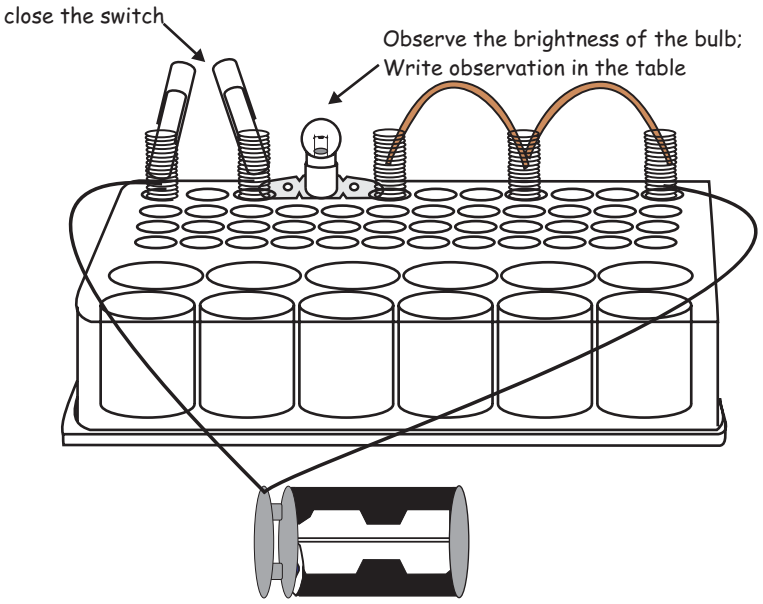
- a comboplate
- 3 x bulbs
- 3 x bulb holders
- 5 x springs
- 2 x paper clips
- 2 x long copper/zinc strips
- a cell holder
- a cell connector
- 2 x 1.5 volt cells

What to do

Work in pairs or groups of three. Use the micro-electricity pieces to construct the series circuits given in the figures below. Complete the given table. Remember to predict the brightness of the bulb/s before you close the switch.

Note: Only pack away your circuits at the end of the Discussion section.

Bulbs	Brightness Prediction for each bulb	Brightness of each bulb
1		
1 and 2		
1, 2 and 3		



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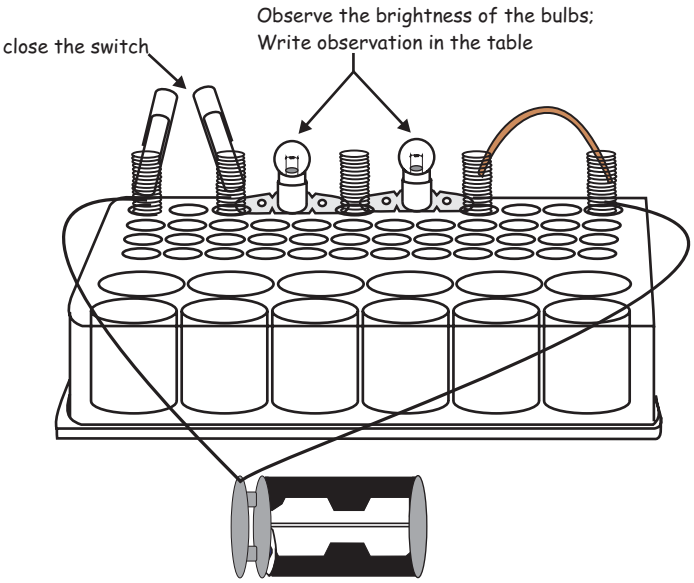

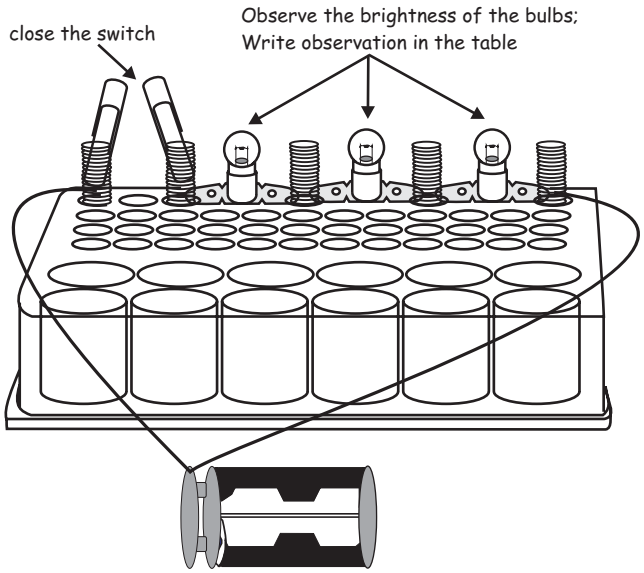

What to discuss

Q1 Describe the changes of the brightness of the bulbs, in terms of electrical current, each time another bulb is added in series.

Q2 In an earlier Activity you met an electrical device called a resistor.

a) What similarities are there between the extra light bulbs added in series and the resistor.

We call the property of a substance that reduces current strength, resistance.

b) Each light bulb has a certain resistance. Discuss, in terms of resistance, how the addition of each light bulb affects the current in a series circuit.

Q3 Predict what will happen if you unscrewed the first light bulb in the last series circuit you set up. Test your prediction. Explain the result.

Q4 Let's consider the possibility of connecting two car headlights and an indicator light in series. What disadvantages and advantages would there be?

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ACTIVITY 4.29 LIGHT BULBS IN PARALLEL

Focus Question: What are the advantages of connecting bulbs in parallel ?

What you need

- a comboplate
- 3 x bulbs
- 3 x bulb holders
- 7 x springs
- 2 x paper clips
- 2 x long copper/zinc strips
- a cell holder
- a cell connector
- 2 x 1.5 volt cells

What to do

Work in pairs or groups of three.

Step 1

Use the micro-electricity pieces to construct the parallel circuit as shown below.

Step 2

Predict whether the other bulbs will glow if you unscrew one bulb.

Step 3

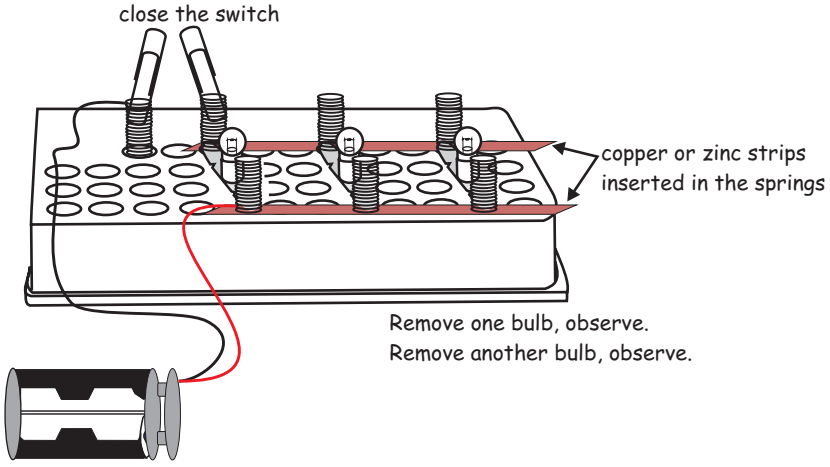
Test your prediction.

Step 4

Predict whether the other bulbs will glow if you unscrew two bulbs.

Step 5

Test your prediction.



Q1 Complete the given table.

Bulbs	"Glow" Prediction for each bulb	"Glow" of each bulb
Remove 1 bulb		
Remove 2 bulbs		

Q2 How do light bulbs connected in parallel differ to light bulbs connected in series?

Q3 You are given some examples of some common circuits below:
Christmas tree lights, traffic lights (robots), torch, ceiling lights in the home, street lights;

a) Which circuits are parallel and which are series?
b) Give the reasons for your choices.

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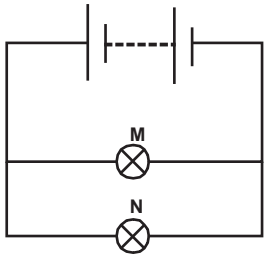
3 COMPLETE THIS QUESTION ON YOUR OWN. After everyone has finished the questions compare answers. If you disagree set up the circuits to check.

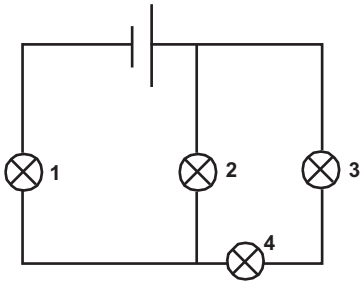
Q4 You are given some circuit diagrams. Chose the correct multiple choice answer for each.

4.1 If the light bulb M suddenly "burns out", what happens to light bulb N?



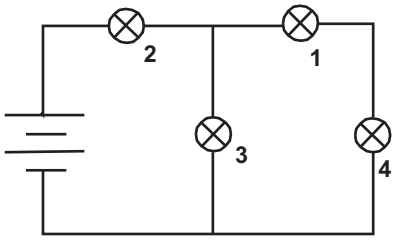
A It glows exactly as before
B It glows brighter
C It glows less bright
D It does not glow

4.2 Which bulb/s will glow with the same intensity (same brightness)? All the bulbs are identical.



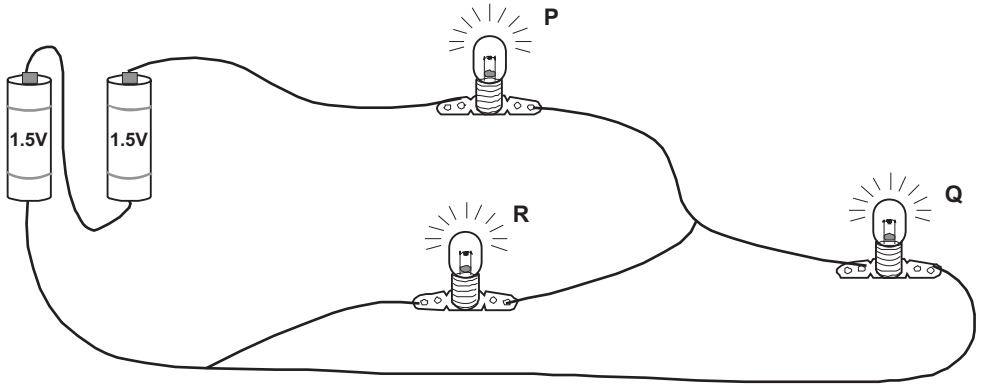
A 1 and 2
B 2 and 3
C 1, 2 and 3
D 3 and 4

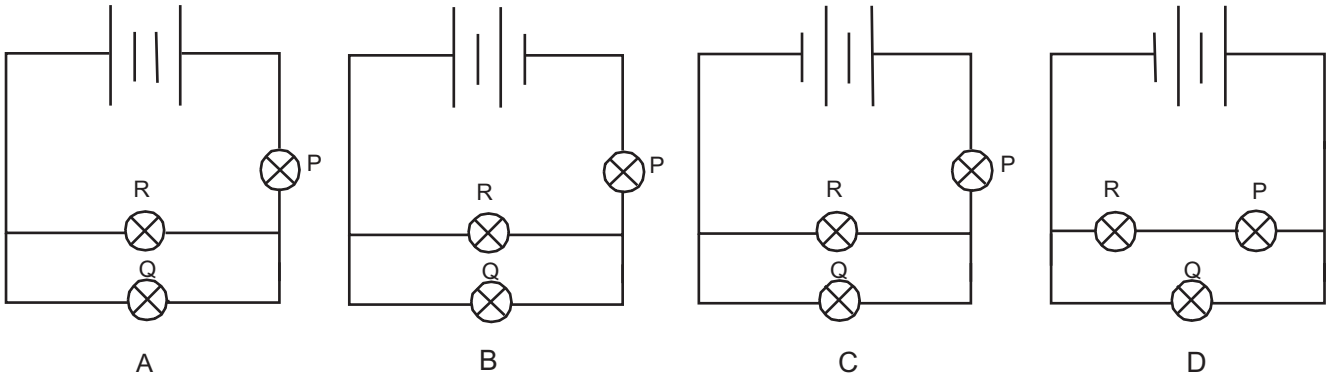
4.3 Which bulb must be removed from the circuit to make ALL the other bulbs go out?



A 1
B 2
C 3
D 4

4.4 Lebala, a Grade 8 learner connects three light bulbs called P, Q and R to two cells. Which circuit diagram corresponds exactly to the circuit she set up ?





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