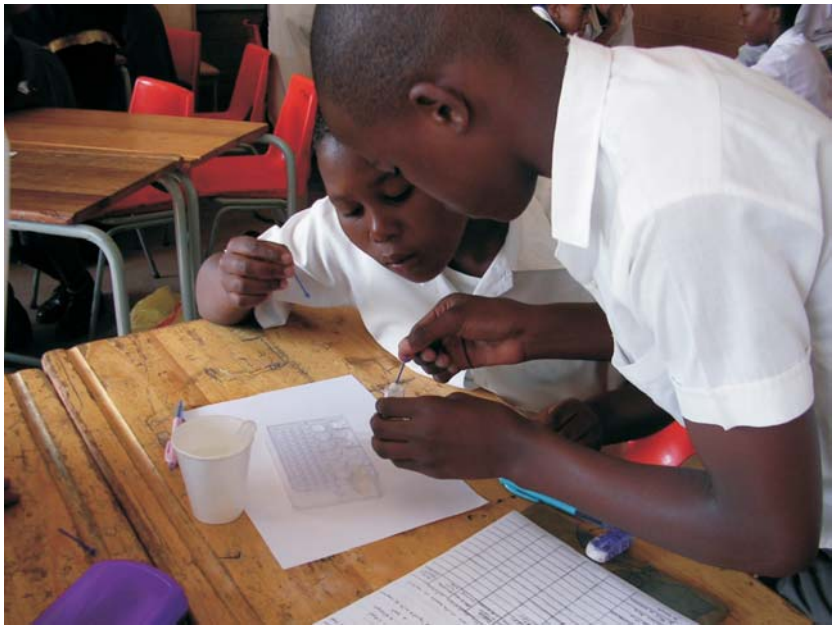
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ADVANCED LEARNING PACKAGES

PRIMARY MICROSCIENCE EXPERIENCES

ENGLISH VERSION
2006



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United Nations Educational, Scientific and Cultural Organization

IN COLLABORATION WITH

The Centre for Research and Development in Mathematics, Science and Technology Education (RADMASTE)
University of the Witwatersrand
Johannesburg, South Africa

The UNESCO-Associated Centre for Microscience Experiments
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ADVANCED LEARNING PACKAGES: PRIMARY MICROSCIENCE EXPERIENCES

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PREFACES

(i) Foreword

All over the world, science educators declare that practical experiences are an essential part of learning science. However, in many countries these experiences are not provided in the majority of their primary and secondary schools. There are several reasons for this: cost, safety, waste disposal and teacher preparation. To help overcome these problems, microchemistry kits and workbooks were designed by the RADMASTE Centre. In cooperation with UNESCO and IUPAC, these have been brought to the attention of secondary school educators in more than 70 countries. This has led to pilot projects and wider implementation in many of these countries.

Another consequence has been the motivation to extend our work into other areas of science, and to other educational levels. The present workbook now introduces the microscience approach to the primary (or elementary) school level.

The primary microscience kits are designed to be easy to use, robust and versatile. They should therefore be useful in all countries, just like the traditional, larger equipment. So students now can do most of the same experiments as students were intended to do before, but more safely and at less cost.

The workbook is a different matter. Each country has its own school curriculum and its own way of delivering that curriculum. Indeed, each teacher is an individual, and in each classroom the story is a little different. This workbook therefore provides a starting point only. The worksheets were originally designed at the RADMASTE Centre, University of the Witwatersrand in South Africa to suit the South African curriculum. Using them, teachers and students in any country should be able to complete successfully a wide range of basic science experiments (biology, chemistry and physics) with the primary microscience kits.

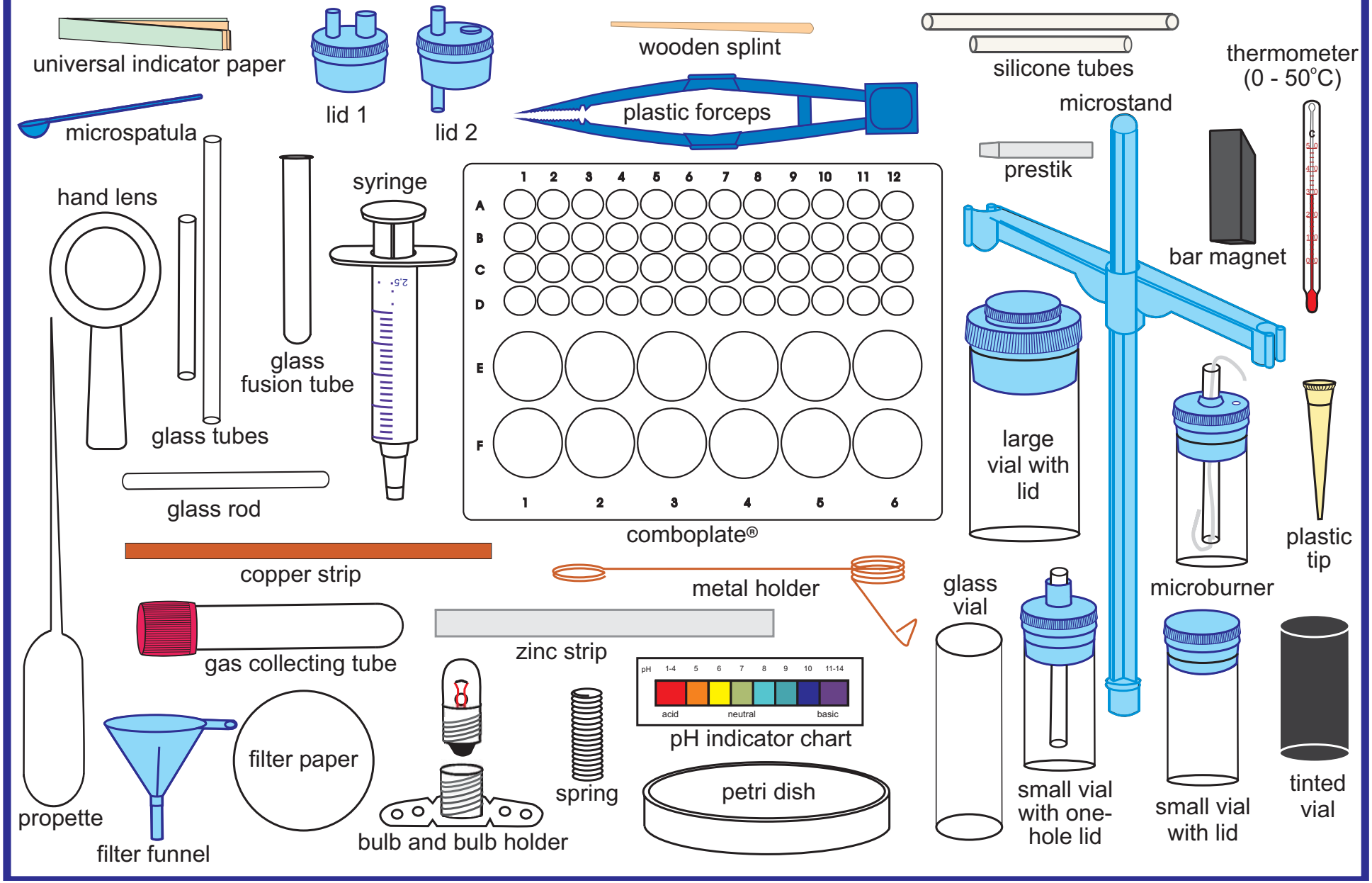
We hope that this experience is enjoyable, and that the teachers will improve and modify the experiments in the light of their experience.

In modern laboratories around the world, science is increasingly done on the small scale. This is because it costs less, is safer and is less damaging to the environment. This workbook can help school science to quickly pick up this trend and make personal experiences accessible to all students. Learning this approach in primary school will ensure that all future citizens have such experiences and lose their fear of science.

Prof J D Bradley
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and UNESCO-Associated Centre
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COMPONENTS OF THE RADMASTE PRIMARY MICROSCIENCE KIT



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Activity 1.1 TRACES OF AIR (I)

Focus question: Does air occupy space?

You will need:

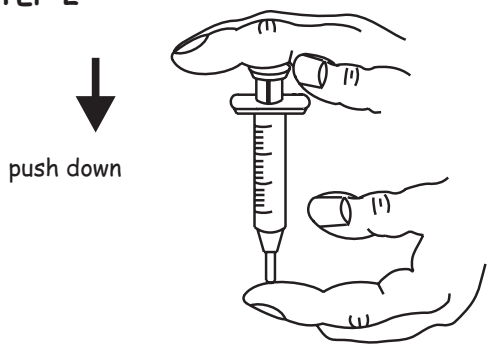
- 1 syringe
- 1 sample vial
- water

STEP 1



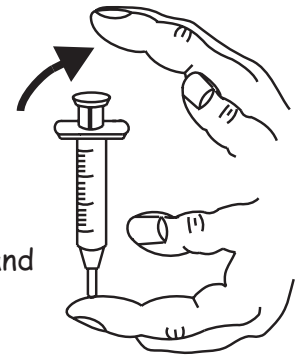
Block the nozzle of the syringe with your finger.

STEP 2



Put the plunger in and press until you cannot press anymore.

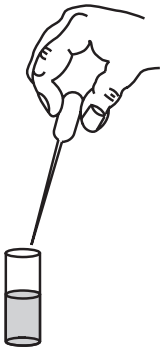
STEP 3



Release the plunger and note what happens.

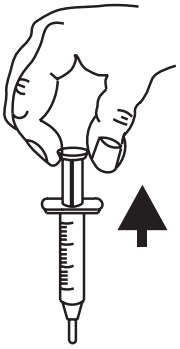
Q1 What is in the syringe?
Q2 Why does the plunger shoot back after being released?
Q3 Can air be compressed or not?

STEP 4



Half fill the sample vial with water.

STEP 5



Pull the plunger halfway out of the syringe.

STEP 6



Insert the syringe into the water in the vial and push the plunger in.

Q4 Why is the water not going into the syringe when you insert it into the water?
Q5 What happens when you push the plunger in?
Q6 What causes the bubbles?
Q7 Does air occupy space? Give reasons for your answer.

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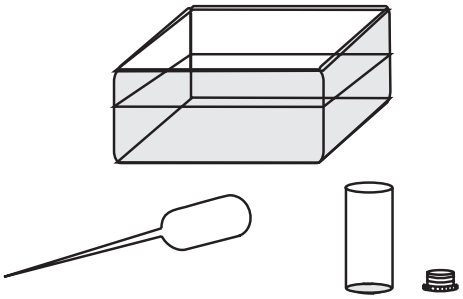
Activity 1.2 TRACES OF AIR (II)

Focus question: Does air occupy space?

You will need:

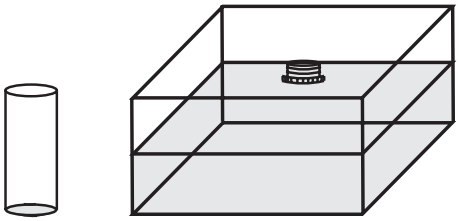
- 1 large sample vial
- lunch box
- 1 propette
- water
- 1 plastic lid (for small sample vial)

STEP 1



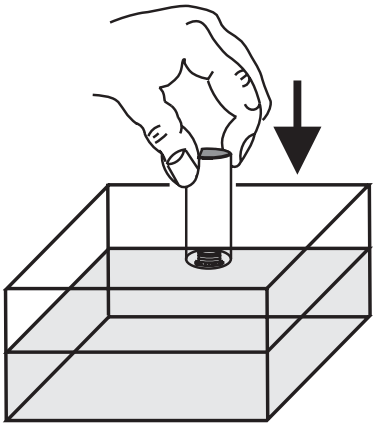
Fill the lunch box to 2/3 with water and let the water settle.

STEP 2



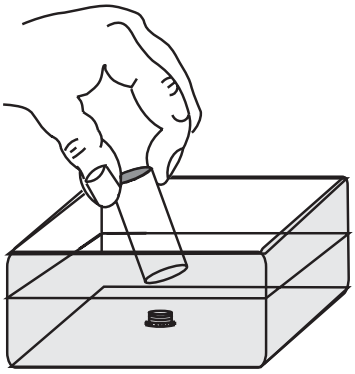
Place the lid in the water on the floor of the lunch box.
Q1 What happens to the lid?

STEP 3



Hold the sample vial upside down and push it over the lid into the water until it touches the floor of the lunch box.
Q2 What happens?
Q3 Why is this happening?

STEP 4

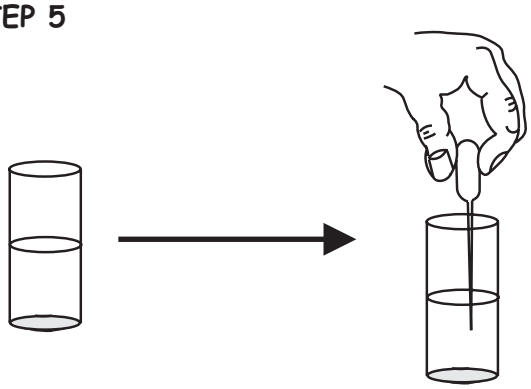


Repeat steps 2 and 3 again and.....

....tilt the vial slightly and note what happens.
Q4 Describe what you see.
Q5 What causes the bubbles?

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STEP 5



Half fill the sample vial with water. Insert the tip of the propette into the water.

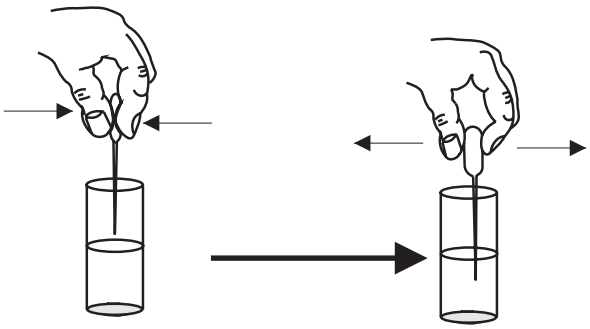
Q6 What happens?

Q7 Is the water entering the propette?

Q8 What is inside the propette?

Take the propette out.

STEP 6



Squeeze the bulb and insert the tip of the propette into the water and then release the bulb.

Q9 What happens?

Q10 Why did the water not enter the propette in step 5?

Q11 Why is the water entering the propette now?

Q12 Does air occupy space?

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Activity 1.3 IS AIR MATTER?

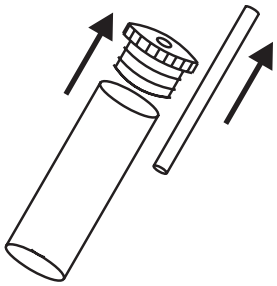
Focus question: Does air occupy space?

You will need:

- 1 comboplate
- 1 small vial with a single hole lid
- 1 propette
- 1 microfunnel
- prestick
- water

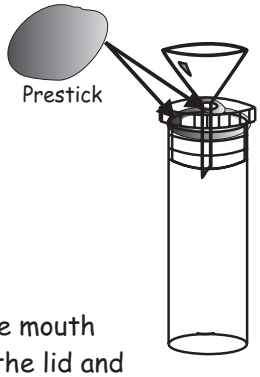
STEP 1





Take the oil dropper vial, open the lid and remove the glass tube from the hole. (**Make sure that the vial is not the microburner**.)

STEP 2



Use prestick to seal the mouth of the vial tightly with the lid and the hole of the lid tightly with the microfunnel.

STEP 3



Use a propette to put water into the funnel.

Q1 What do you observe?
Q2 Why is the water not passing into the vial?

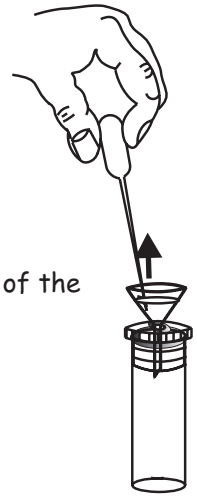
STEP 4



Insert the stem of the propette through the hole of the funnel into the vial.

Q3 What happens?

STEP 5

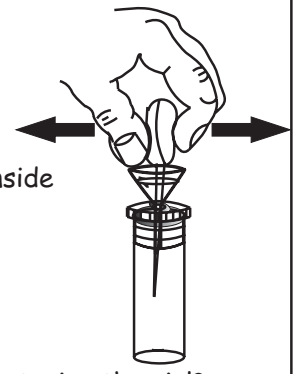


Gently remove the stem of the propette by pulling the propette out.



Squeeze the bulb of the propette and ...

STEP 6



...insert the stem of the squeezed propette through the funnel again. Once the tip of the stem is inside the vial, release the bulb.

Q4 What do you observe?
Q5 Why is this happening?
Q6 Why was the water not entering the vial?
Q7 Does air occupy space? Explain your answer.
Q8 Complete the concept map of air in the next page.

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Activity 1.4 DIRECTION GAME

Focus Question: Instill the sense of direction, numeracy skills and recording skills.

What you need:

- 2 pencils
- rubber
- 2 players

How to play:

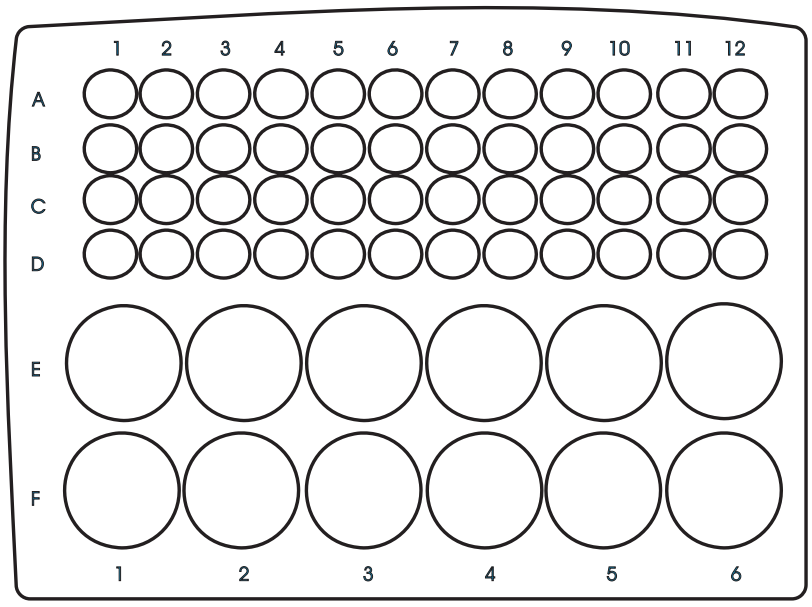
1. One of the players (P1) secretly choose a square on the chart, identify it by the number of the column (X) and the number of the row (Y) that is x,y e.g the choice 3,4 implies that the square is in column 3 and row 4.
2. The choice is recorded (written) under choice below.
3. The other player (P2) picks any square on the game board to start the game.
4. Record (write) the choice of P2 under guess 1 on the table below.
5. P1 should then give P2 a clue of which direction to take, to reach the correct square e.g NW (move in the north west direction).
6. This should be recorded under clue 1 in the table below.
7. There are only 6 chances in each cycle and then the game is over.
8. Each chance has a value and the faster one arrives at the correct square without many clues, the higher the value.
9. The winner is determined after each player had 4 chances to play and therefore has 4 values.
10. The winner is the one with the highest score when the 4 values are added together.

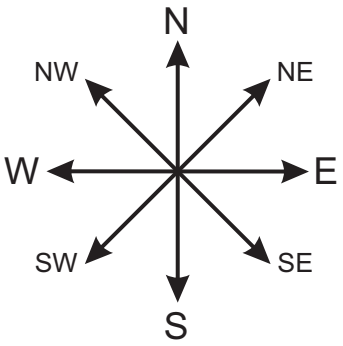
Choice _____

Table (a)

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Activity 1.4: Direction Game (continued)





Table(b): Value of Each Chance Required to Reach the Correct Position

Chance	1	2	3	4	5	6	7	8
Value	7	6	5	4	3	2	1	0

Choice: _____

Table (c):

Chance	Clue	Guess (well)	Value
0	start		8
1			
2			
3			
4			
5			
6			
7			
8			
		TOTAL	

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Activity 1.5 USING A SHADOW TO DETERMINE MAIN DIRECTIONS

Focus question: In which direction does the sun rise and set?

You will need:

- 1 comboplate
- 1 ruler
- 1 microstand
- soft or sandy soil
- A sunny place

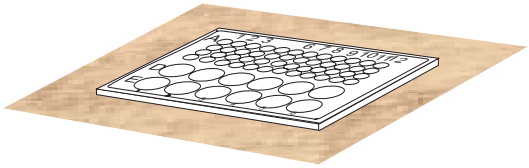
STEP 1

Together with your teacher and your team mates, find a sunny place with soft or sandy ground outside your classroom.

STEP 2

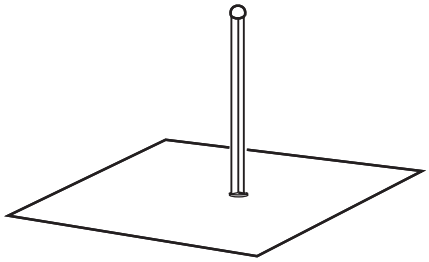
Find a spot at least 1 metre away from your friends' spots

STEP 3



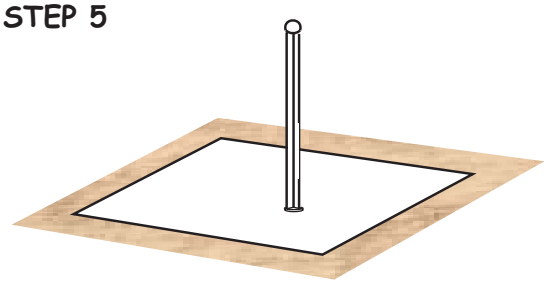
Embed your comboplate firmly in the soil on your spot.

STEP 4



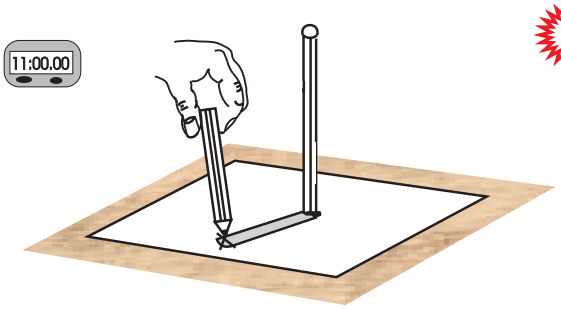
Fit the base of your microstand stem into the centre of a blank page.

STEP 5



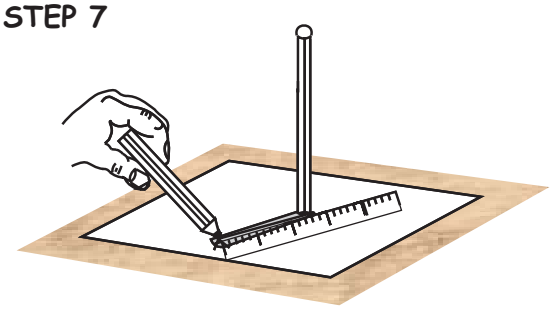
Insert the stem together with blank page in well D6 of the comboplate so that the page covers the comboplate.

STEP 6



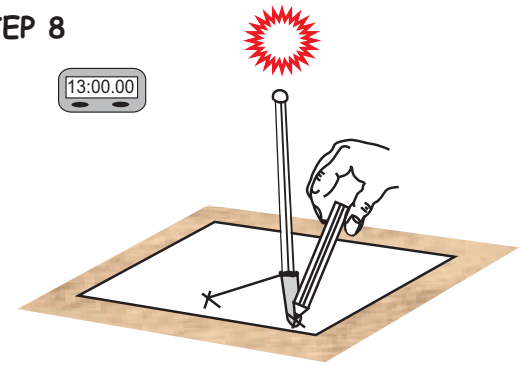
At 11h 00 mark off the shadow of the stem.

STEP 7



Use a ruler and a marker to draw a line along the shadow on the page.

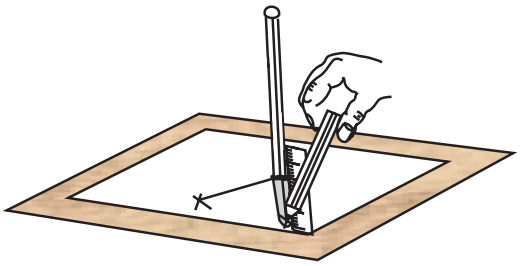
STEP 8



At 13h00 repeat step 6.

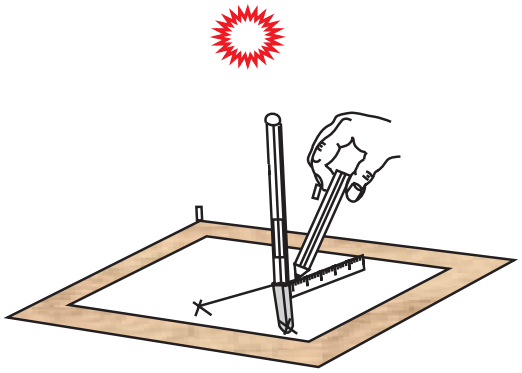
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STEP 9



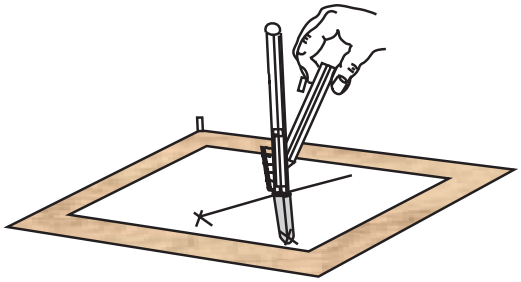
Draw a line along the shadow on the page using a ruler.

STEP 10



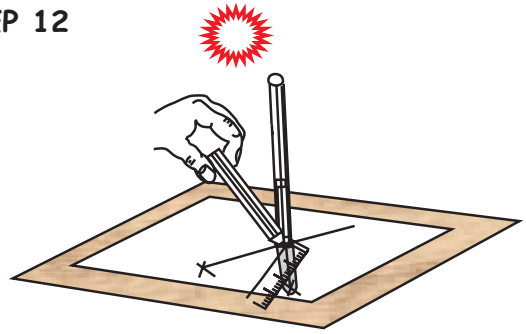
Extend the first shadow line backwards.

STEP 11



Extend the second shadow line backwards.

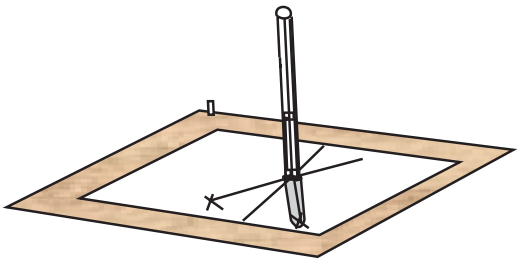
STEP 12



Draw a line exactly in between the shadow lines. This line will point south. Extend the line backwards to find north.

Q1 How can you find east and west?

STEP 13



Draw a line in your plot pointing in the east-west direction.

STEP 14

Compare your main directions with those of your mates.

Q2 In which direction is your favourite friend's plot from yours?

Q3 Whose plots are to the north and which are to the east of your plot?

Q4 In which direction is your classroom in relation to your plot?

Q5 Name two things which are to the south-west of your plot.

Q6 In which direction is your home?

Q7 In which direction does the sun rise and set?

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Activity 1.6 MAKING A WIND VANE

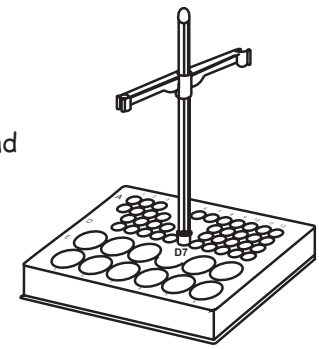
Focus question: How can we find out in which direction the wind is blowing?

You will need:

- 1 comboplate
- 1 compass
- 1 straw
- 1 pair of scissors
- 1 thin card
- 2 x microstands
- 1 propette
- 1 drawing pin
- glue
- prestik

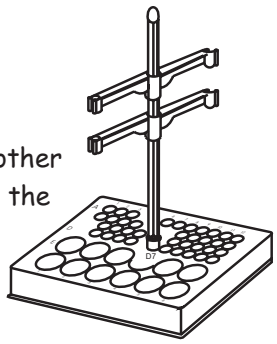
STEP 1

Insert a microstand into well D7.

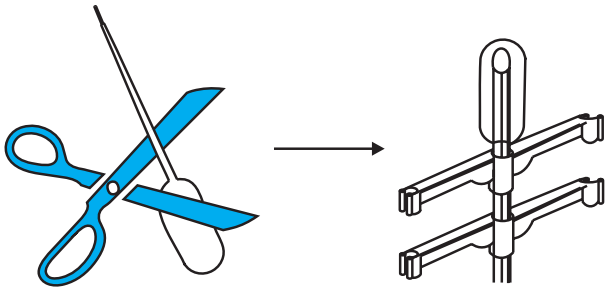


STEP 2

Remove a side arm from another microstand and attach it to the microstand in D7.

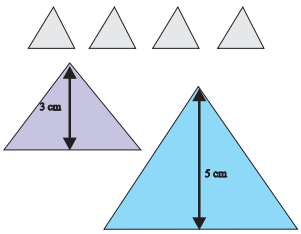


STEP 3



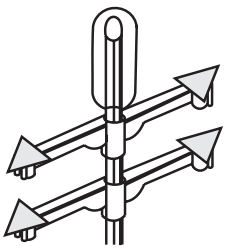
Cut off the stem of the propette at the base of the propette bulb. The hole should be large enough to be able to fit the bulb over the microstand stem.

STEP 4



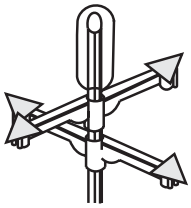
Cut four small triangles out of the card. Then cut out a triangle about 3 cm in height and a bigger one, about 5 cm in height.

STEP 5



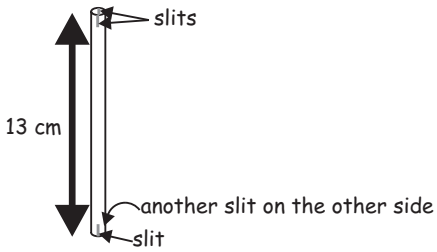
Attach the four small triangles to the upper side of the ends of the two side arms with prestik.

STEP 6



Rotate the arms so that they form a cross with the four triangles pointing in four different directions.

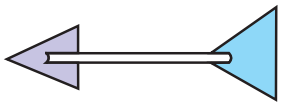
STEP 7



Cut off a 13 cm piece of straw and make a slit on both sides of each end of the straw.

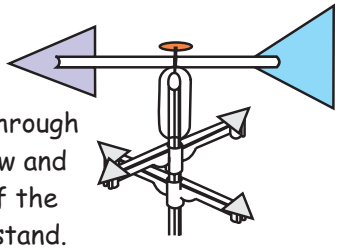
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STEP 8



Slot the two big triangles into the slits pointing in the same direction.

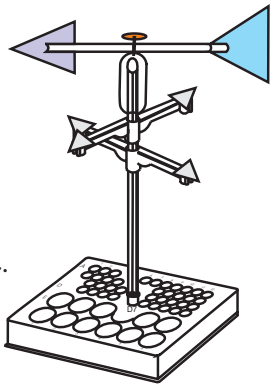
STEP 9



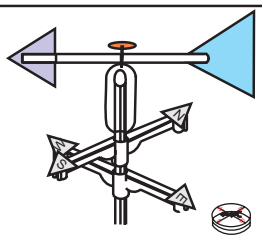
Push the drawing pin through the centre of the straw and then into the centre of the propette on the microstand.

STEP 10

Stand the wind vane outside on a flat surface.



STEP 11



Use a compass to position the microstand so that one of the triangles points north and mark it N (north). Mark the opposite arrow S (south), and the other two E (east) and W (west).

STEP 12

Record the wind direction daily for a week at 9:00 and at 12:00.

STEP 13

Record your findings in the table provided.

Table 4.5

Day	Time	Short description of the day e.g sunny and warm	Wind direction
1			
2			
3			
4			
5			
6			

Q1 What was the wind direction on day 3 at 9:00?

Q2 What do you conclude from your observations?

Q3 Name things which are in the north direction from your classroom.

Q4 Where does the sun rise?

Q5 Where does the sun set?

Q6 In which direction is the play ground from your classroom?

Q7 In which part (N,S,E & W) of town (village) is your school?

Q8 What conclusions can you make from the wind observations in your table?

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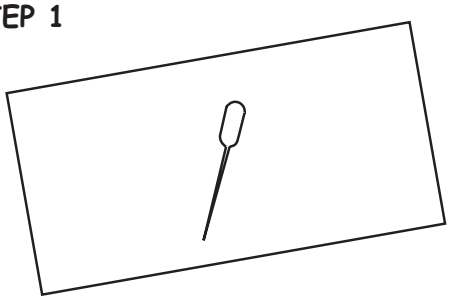
Activity 1.7 AIR CAN DO WORK

Focus question: Can air move things?

You will need:

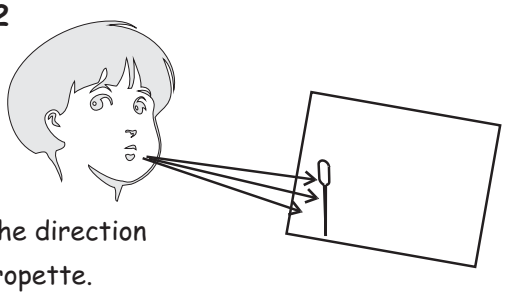
- 1 comboplate
- 1 microstand
- 1 propette
- prestik

STEP 1



Place a propette on your table.

STEP 2

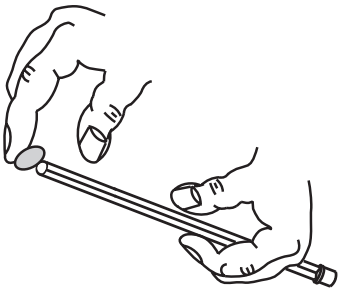


Blow in the direction of the propette.

Q1 What happens?

Q2 What can happen to the propette if it is exposed to wind blowing in the south direction?

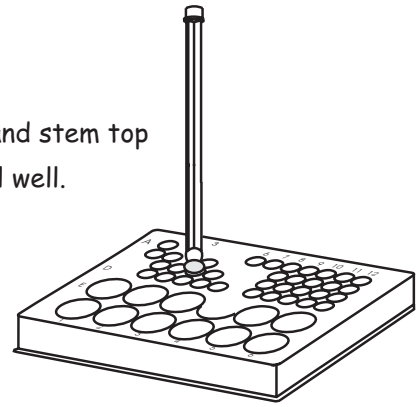
STEP 3



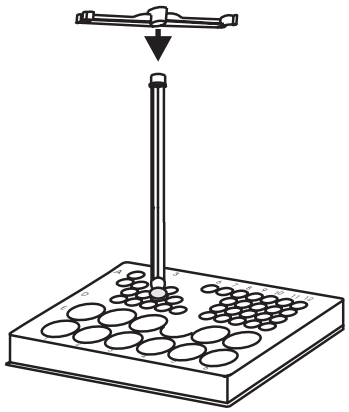
Put a piece of prestik on the top end of microstand stem.

STEP 4

Put the microstand stem top down into a small well.

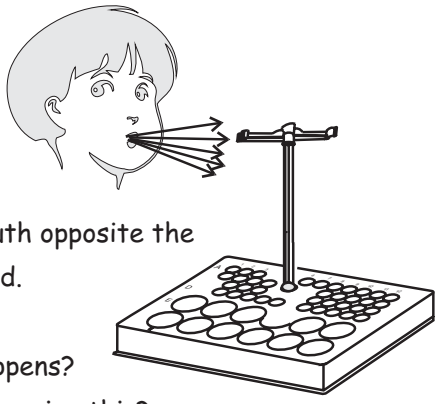


STEP 5



Insert the arm of the microstand upside down onto the end of the stem.

STEP 6



Position your mouth opposite the arm and blow hard.

Q3 What happens?

Q4 What is causing this?

Q5 What would happen if you were to place this system outside during a windy day?

Q6 Can air move things?

Q7 Is your guess in Q5 correct or not?

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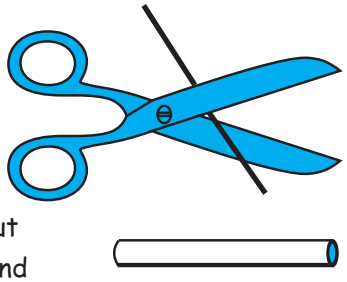
Activity 1.8 THE AIR PUMP ON MY COMBOPLATE

Focus question: How does the bicycle pump work?

You will need:

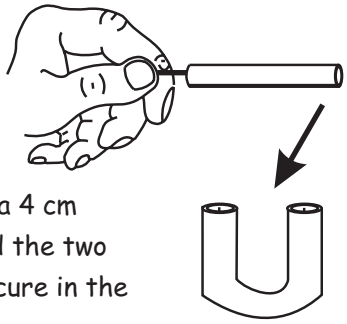
- 1 comboplate
- 1 syringe
- 1 silicone tube (4 cm)
- 1 lid 2
- 1 propette
- 1 paper clip
- 1 pair of scissors

STEP 1



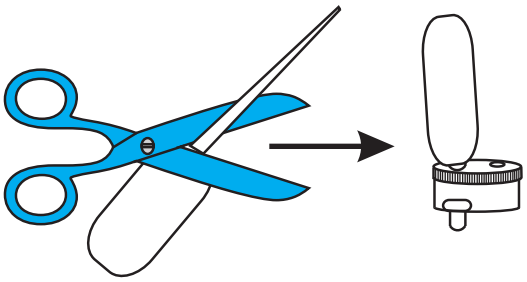
Straighten out a paper clip and cut off a 3.5 cm piece.

STEP 2



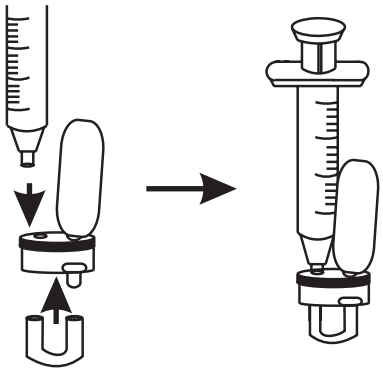
Insert the piece into a 4 cm silicone tube and bend the two so that the wire is secure in the tube.

STEP 3



Cut off the stem of a propette and insert the bulb tightly into the protruding hole of lid 2.

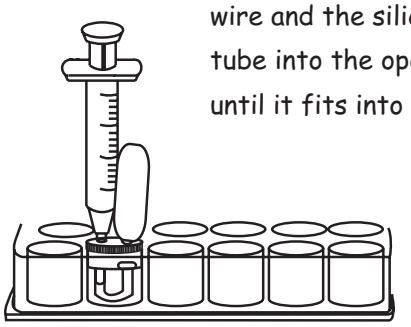
STEP 4



Insert the syringe into the other hole of the lid. Close the openings of the underside of the lid with the silicone tube.

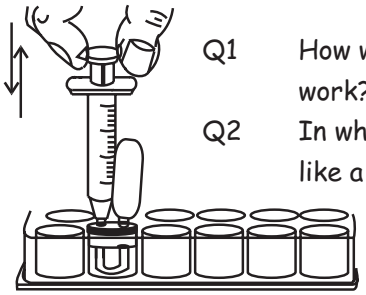
STEP 5

Fit the lid into one of the large wells. If the lid does not fit in the well, push the wire and the silicone tube into the opening until it fits into the well.



STEP 6

Use the syringe as a pump and see what happens.



Q1 How well does the pump work?

Q2 In what ways does it work like a bicycle pump?

Q3 Why does the bulb deflate when you pull the plunger out?

Q4 How does it differ from a bicycle pump?

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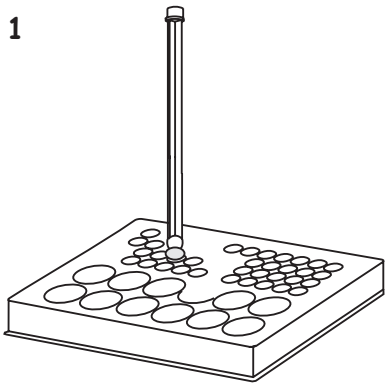
Activity 1.9 WHAT IS MOVING THE PROPETTE ON MY PETRI DISH?

Focus question: Can water move things?

You will need:

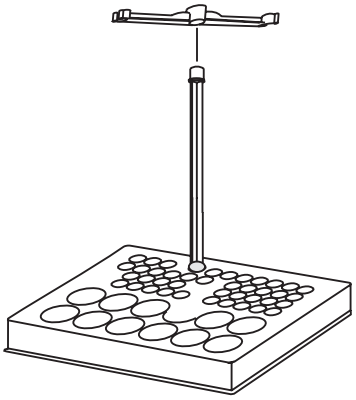
- 1 comboplate
- 1 Petri dish
- 1 micro stand
- prestik
- 1 propette
- water

STEP 1



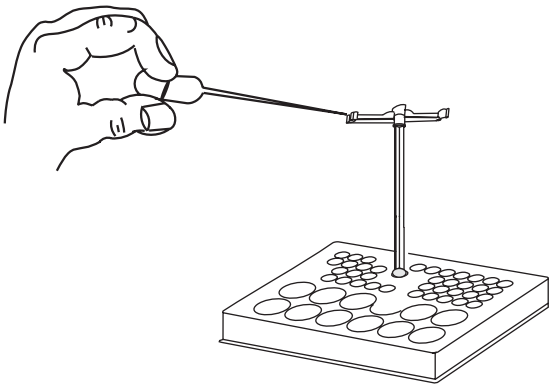
Put a piece of prestik on the top end of a microstand and put the stem into a small well of the comboplate.

STEP 2



Insert the arm of the microstand upside down onto the end of the stem.

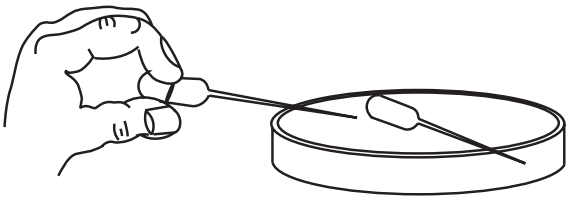
STEP 3



Fill a propette with water and jet the water at the arm of the microstand.

Q1 What happens?
Q2 What is causing this?
Q3 Is there work done in this instance?

STEP 4



Place one propette in the centre of a Petri dish and spray its side with water from another propette.

Q4 What happens to the propette?
Q5 What is actually moving the propette?
Q6 What is moving the water in the Petri dish? Can water do work?

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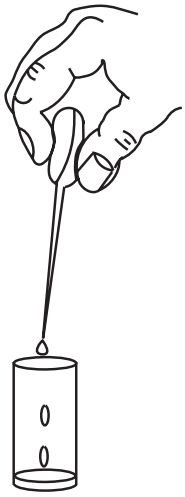
Activity 1.10 HOW FAST IS THE WATER MOVING UP?

Focus question: Where and how do the leaves of a very high tree get water?

You will need

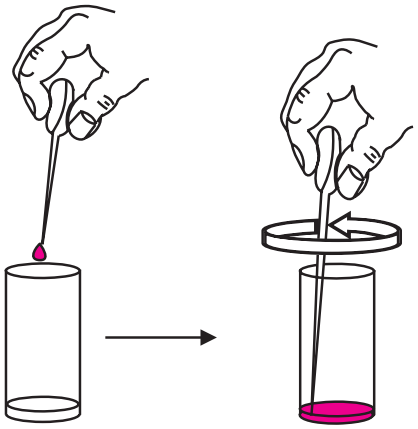
- 1 sample vial
- 1 propette
- filter paper
- food colouring
- 1 pair of scissors
- 1 ruler
- 1 stop watch
- water

STEP 1



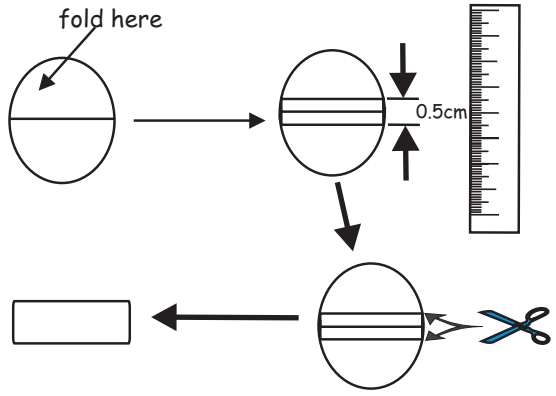
Use a propette to put 12 drops of water into the vial.

STEP 2



Add three drops of food colouring and stir the mixture with the tip of a propette.

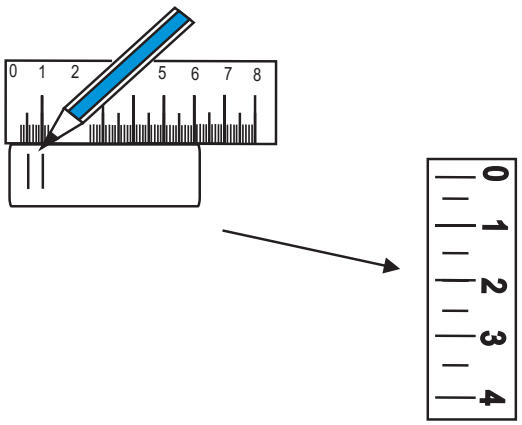
STEP 3



Fold the filter paper in half and open up.

Draw two lines 0.5cm apart in the middle of the filter paper and make a strip by cutting along the lines you have drawn.

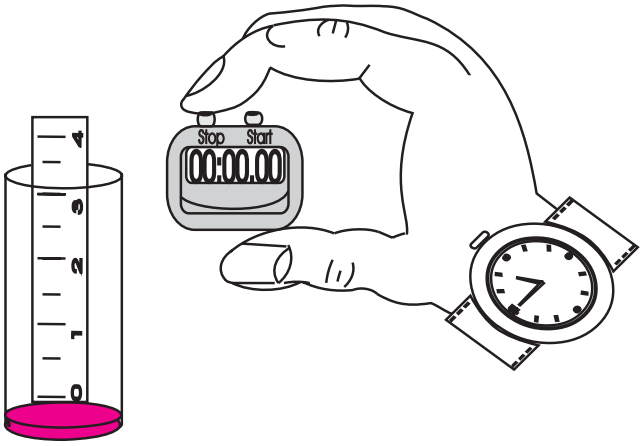
STEP 4



On this strip mark 0.5 cm; 1 cm; 1.5 cm; 2 cm; 2.5 cm; 3 cm; 3.5 cm; 4 cm using a ruler.

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STEP 5



Put the paper strip in the vial with the coloured mixture and start the stop watch immediately. Observe and record the time it takes the solution to reach 1cm; 2cm; 3cm; 4cm and the top, on the table below.

Table 1

Height in cm	Time in seconds
1	
2	
3	
4	
top	

Answer the following questions:

Q1 What happened in step 5?

Q2 How long did it take the water to reach a height of 2 cm?

Q3 What was the height of the water in 30 seconds' time?

Q4 How long did it take the water to reach the top of the paper?

Q5 Where do the leaves of a very tall tree get water?

Q6 How do these leaves get the water?

Q7 Why is the water able to reach the top of the paper?

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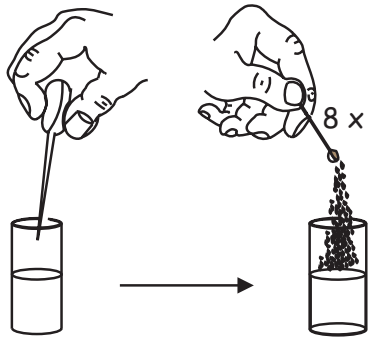
Activity 1.11 MUDDY,MUDDY WATER: CAN WE MAKE IT SAFE TO DRINK?

Focus question: How is the water purified and which household cleaner can be used to kill germs in water?

You will need:

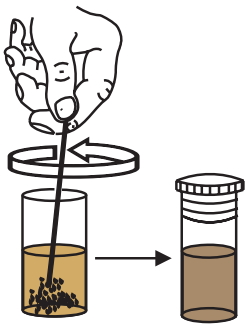
- 2 vials with lids
- 1 microspatula
- 1 propette
- 1 microfunnel
- filter paper
- chlorine water
- soil
- water

STEP 1



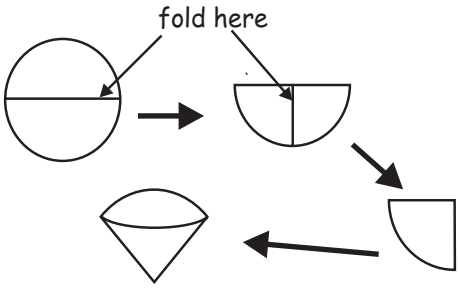
Make a mixture of soil and water by half filling the vial with water and then adding 8 microspatulas of soil to it.

STEP 2



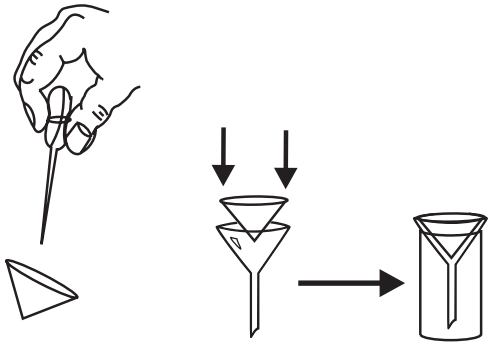
Mix with the end of the microspatula and close the vial with a lid.

STEP 3



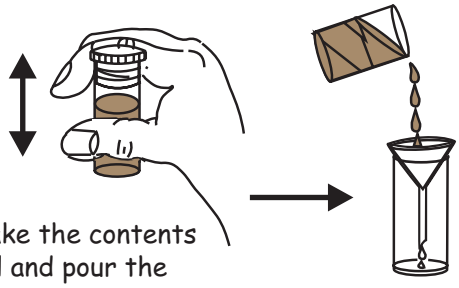
Follow the steps shown to fold the filter paper properly.

STEP 4



Wet the filter paper with a few drops of water and fit it into the microfunnel.

STEP 5

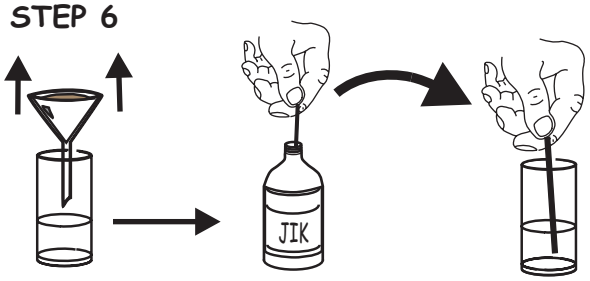


First shake the contents in the vial and pour the muddy water carefully into the microfunnel.

Q1 What does the water look like which drips through?

Q2 Do you think the water is pure enough for drinking?

STEP 6



Remove the funnel when all the water has dripped through. Dip a tip of a microspatula into chlorine water. Then dip the tip into the water in the vial.

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Q3 Which substance is used to purify water in swimming pools?

Q4 What do you think Jik is used for in this activity?

Q5 What does 'to purify' mean?

Q6 What is the method of separation used in this activity?

Extension questions:

Q7 Where does the water we drink come from?

Q8 What happens to the water in our sewerage system? Is it disposed of in some place or is it cleaned and reused again?

Q9 How is the water purified and which household substance can be used to kill germs in water?

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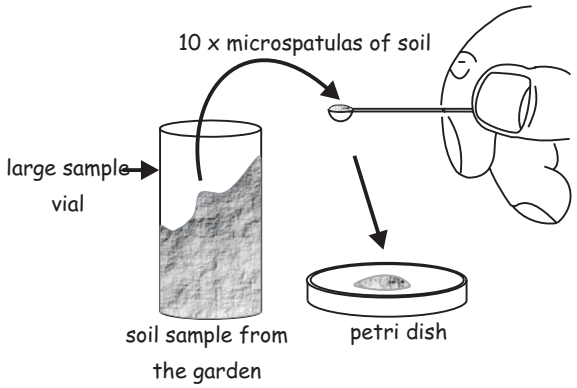
Activity 1.12 WHAT FORMS SOIL ?

Focus Question: What does soil contain?

You will need:

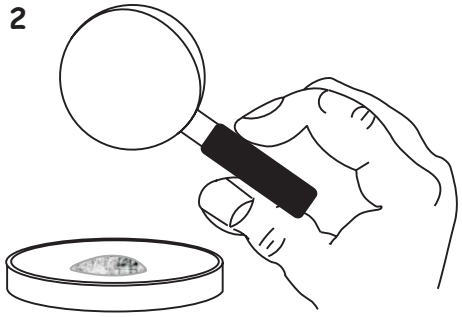
- comboplate
- microburner
- microspatula
- petri dish
- large and small sample vials
- glass fusion tube
- metal tube holder
- magnifying glass
- soil sample

STEP 1



Use a large sample vial to collect a soil sample from the garden.
Put 10 microspatulas full of soil in the petri dish.

STEP 2



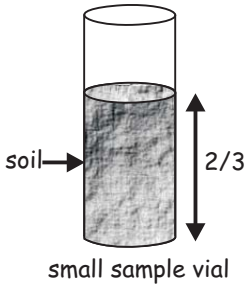
Use the magnifying glass to study the soil sample.

Q1 What do you see?

Q2 Are there living things in the soil. Explain.

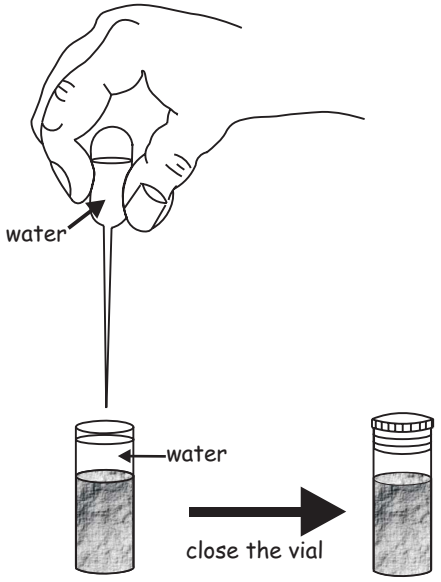
Q3 Make drawings of all the things you see and label them.

STEP 3



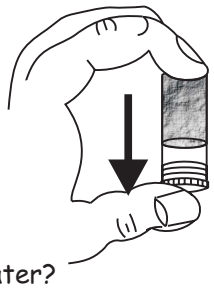
Fill two thirds of the small sample vial (which has a lid) with the soil.

STEP 4



Add water to just about fill the vial and close the vial with the lid.

STEP 5



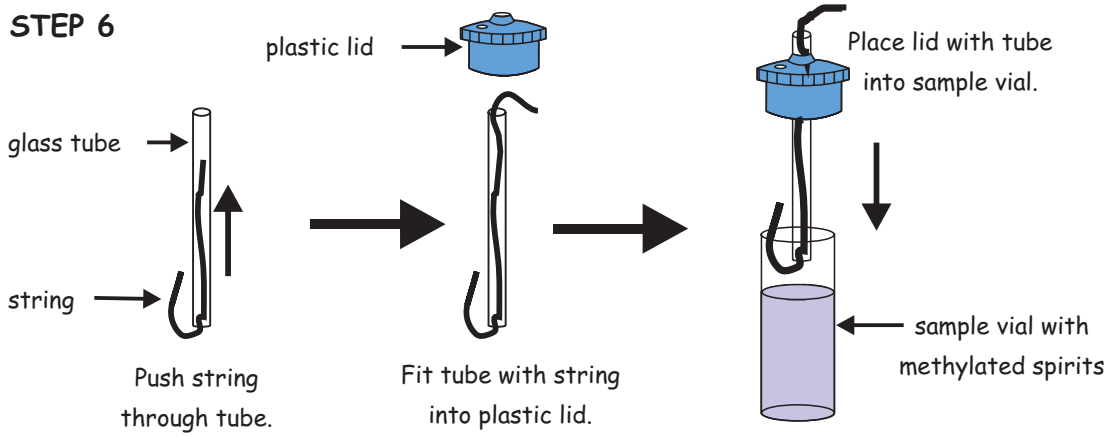
Tilt the vial gently upside down while observing.

Q4 What happens when the soil mixes with water?

Q5 What do you know when you see bubbles in the water?

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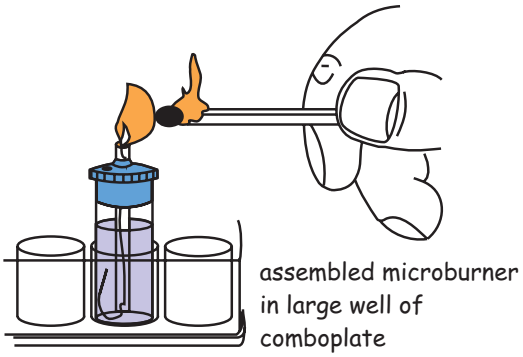
STEP 6



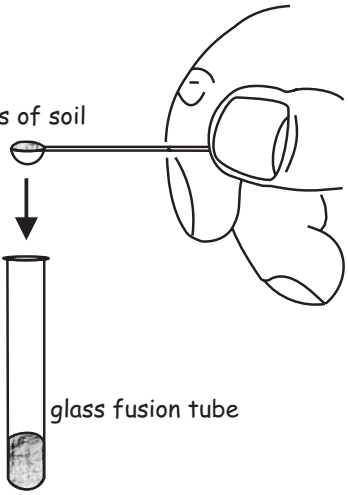
Assemble the microburner and add methylated spirits.

STEP 7

Put the microburner in one of the large wells of the comboplate and light it.



STEP 8



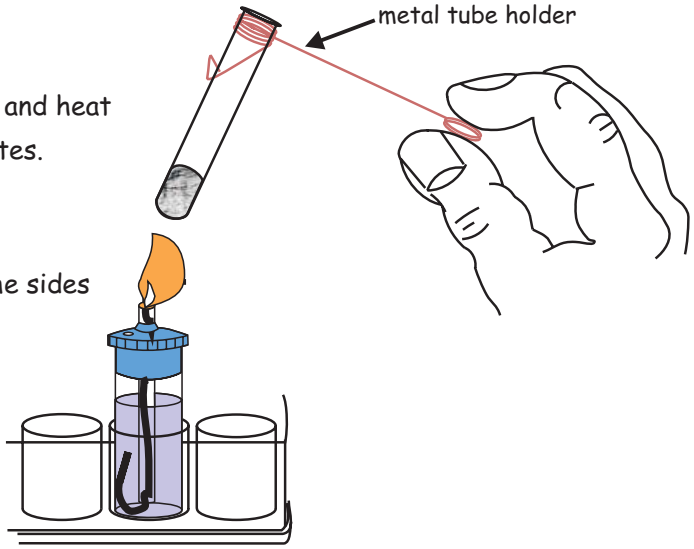
Put 10 microspatulas of soil into the fusion tube.

STEP 9

Hold the tube with a metal tube holder and heat the tube with the flame for a few minutes. Observe what happens.

Q6 What do you see accumulating on the sides of the tube?

Q7 What does soil contain?



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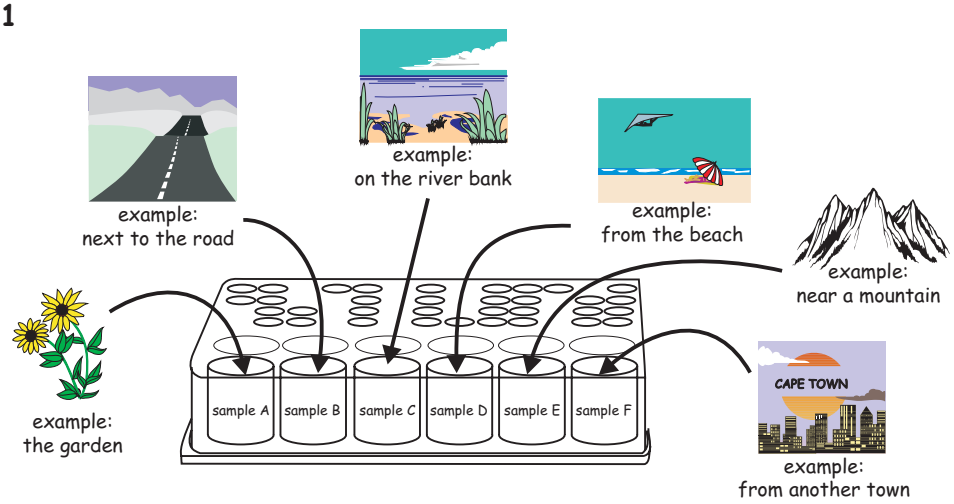
Activity 1.13 IS SOIL THE SAME EVERYWHERE?

Focus Question: What are the main types of soil?

You will need:

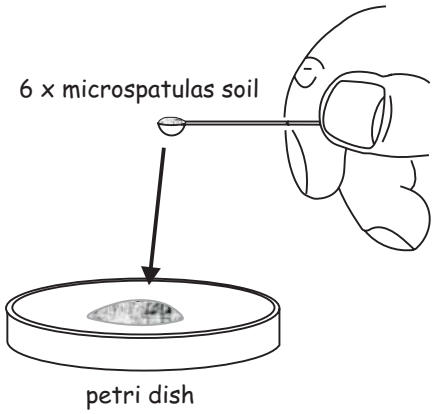
- comboplate
- microspatula
- petri dish
- magnifying glass
- different types of soil samples

STEP 1



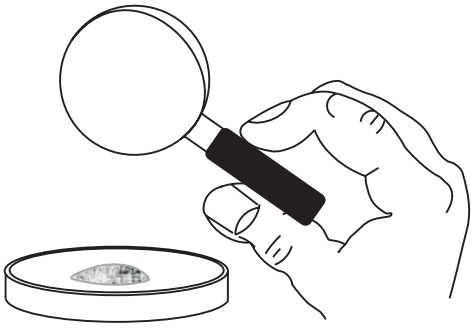
Collect as many different types of soil samples as possible (from the garden, next to the road, on the river bank, from the beach, near a mountain, from another town). Put each sample into one of the large wells of the comboplate.

STEP 2



Use a microspatula to put 6 scoops of one soil sample into the petri dish.

STEP 3



Use the magnifying glass to study the soil sample. Write a description of what you see in a table like the one on the next page.

STEP 4

Put the soil back in the well and repeat steps 2 and 3 with all other soil samples.

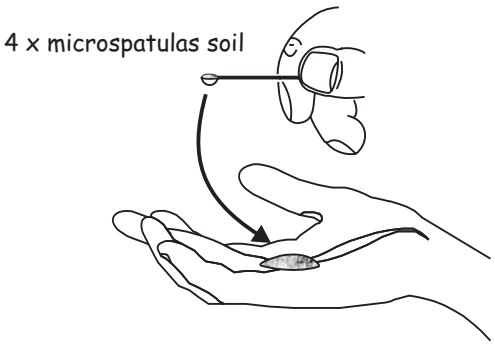
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Sample	Soil Description	Good/Bad Garden Soil
A		
B		
C		
D		
E		
F		

Q1 Which soil sample do you think is a very good garden soil? State your reasons.

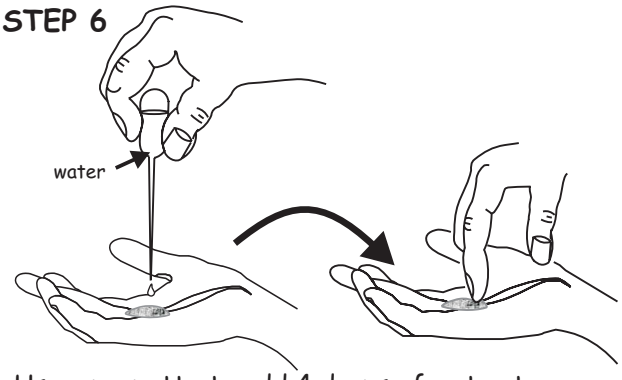
Q2 What other things did you see in your soil samples?

STEP 5



Use a microspatula to put 4 scoops of one soil sample on the palm of your hand.

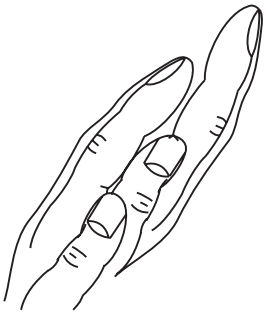
STEP 6



Use a propette to add 4 drops of water to your soil. Rub the mixture with one finger to make mud.

Q3 How does the mud feel on your hand?

STEP 7



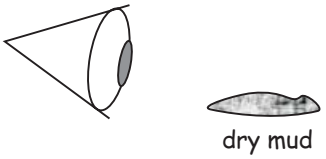
Squeeze out as much water as you can and try to roll the mud between the palms of your hands.

Q4 Note what happens.

STEP 8

Repeat steps 5 to 7 with the rest of the soil samples.

STEP 9



Leave the mud of each soil sample overnight to dry. Observe and describe the mud.

Q5 Use the soil type chart to classify the soil samples. Which soil samples have some features of each type?

Q6 From the chart, none of the three types of soil provides good mineral flow for plants. Explain why each type fails.

Q7 What if the soil is a combination of these three types of soil? Do you think it can provide good mineral flow? Give reasons.

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Activity 1.14 IS IT A CLAYEY OR A SANDY SOIL?

Focus Question: Which soil has a greater water retention?

You will need:

- comboplate
- 2 microstands
- stop watch
- piece of cotton wool
- 2 small vials
- 2 propettes
- 2 funnels
- 2 soil samples (A & B)
- marking pen (permanent marker)
- water

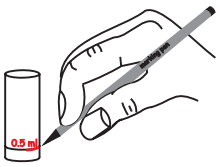
STEP 1 Put a scale on two of the small sample vials. To do this:



a) draw 0.5 ml of water into a syringe.



b) push the plunger in to put all the water into a small vial.



c) use a marking pen to mark the level of the water in the vial and label the water level 0.5 ml.

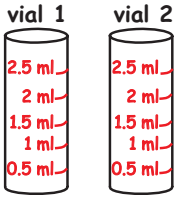


d) Repeat a) to c) and label the next water level 1 ml.



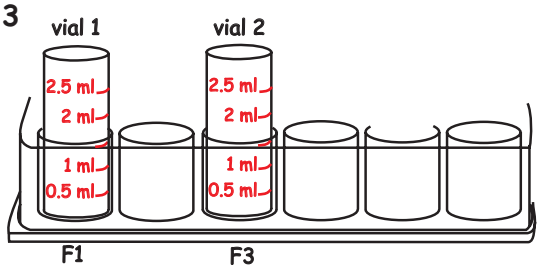
e) Repeat this another three times and therefore mark 1.5 ml, 2ml and 2.5 ml.

STEP 2



Repeat steps 1 a) to e) using the second vial. Empty the water from each vial.

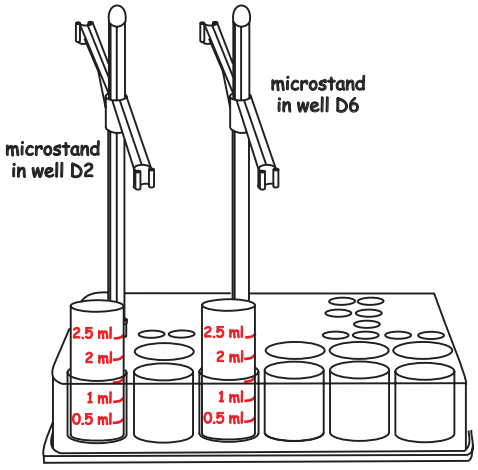
STEP 3



Place one of the vials into well F1 and the other in well F3.

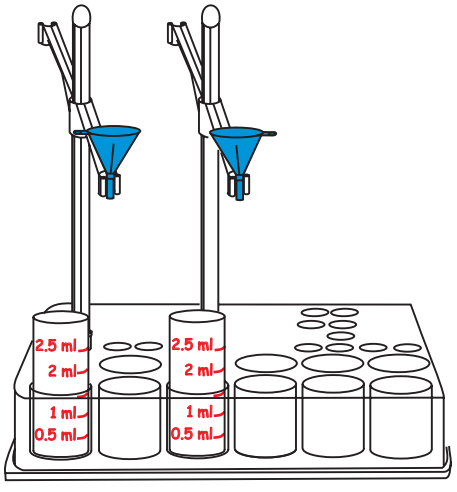
STEP 4

Insert one microstand into well D2 and the other into well D6.



STEP 5

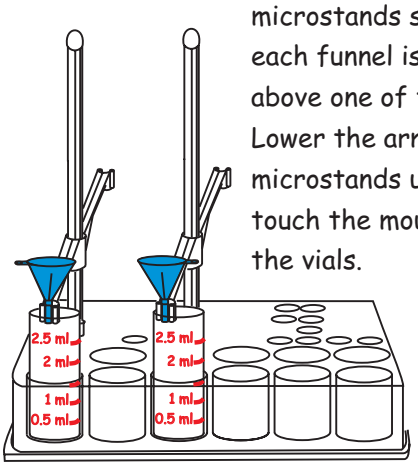
Clamp one funnel to one side arm of each microstand.



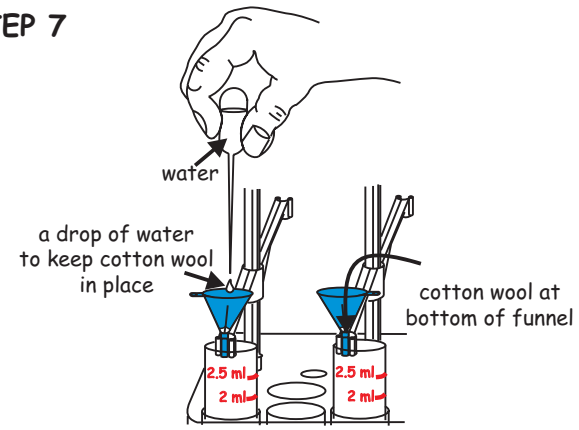
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STEP 6

Move the arm of the microstands such that each funnel is directly above one of the vials. Lower the arms of the microstands until they touch the mouths of the vials.

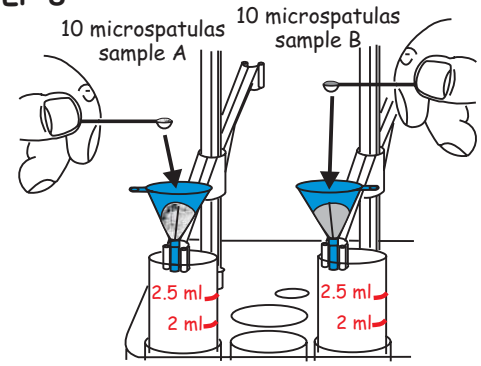


STEP 7



Put thin equal,very small pieces of cotton wool at the bottom of each funnel and add a drop of water with a propette to keep them intact.

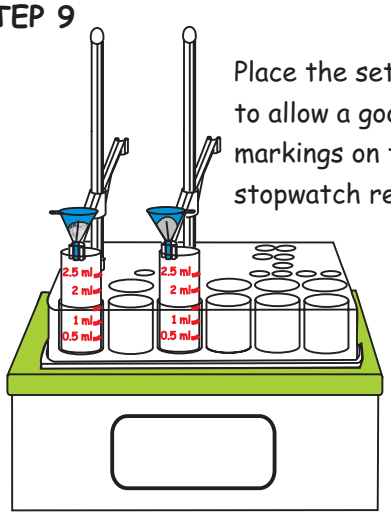
STEP 8



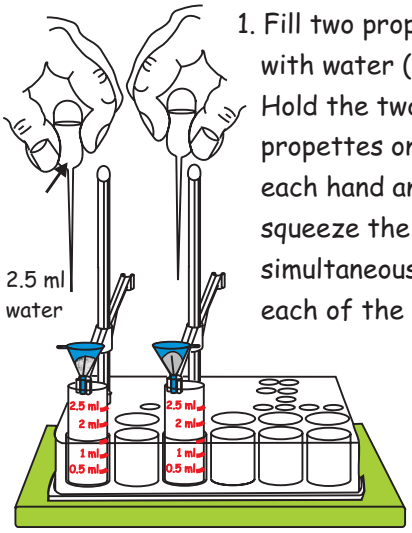
Add 10 microspatulas full of soil sample A into one funnel and 10 microspatulas of soil sample B into the other funnel.

STEP 9

Place the set-up on a lunch box to allow a good view of the markings on the vials. Get the stopwatch ready.



STEP 10



1. Fill two propettes with water (2.5 ml). Hold the two propettes one in each hand and squeeze the water simultaneously into each of the funnels.

2. Now start the stop watch immediately and note what happens against time.

STEP 11

Observe and record the time it takes for 0.5 ml, 1.0 ml, 1.5 ml and 2.0 ml of water to drip through in each case. Record your findings in a table like the one below:

volume (ml) of water dripping	time (sec) taken for sample A	time (sec) taken for sample B
0.5		
1.0		
1.5		
2.0		

Q1 Explain your results.

Q2 Which sample is a clayey and which is a sandy soil? Give reasons for your answer.

Q3 How long did it take for 2 ml of water to drip through in each case?

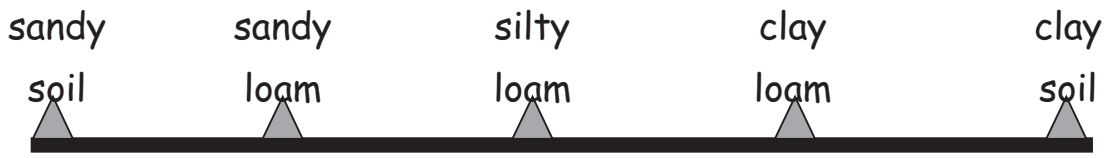
Q4 Draw a volume versus time graph for each sample to represent your findings.

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Activity 1.15 WHAT TYPE OF SOIL DO YOU HAVE?

You have identified the main inorganic parts of soil which are coarse sand, fine sand (silt) and clay. The amounts of sand, silt and clay in soil determine which type of soil it is.

The scale below shows a range of soils. At the one end the soil is sandy and at the other end it is clay. A mixture of sand, silt and clay gives us a loamy soil. Again the loamy soil can be different depending on the mix of the soil particles. A loamy soil is the best soil for plants to grow in.

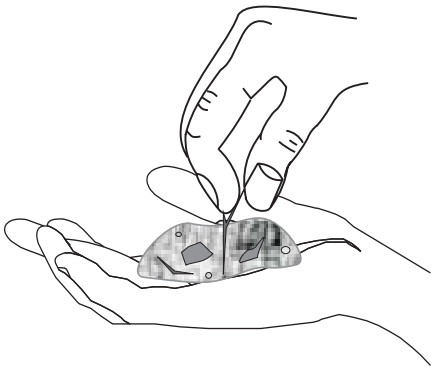


You will need:

- a sample of soil
- water

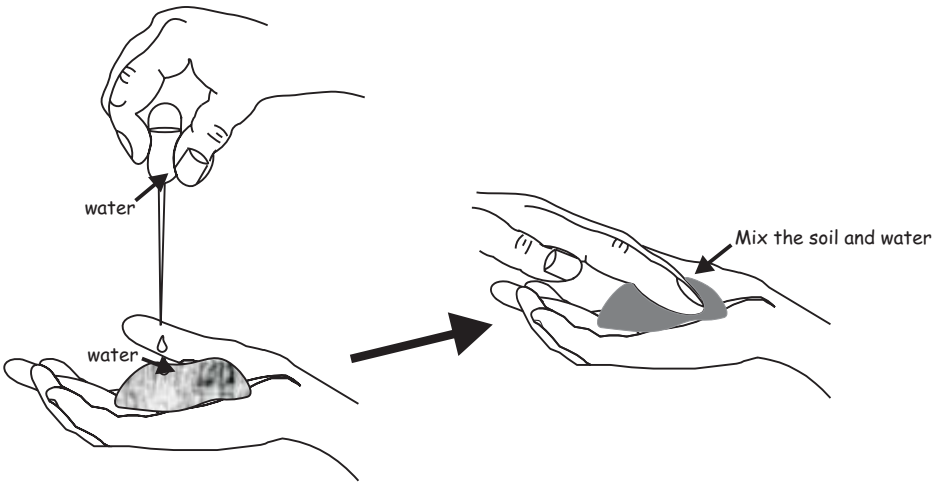
One person will work with the soil and the other person will use the identification key.

STEP 1



Take a handful of soil. Remove all the big stones and bits of sticks etc.

STEP 2



Keep the soil in your hand and add some water. Mix the soil and water well. If your mixture is too runny add a little more soil.

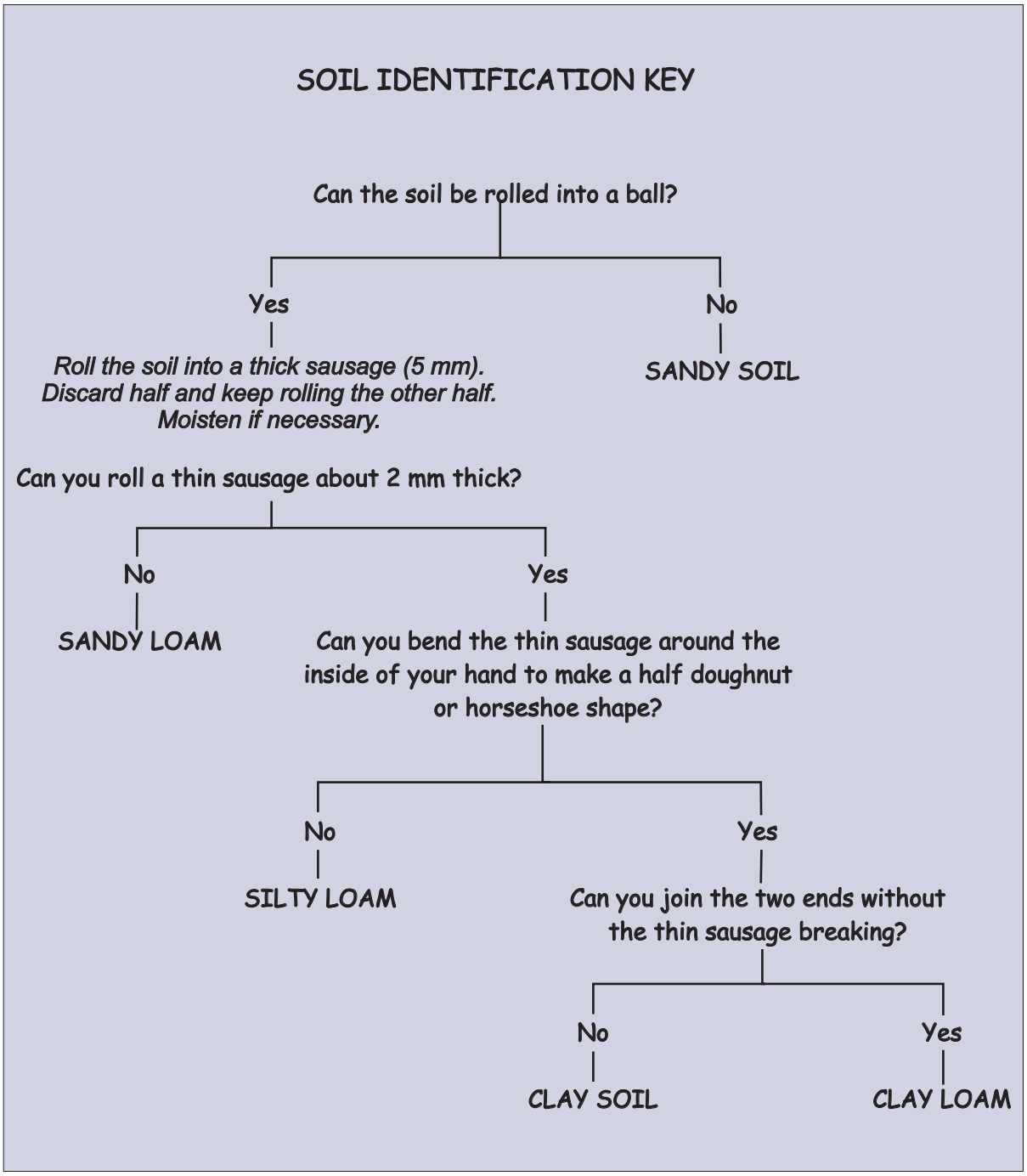
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STEP 3

Use the key below to identify the type of soil in your hand.

STEP 4

When you have identified your soil, discuss with other groups in your class how many have the same type of soil as you. If any groups have different soil samples, how do they differ?



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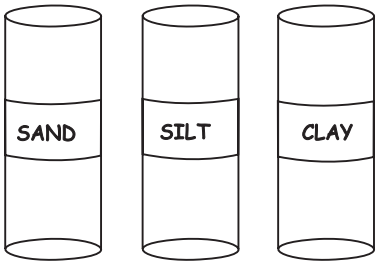
Activity 1.16 STUDYING SOIL TYPES

Focus Question: How different are the soil types?

You will need:

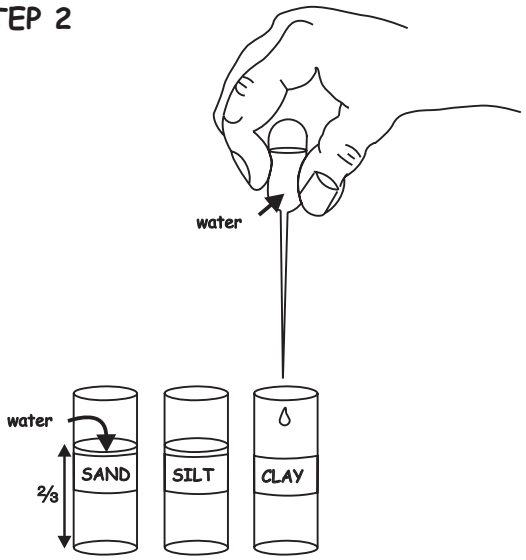
- 3 large sample vials
- sandy soil
- propettes
- clayey soil
- dish washing liquid
- silty soil

STEP 1



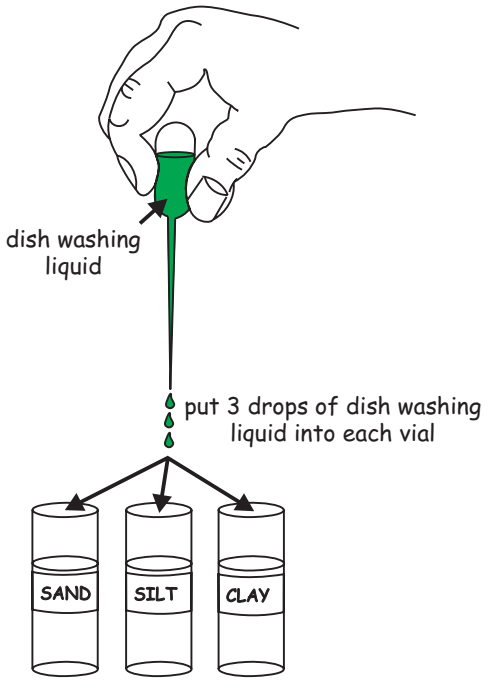
Label one vial sand, the second silt and the other clay using small pieces of labels.

STEP 2



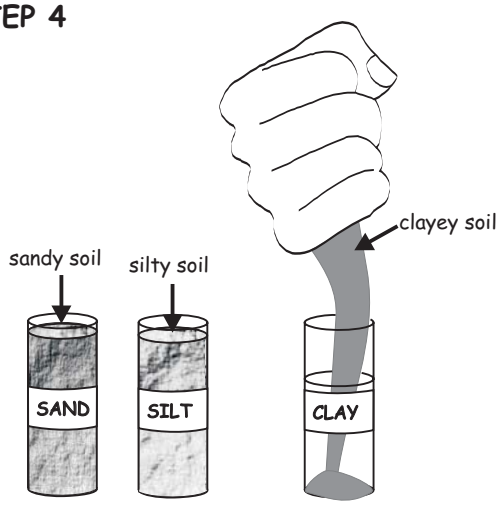
Use a propette to fill the three large vials equally to two thirds with water.

STEP 3



Add three drops of dish washing liquid into the water in each vial using a propette.

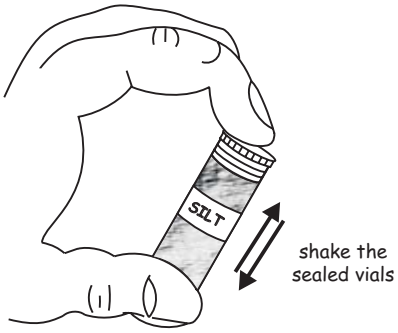
STEP 4



Add sandy soil to the soap mixture in the vial labeled sand to just about fill the vial. Repeat for clayey and silty soils respectively.

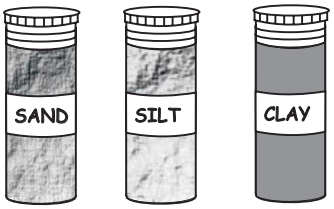
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STEP 5



Close the three vials tightly with the lids and shake them well.

STEP 6

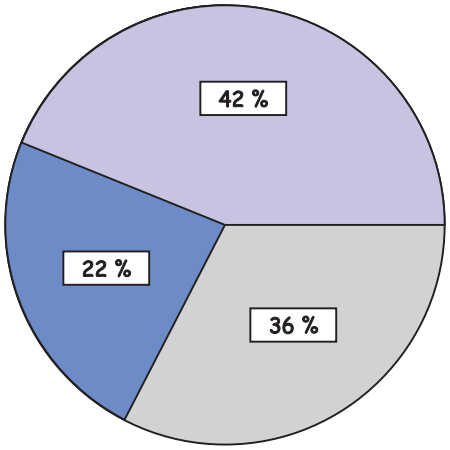


Put the vials in a place to stand overnight where they cannot be disturbed.

STEP 7

The next day, observe the vials without shaking.

Q1 Describe what you see.
Q2 Make a drawing of what you see.
Q3 Draw three pie charts like the one below, to represent your findings of the composition of sandy, clayey and silty soils.



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Activity 1.17 IS MY GARDEN SOIL ACIDIC OR BASIC?

Soil pH is important to know because it affects how plants absorb nutrients from the soil. A pH scale is used to measure whether substances are acidic, like a lemon, or basic (alkaline) like some batteries. There are different types of indicators which are used to determine this. The indicator used in this activity is called Litmus paper. It turns red (pink) in an acidic substance and blue in a basic substance. Different plants grow in soils of different pH level.

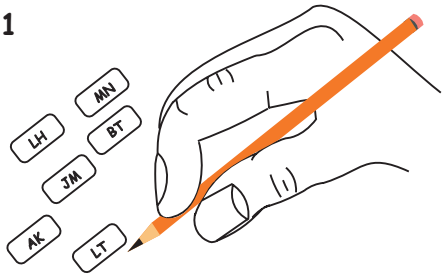
Focus Question: Is the soil sample acidic like lemons or basic like an oven cleaner?

You will need:

(to bring a sample of soil from your garden in a small sample vial)

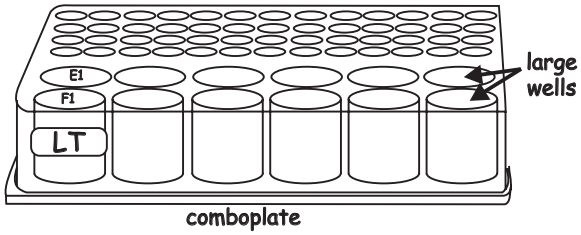
- comboplate
- propette
- labels
- soil samples
- microspatula
- 3 funnels
- water
- blue and red litmus paper strips

STEP 1



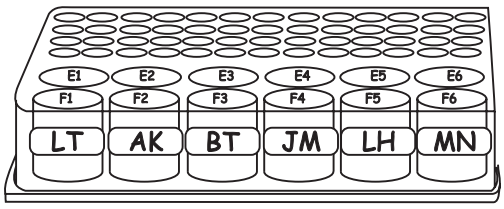
Work with five friends from your class by sharing soil samples. Write your initials (e.g LT for Lebo Taole) on one of the labels and the initials of your five friends each on a label.

STEP 2



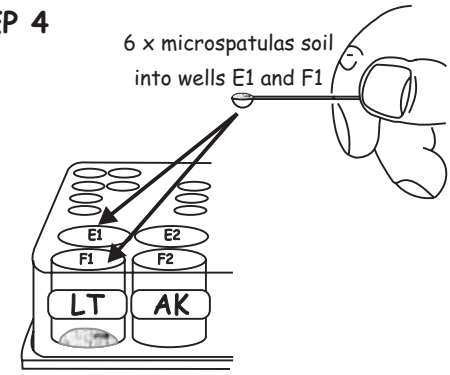
Put the label with your initials on the wall next to the first large well (F1) of the comboplate as shown in the picture.

STEP 3



Allocate the other labels to each of the remaining five wells by putting the labels on the side wall next to the wells.

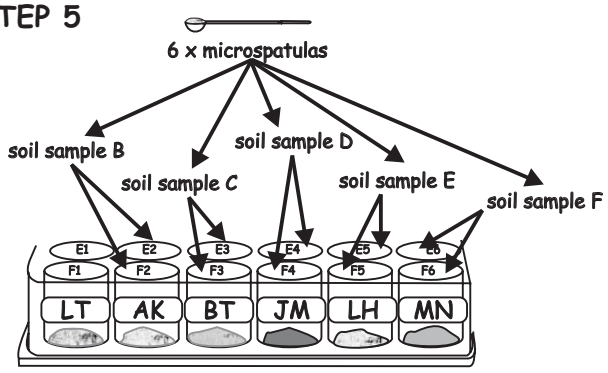
STEP 4



Use a microspatula to put 6 scoops of soil from your sample into well F1 and another 6 scoops into well E1. Wipe the microspatula with a piece of toilet paper or cloth.

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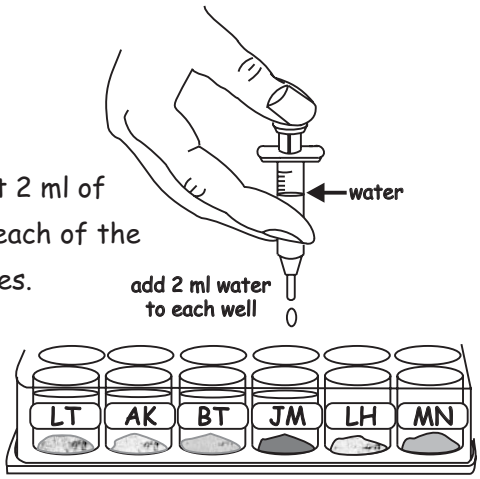
STEP 5



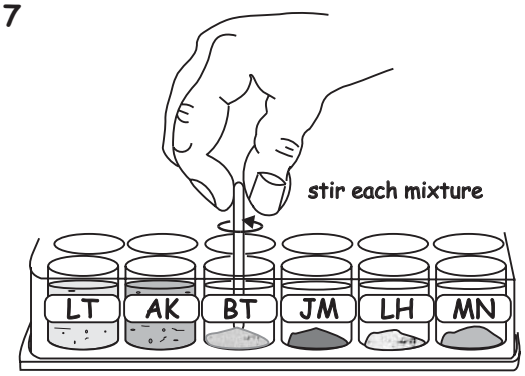
Repeat step 4 with the soil samples from your five friends, and let them also have their share in your soil sample.

STEP 6

Add about 2 ml of water to each of the soil samples.

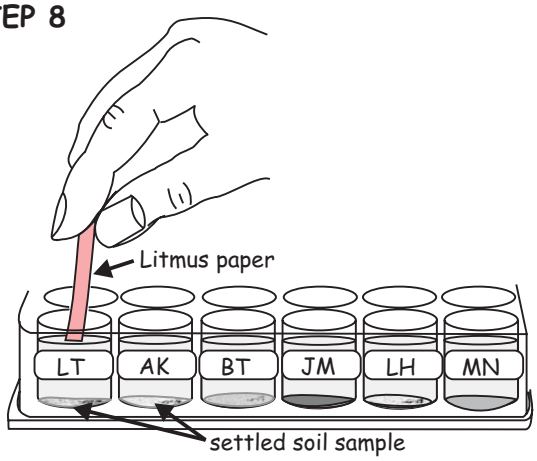


STEP 7



Stir each of the mixtures and leave them to stand until the soil has settled in each well.

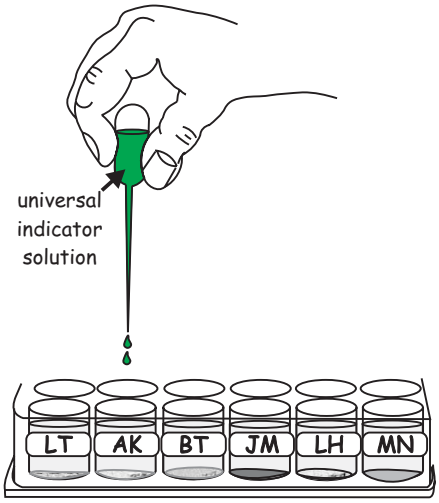
STEP 8



Test each soil mixture with a piece of red and a piece of blue Litmus paper. Draw a table like the one below and record your findings.

soil sample	colour with red litmus	colour with blue litmus	colour with indicator	pH	Acidic or Basic
A					
B					
C					
D					
E					
F					

STEP 9



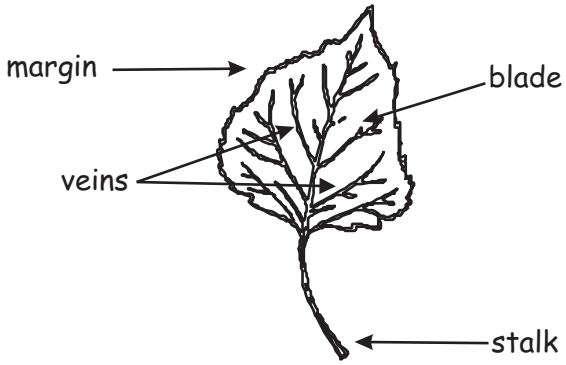
Use a propette to add 1 to 2 drops of universal indicator to each mixture. Use the indicator chart to identify the pH of the soil samples. Record your findings in the table.

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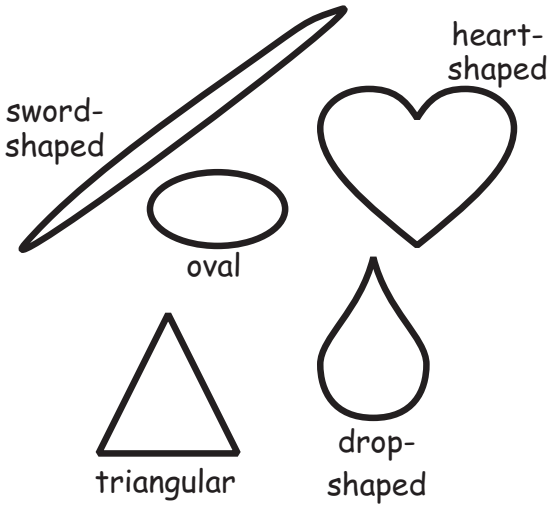
INTRODUCTION

Many plants have leaves.

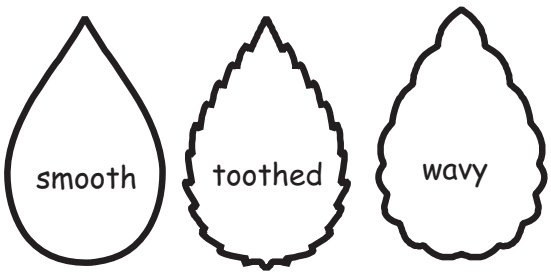
A leaf looks like this:



Leaves come in different shapes, like:



Leaf margins can be:



as well as other types

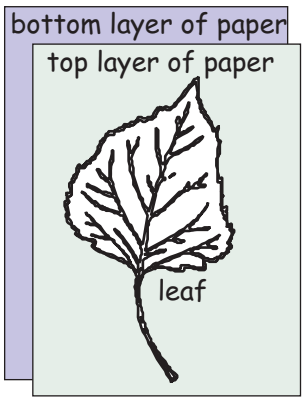
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To study leaves you need:

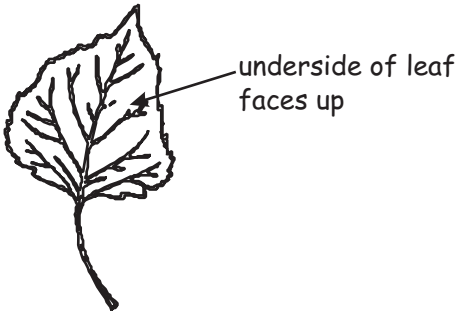
- some leaves from your home the school grounds or the roadside
- hand lens
- plain paper (old computer paper is good)
- wax crayons

What to do:

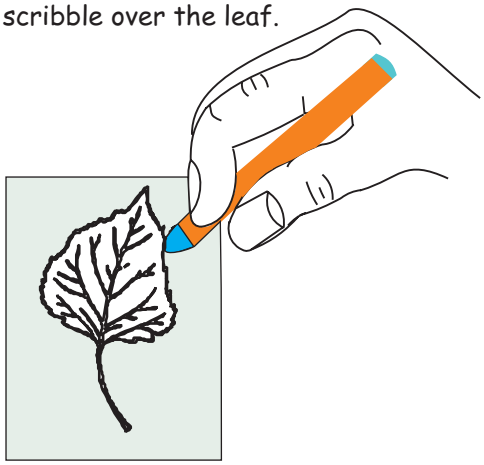
1. Place a leaf between two sheets of paper.



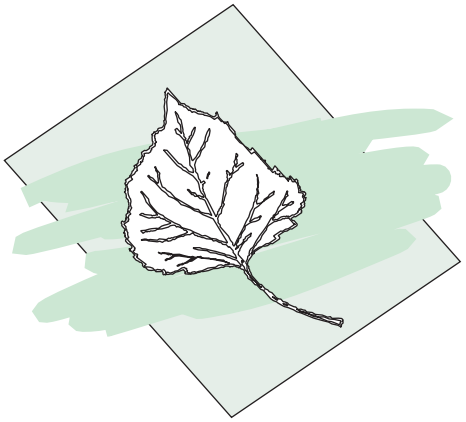
2. Keep the under side of the leaf up so that you can feel the veins.



3. Hold the paper steady and use the wax crayon to scribble over the leaf.



4. A leaf pattern will appear on the paper.



QUESTIONS

Q1 What is the shape of your leaf?

Q2 What is the margin like?

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ACTIVITY 1.19 SEEDS

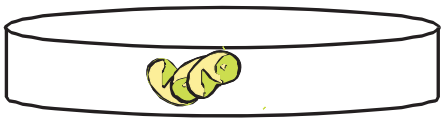
INTRODUCTION

Many plants produce seeds. These seeds grow into new plants.

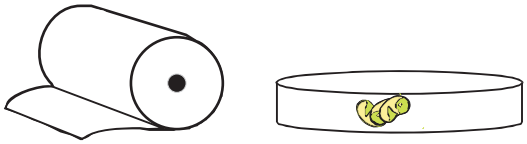
To study a seed you need:

- petri dish
- a few dry bean seeds and pea seeds/lentil seeds
- water
- forceps
- hand lens
- paper towel

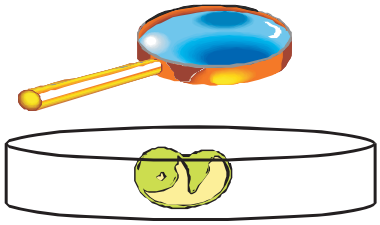
1. First soak the bean seeds in water in the petri dish for about a day.



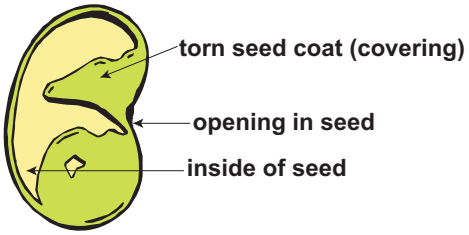
2. Remove the seeds, dry the dish and replace the seeds in the dried dish.



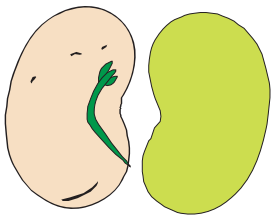
3. Use the hand lens to look at one of the seeds.



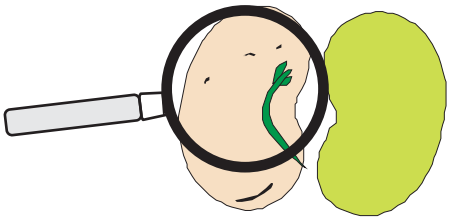
4. Find the labelled structures on your own seed.



5. Use forceps to remove the torn seed coat. The seed breaks into two halves.



6. Use the hand lens to look at the baby plant inside the seed.



Q1 Make a drawing of the baby plant to show the young root and the young stem.

Q2 Plant a seed which you have not broken. Watch the seed every day for one to two weeks. Talk about what happens with your teacher, your friends and with other people.

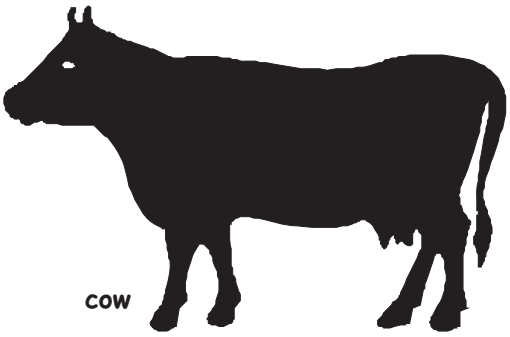
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Activity 1.20 WHAT ARE FABRICS?

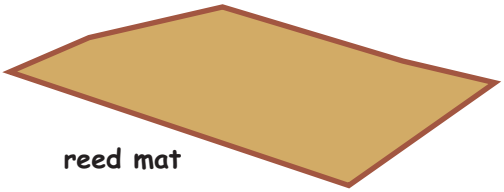
A fabric is a cloth which we use for clothing, sheets and blankets and other things.
Plants and animals provide many of the fabrics we use.

Part 1 Where do fabrics come from? A Linking Exercise

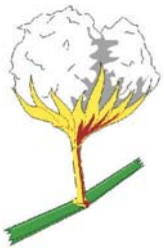
Draw lines to link the animal or plant with the article we can make from it.



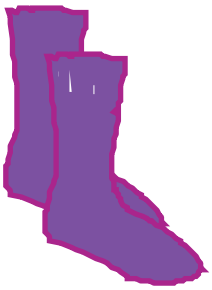
cow



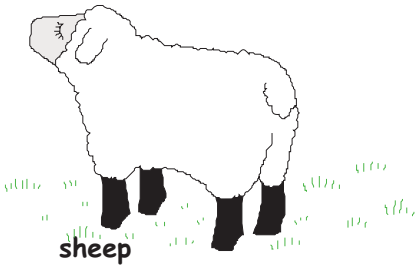
reed mat



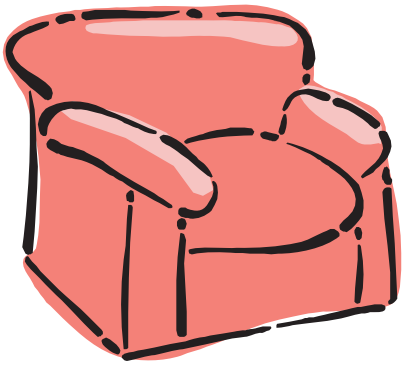
cotton plant



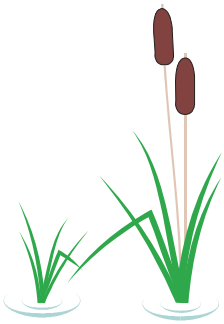
woollen socks



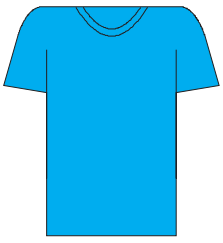
sheep



leather armchair



bulrushes



T-shirt

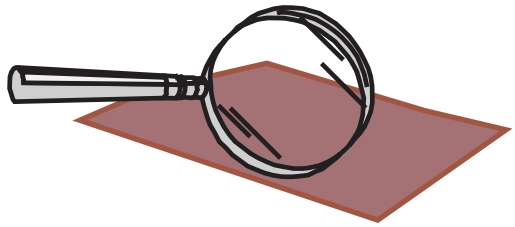
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Part 2 What do fabrics look like?

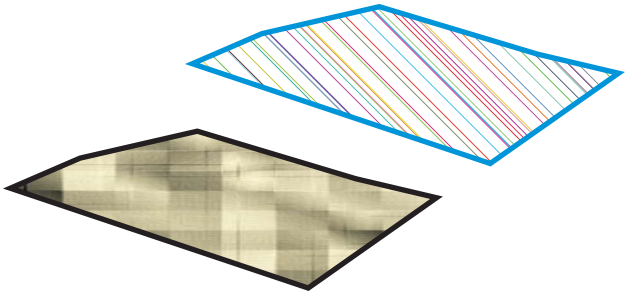
To look at fabrics you need:

- Different fabrics cut into small squares (about 3 cm x 3 cm)
- petri dish
- hand lens

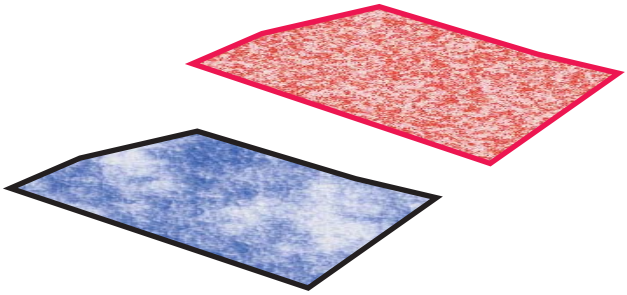
1. Look at some of the fabrics using a hand lens.



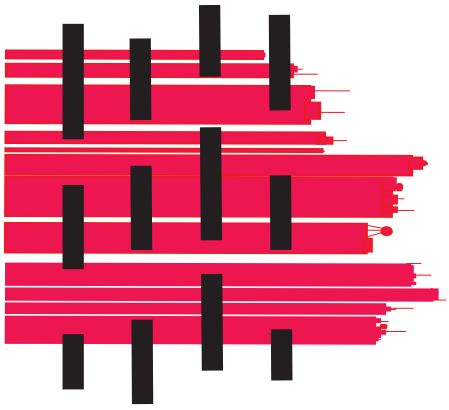
2. Choose fabrics which seem to be made of woven threads.



3. Place on one side those fabrics which do not seem to be made of woven threads. You may need these later.



4. Make drawings to show how each fabric is woven. eg.



Questions:

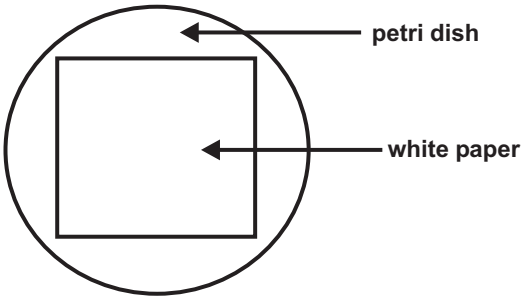
Q1 In which types of fabrics are the threads quite far apart?
Q2 In which types of fabrics are the threads closely woven?
Q3 In which types of fabrics are the threads the same distance apart?
Q4 In which types of fabrics are the threads all the same size?
Q5 In which types of fabrics are the threads all the same colour?

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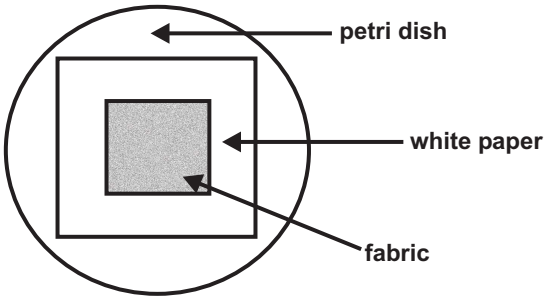
Part 3 Which fabrics stain easily?

To test fabrics for staining you need:
small pieces of fabrics (2 cm x 2 cm), small pieces of white paper (3 cm x 3 cm), propettes, inks or paints, petri dish, forceps.

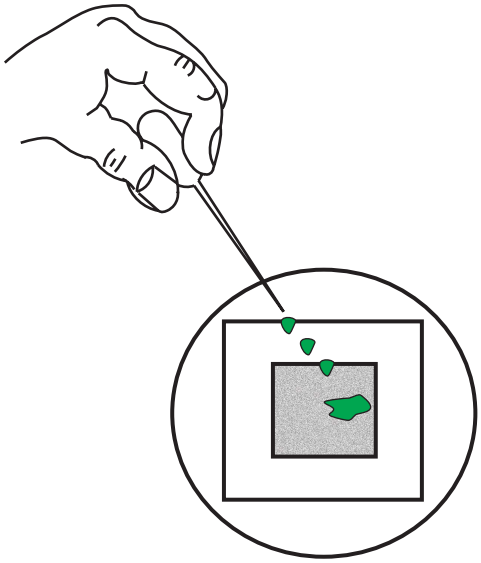
1 Place a piece of white paper in the petri dish.



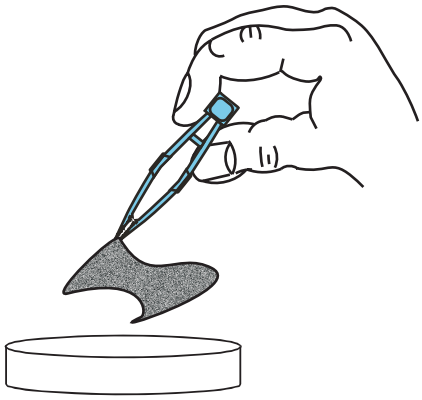
2 Place a piece of fabric on top of the paper in the dish.



3 Use a propette to place a few drops of ink or paint onto the fabric - **NOT ONTO THE PAPER**.



4 Use forceps to remove the fabric from the paper.



Carefully look at the fabric and at the white paper in the petri dish.

QUESTIONS

Q1 Did any of the ink or paint stay on the fabric?
Q2 Did any of the ink or paint go through the fabric?
Q3 Did any of the ink or paint stain the white paper?

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Repeat steps 1 to 4 with different types of fabrics. Use those which are made of woven threads AND those from Part 2 which did not seem to be made of woven threads. Answer questions 1 to 3 for each fabric. Write what you found in a table like the one below.

Fabric	1	2	3	4	5
Is it made of woven threads?					
Did the ink/ paint stay on the fabric?					
Did the ink/paint go through the fabric?					
Did the ink/paint stain the white paper?					

QUESTIONS (continued)

Q4 Which fabrics did not allow the ink or paint to pass through onto the white paper?

Q5 Which fabrics did allow the ink or paint to pass through onto the white paper?

Q6 Which fabrics do you think would make good aprons?

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CHAPTER 2

CHAPTER 2

Expansion And Contraction

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Activity 2.1 THE UNDECIDED DROP

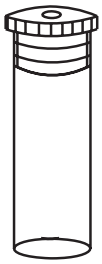
Focus question: What happens to a gas when it is heated and when it is cooled?

You will need:

- 1 vial with a single hole lid
- 1 propette
- 1 Petri dish lid
- hot water
- 1 glass tube
- 1 plastic container
- icy cold water
- oil

STEP 1

Take a sample vial with a lid that has one hole in it.



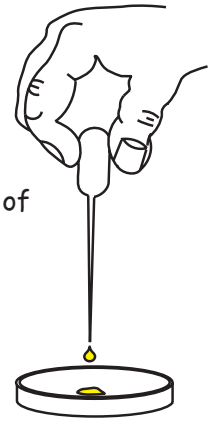
STEP 2

Push the glass tube in the lid so that most of the tube sticks out above the lid surface and only a small part shows beneath the lid.



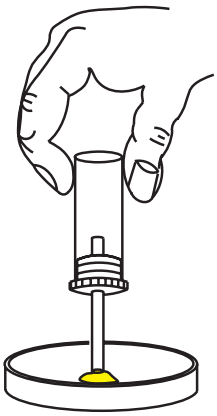
STEP 3

Put a drop of oil in the lid of the Petri dish with a propette.



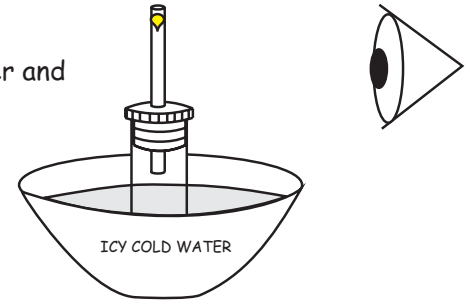
STEP 4

Turn the vial upside down and dip the end of the glass tube into the oil.



STEP 5

Place the vial in a plastic container with icy cold water and watch the oil drop for a while.

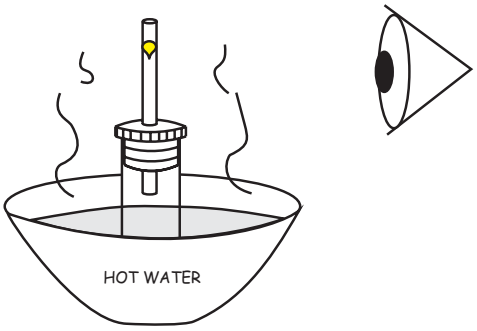


Q1 What do you observe?
Q2 What is inside the vial?
Q3 Why do you think this is happening?
Q4 Is it possible that some air is leaving the sample vial?

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STEP 6

Now place the vial in a container with hot water and watch the oil drop.



Q5 What do you see?

Q6 What makes the drop move up and down in this activity?

Q7 What is the effect of heating on gases?

Q8 What is the gas in this activity?

Q9 What is the effect of cooling on gases?

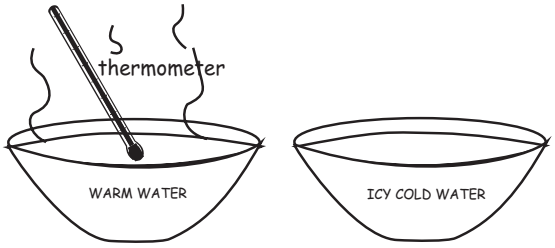
Q10 Describe what happens to the particles of this gas when the vial is immersed in icy cold water.

Q11 Describe what happens to the particles of this gas when the vial is immersed in hot water.

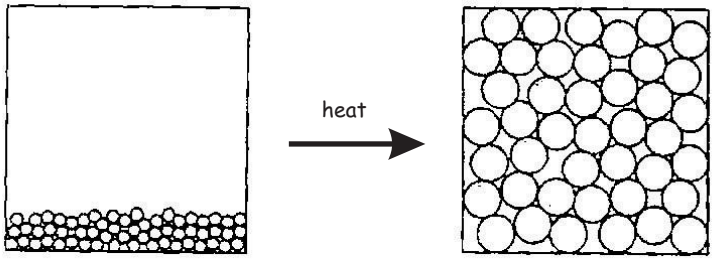
Q12 Make a drawing to represent the air in the vial when the vial is immersed in the hot water and when the vial is immersed in the cold water.

Q13 Put a thermometer in warm water and note what happens. Put it in the cold water. What happens?

Q14 How does this activity on 'the undecided drop' relate to how the thermometer works?



Mrs Mahlangu asked her grade 5 learners to show with a drawing what happens to the particles of a substance when it is heated.
This is a microscopic representation Lebo gave.



A representation of learner's concept that molecules expand upon heating

Q15 According to the particulate theory of matter, what happens to the particles of a substance when it is heated?

Q16 Is Lebo's view about the concept of expansion of substances on heating, similar to those commonly held by the scientific community? Explain your views.

Q17 Is this substance a gas, a liquid or a solid? How do you know?

Q18 Make a drawing of a scientifically acceptable representation.

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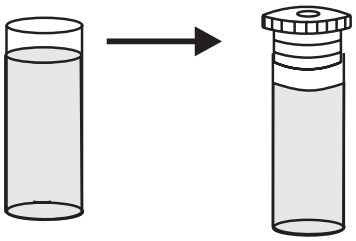
Activity 2.2 WHERE DOES THE EXTRA LIQUID COME FROM?

Focus question: How does a thermometer work?

You will need:

- 1 vial with a single hole lid
- 1 propette
- hot water
- 1 marker
- 1 glass tube
- 1 plastic container
- icy cold water

STEP 1



Fill the vial with water and close it tightly with the lid.

STEP 2

Use the propette to add more water through the hole in the lid so that the vial is completely filled.



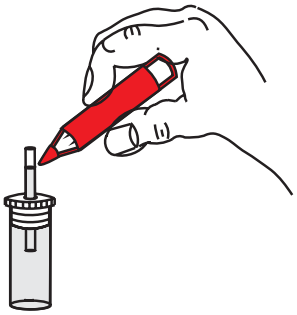
STEP 3

Push the glass tube into the hole in the lid so that there is some water in the tube.



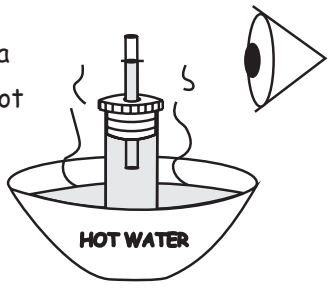
STEP 4

Mark the level of the water with a marker.



STEP 5

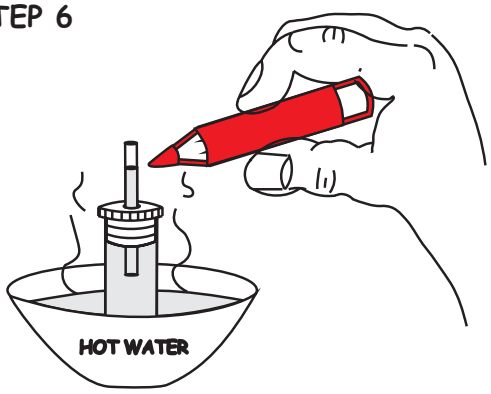
Place the vial in a container with hot water and watch the water level.



Q1 What happens to the water level when the vial is placed in hot water for some time?

Q2 Where does the extra water come from?

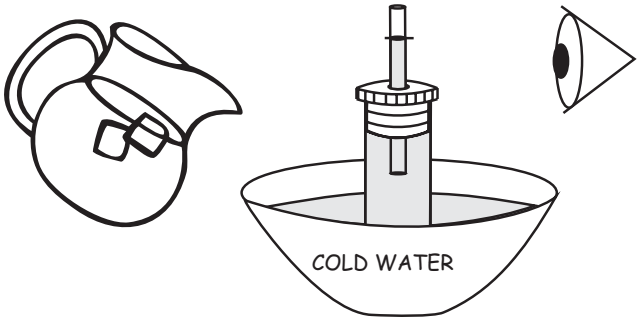
STEP 6



After a few minutes, mark the new water level.

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STEP 7



Replace the hot water in the container with cold water and watch the level of the water in the tube.

Q3 What happens to the level of water when the vial is placed in icy cold water for a while?

Q4 Is it possible that some water may be leaving the vial?

Q5 Why is this happening?

Q6 How is this system similar to a thermometer?

Q7 Can this system serve as a thermometer?

Q8 What can be done to make this system serve as a thermometer?

Q9 What happens to water when it is heated and when it is cooled?

Q10 How does a thermometer work?

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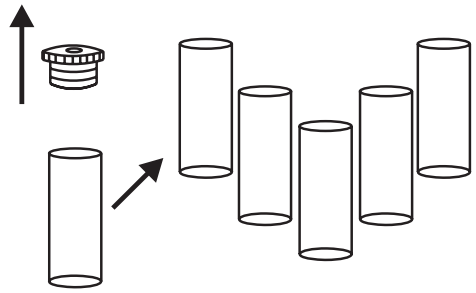
Activity 2.3 THE TALLEST LIQUID

Focus question: Do different liquids have the same expansion when heated?

You will need:

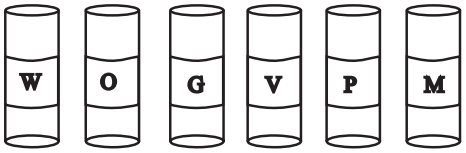
- 1 comboplate
- 6 x sample vials with single hole lids
- 6 x glass tubes
- 6 x propettes
- labels
- 2 x plastic containers
- cold and hot water
- oil, glycerine, vinegar, paraffin, methylated spirits, water

STEP 1



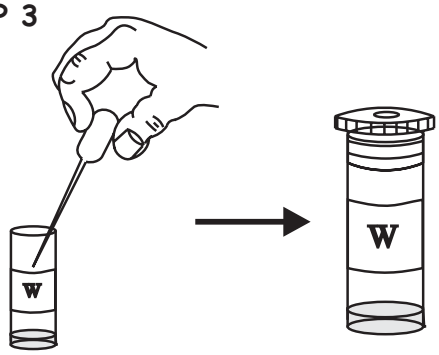
Remove the lids from each of the sample vials.

STEP 2



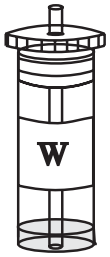
Write the first letter of each liquid on a different label (eg. W for water). Stick each label onto a vial.

STEP 3



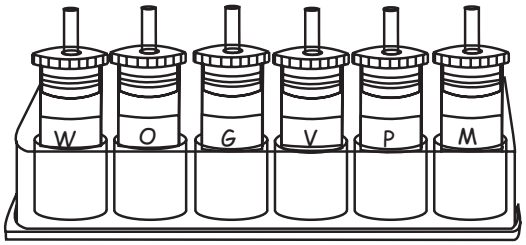
Use a propette to add 20 drops of water in the vial labelled 'W' and close it tightly with the lid.

STEP 4



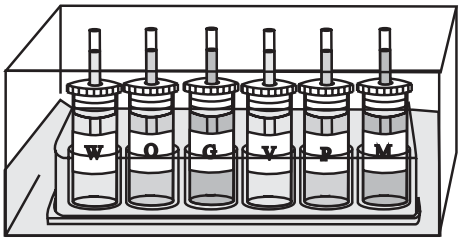
Push the glass tube into the lid such that there is some water going into the tube. Repeat steps 3 and 4 for all other liquids.

STEP 5



Place each of the vials with the liquids in wells F1, F2, F3, F4, F5 and F6.

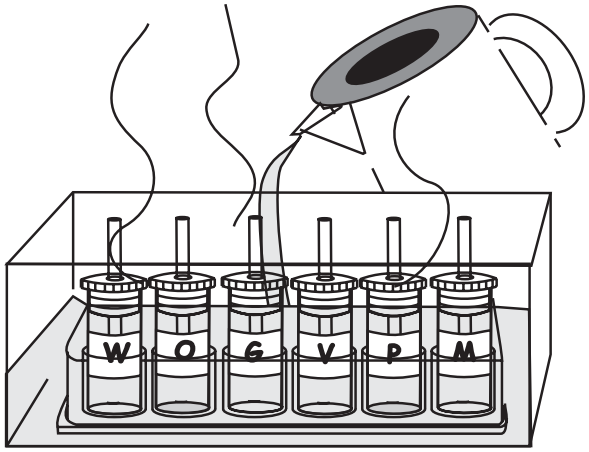
STEP 6



Put the comboplate with the vials inside a big container.

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STEP 7



Now pour in hot water to cover the surface of the combo plate and watch the levels of the liquids in the tubes.

Q1 What happens?

Q2 Do the different liquids have the same thermal expansion?

Q3 Which liquid level rises highest?

Q4 Name the liquids in the increasing order of expansion.

Q5 What can you say about the effect of heating on different liquids?

STEP 8



Now replace the hot water in the container with cold water and again watch the level of each liquid in the glass tubes.

Q6 What happens?

Q7 What can you say about the effect of cooling on different liquids?

Q8 Which liquid has the greatest extent of contraction?

Q9 Name the liquids in increasing order of contraction.

Extension Questions:

Q10 Is there any relationship between the order of expansion and the order of contraction?

Q11 What can you say about the effect cooling has on different liquids?

Q12 a) When you are ill you use a thermometer to measure your body temperature. Does this activity remind you of of the way a thermometer works?

Q12 b) If yes, in what way?

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Activity 2.4 THE STORY OF A SLENDER AND A PLUMP PROPETTE

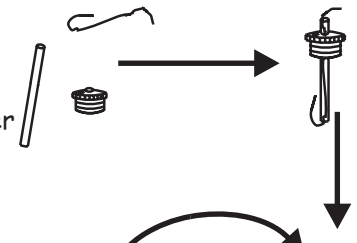
Focus question: Why does a football feel hard during a hot day, but soft during the night or in the early morning?

You will need:

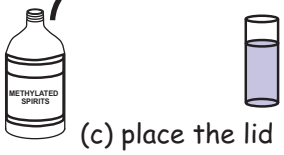
- 1 comboplate
- matches
- 2 x paper clips
- 1 microburner
- 1 pair of scissors
- 2 propettes
- hot water
- 2 polystyrene cups
- icy cold water

STEP 1

(a) assemble the lid of the microburner as shown.

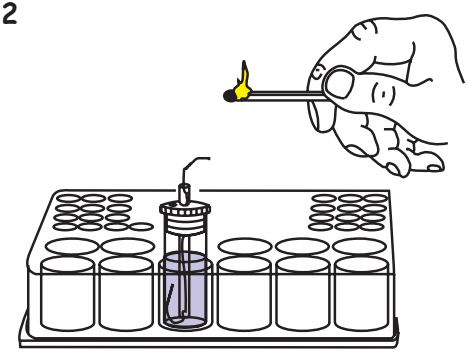


(b) half fill the vial with methylated spirits.



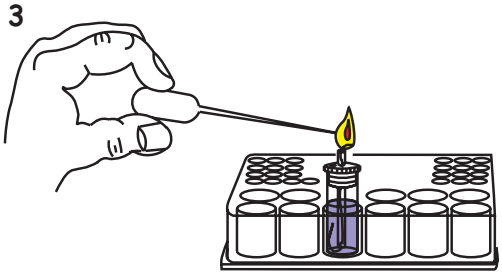
(c) place the lid on the vial.

STEP 2



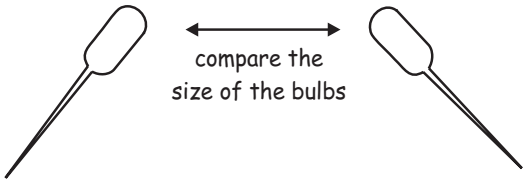
Put the microburner into one of the large wells and light.

STEP 3



Ask your teacher to help you seal the ends of your two propettes, using the flame and clamping with tweezers..

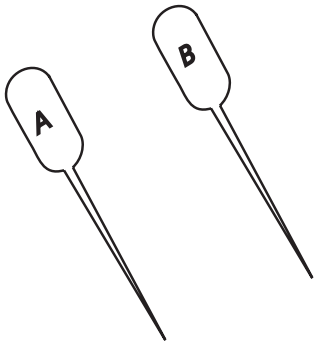
STEP 4



Look at the bulbs of the two propettes.

Q1 Is there any difference in size, between the two propette bulbs?

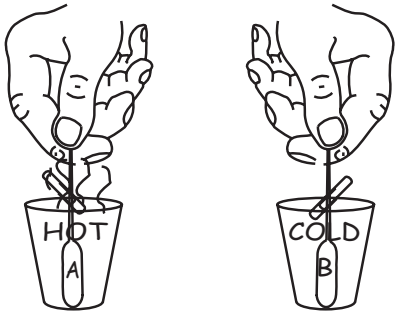
STEP 5



Label the one propette "A"and the other "B"

Q2 What is inside the propettes?.

STEP 6

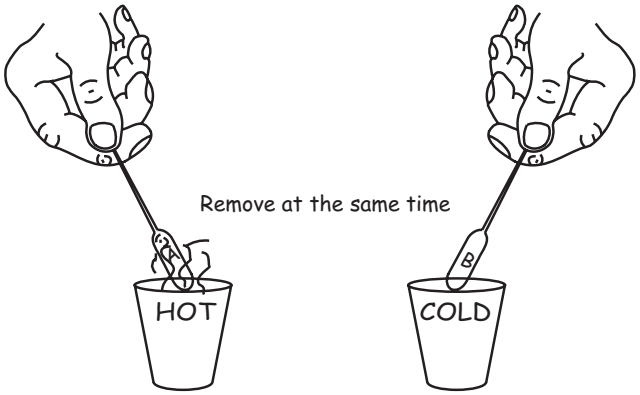


Immerse the bulb of propette A into hot water. At the same time immerse the bulb of propette B in icy cold water. Keep the bulbs in the hot and cold water for about 5 minutes by using paper clips.

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STEP 7

Remove the propettes at the same time and look at the bulbs.



Q3 Do you see any difference between them?

Q4 Describe what you see.

Q5 What caused this?

Q6 What do you think will happen if you immerse the bulb of propette B in hot water for a few minutes?

STEP 8



Now immerse the bulb of propette B into the hot water for 3 minutes.

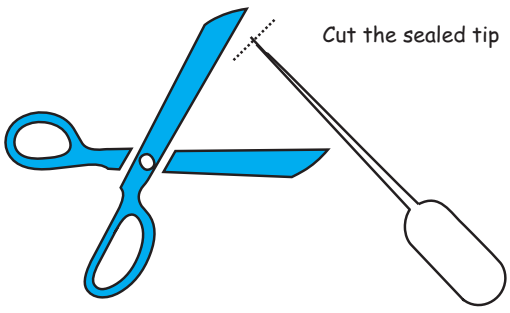
Q7 What happened?

Q8 What causes the inflation of balloons and balls?

Q9 A football is pumped up hard during the day when it is warm. When the temperature falls in the evening the football does not feel so hard anymore. Explain this.

STEP 9

Use a pair of scissors to snip off the sealed end of each propette so that they can be used again.



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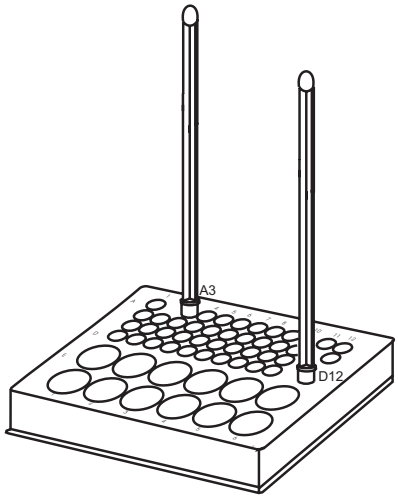
Activity 2.5 THE LAZY THIN WIRE

Focus question: What happens to the length of a piece of wire when it is heated?

You will need:

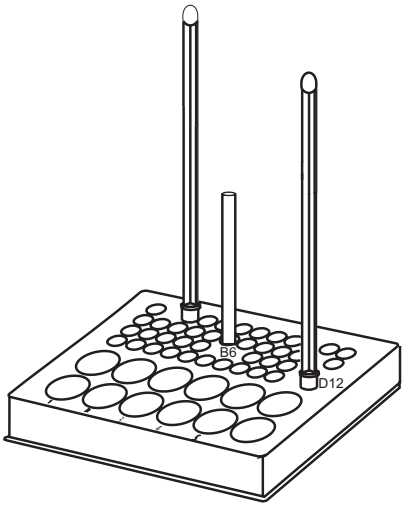
- 1 comboplate
- 2 x microstands
- 1 thin rubber band
- 1 piece of cardboard
- 1 microburner
- 12 cm copper wire
- 1 glass tube
- 1 straw

STEP 1



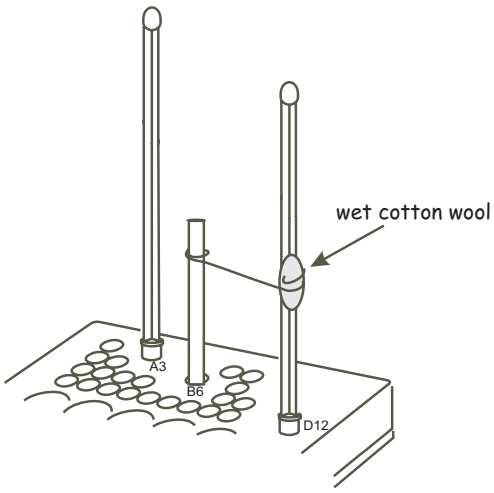
Insert one microstand into well A3 and another in well D12.

STEP 2



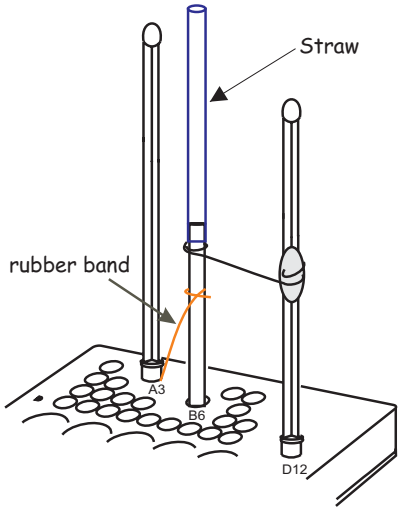
Insert a glass tube into well B6.

STEP 3



Tightly tie a piece of copper wire to the glass tube and to the microstand in well D12.

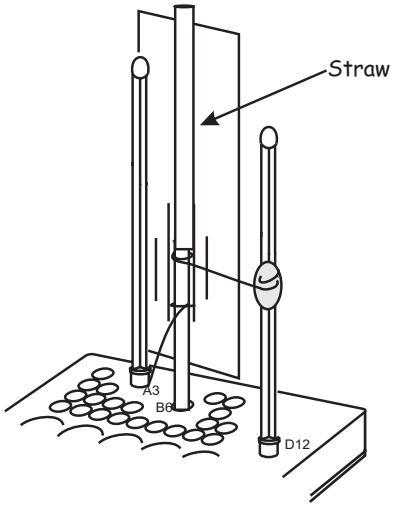
STEP 4



Tie one end of a rubber band to the glass tube. Insert the other end in well A3 and press in with the microstand. Insert the straw on the glass tube.

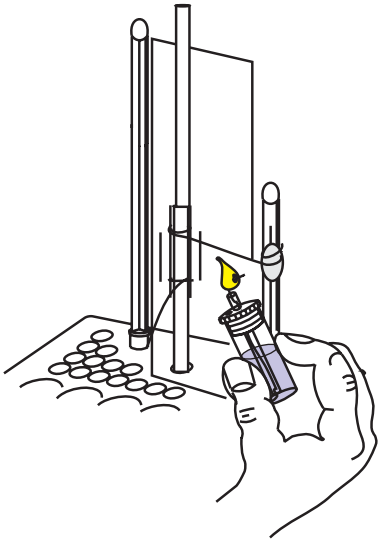
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STEP 5



Place a piece of cardboard with markings (as illustrated) in the background of the glass tube and make a mark on the cardboard to show the position of the tube before heating.

STEP 6



Heat the wire with the microburner for some minutes and note the position of the tube as the wire is heated.

Q1 What happened to the position of the straw when the wire was heated?

Q2 What does this mean for the length of the wire?

Q3 What is actually happening to the particles of the wire when it expands?

Q4 What do you think will happen when the wire is cooled?

Q5 When a substance expands on heating, does that mean the particles have become bigger?

Q6 Why do lifts sometimes jam on very hot or very cold days?

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Activity 2.6 ICE AND LIQUID WATER

Focus question: What actually happens when ice melts?

You will need:

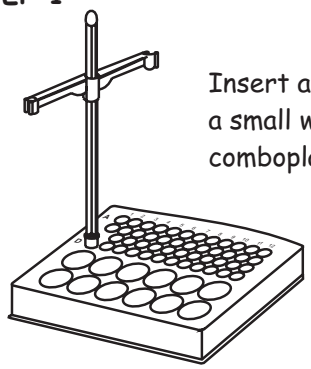
- 1 comboplate
- 1 microstand
- 1 propette
- 1 syringe
- 1 thermometer
- prestik
- a freezer
- water

Decide what you think will happen to water if left in a freezer overnight. Write your decision under the second column on the table below.

Table (a)

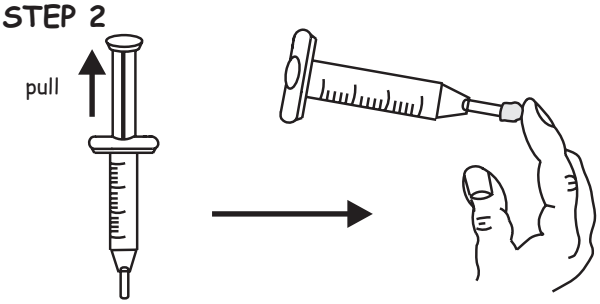
Change	What do you think?	What actually happened?
Will the water become ice?		
Will its volume increase, decrease or stay the same?		
Will its temperature increase, decrease or stay the same?		

STEP 1



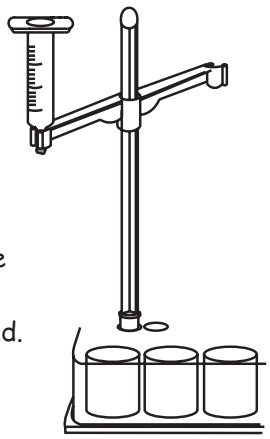
Insert a microstand into a small well of a comboplate.

STEP 2



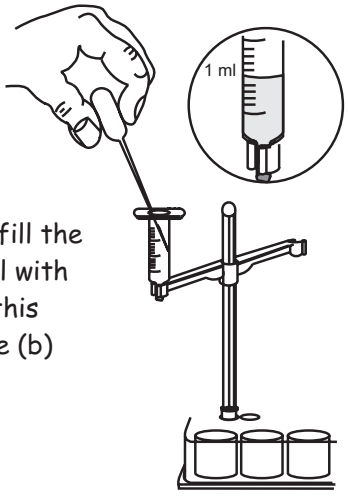
Remove the plunger of the syringe and use prestik to seal (block) the opening of the nozzle.

STEP 3



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

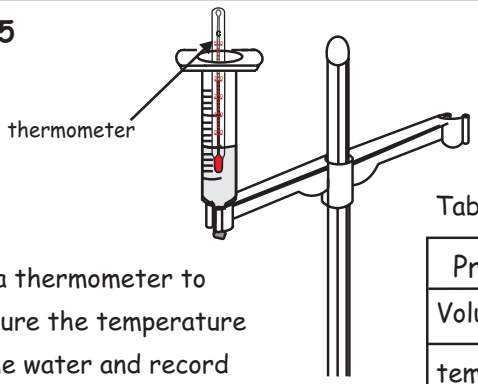
STEP 4



Use a propette to fill the syringe up to 1.0 ml with water and record this volume on the table (b)

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STEP 5



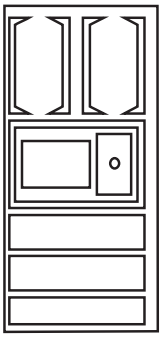
Use a thermometer to measure the temperature of the water and record your findings on table (b) under '**Before**'.

Table (b)

Property	Before	After
Volume/ ml		
temperature/ ^{0}C		
state		

STEP 6

Put the system (syringe, comboplate, microstand) in the freezer and leave for two hours or overnight.



STEP 7

Remove the syringe from the freezer (after two hours or overnight) and note the volume and state of water; measure the temperature with a thermometer.

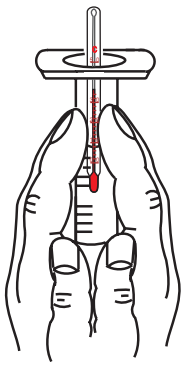
Q1 Record your findings on table (b) under 'after'.

Q2 Answer the questions in table (a) and write them in the third column.

Q3 Are there differences between what you thought would happen and what actually happened?

Q4 Does water expand or contract when it freezes?

STEP 8

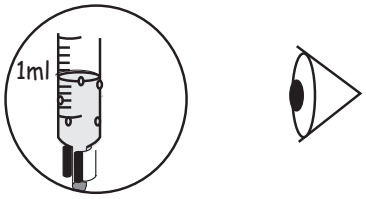


Insert the thermometer in the syringe and use the warmth of your hands to melt the ice in the syringe. As the ice melts watch the temperature closely.

Q5 Does the temperature of water increase, decrease or stay the same as ice melts?

Q6 What is the melting point of ice?

STEP 9



Look at the ice and water in the syringe as the ice melts.

Q7 Look at the ice and liquid water. Which is at the bottom and which is at the top?

Q8 Does ice float on water or does it sink?

Q9 Which has a higher density: ice or liquid water?

Q10 Note the volume of water after melting and say whether there is expansion or contraction or no volume change when ice melts.

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Activity 2.7 WHERE DOES THE WATER COME FROM?

Focus question: Does air contain water vapour?

You will need:

- large glass sample vial
- 1 propette
- thermometer
- crushed ice

STEP 1

Take a clean vial. Feel its outside with your fingers. Is the vial dry or wet?



STEP 2



Fill the vial to capacity with crushed ice.

STEP 3



Leave the vial to stand for a few minutes until the ice starts to melt.

Q1 What is the temperature of the ice?

Q2 Observe the outside of the sample vial. What do you see?

Q3 Where does the water come from?

Q4 Is the water you see outside the vial a solid, a liquid or a gas?

STEP 4

Observe the water in the vial.



Q5 How many states of water can you see?

Q6 How many states of water are involved in this activity?

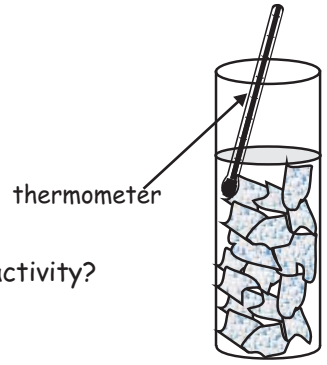
Q7 Give the names of these various states of water.

Q8 Which is more dense? Liquid water or solid water?

Q9 What do you think is the temperature of the icy water in the vial?

STEP 5

Use the thermometer to find what the temperature of the water is.



Q10 Explain what is happening to the molecules of water in the vial.

Q11 What are the changes of state that you have observed in this activity?

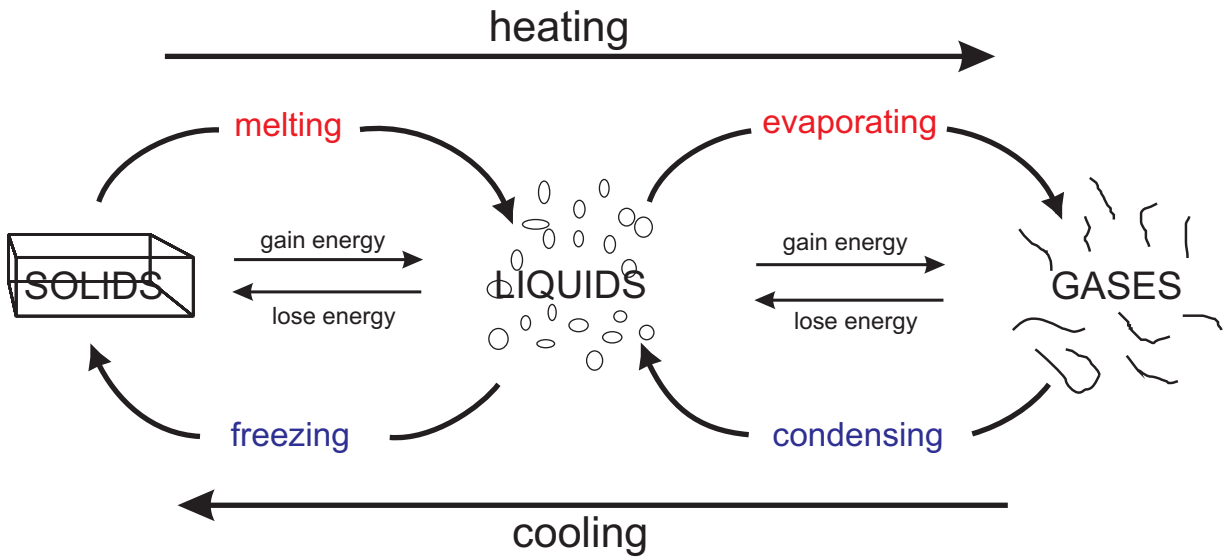
Q12 Can we see all states of water?

Q13 If there is water in the air, in which state do you think it is?

Q14 Explain how this activity applies in nature and in the formation of rain.

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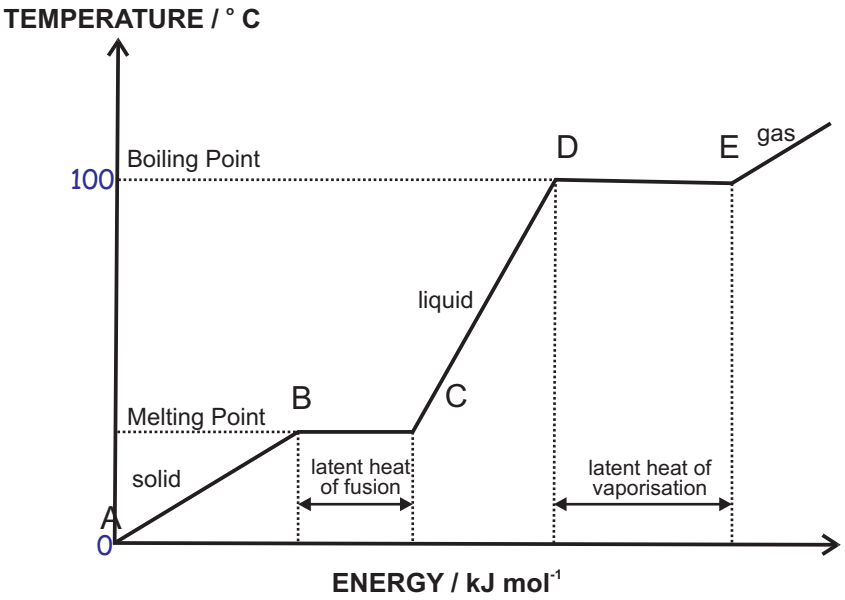
Q15 Study the diagram below and answer the questions that follow:



a) Explain the relationship between the gaining or losing of energy and the heating and the cooling.

b) Explain what happens to the energy of the particles of a substance when it changes from a solid to a liquid state.

c) Explain what happens to the energy of the particles of a substance when it changes from a gaseous state to a liquid state.



Q16 The graph above shows the change in temperature of a substance when it is heated. Study the graph and answer the questions that follow:

a) What is the name of the substance? How do you know?

b) What is happening between A and B?

c) Give a microscopic description of what is happening between B and C.

d) Explain what is happening to the energy and movement of the particles between C and D.

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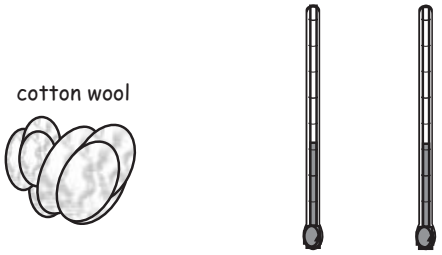
Activity 2.8 MEASURING EVAPORATION

Focus question: How is the temperature drop related to evaporation?

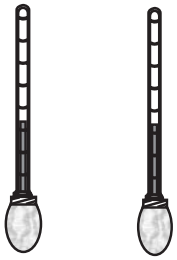
You will need:

- 1 comboplate
- 2 thermometers
- 2 rubber bands
- 1 stop watch
- water
- 1 microstand
- cotton wool
- 2 propettes
- methylated spirits

STEP 1



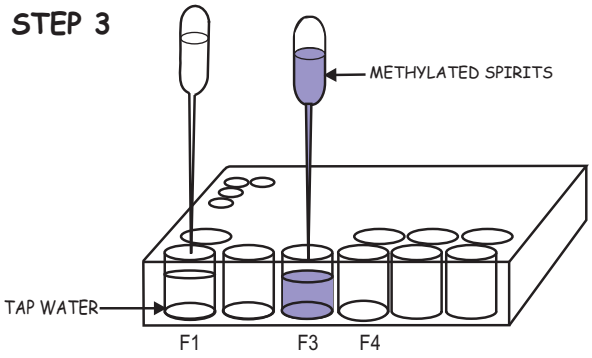
STEP 2



Wrap the bulb of each thermometer with a piece of cotton wool and keep it firm with a rubber band.

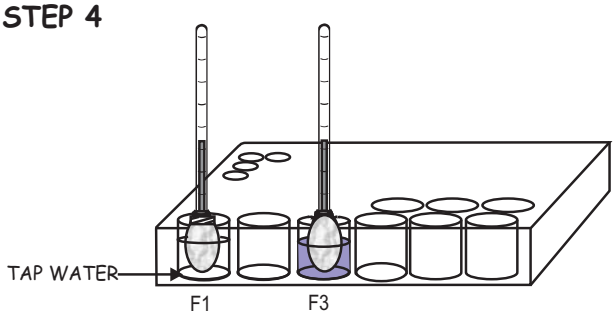
Q1 What is the temperature of the cotton wool?

STEP 3



Using a propette put about 1 ml methylated spirits into F3. Use another propette to transfer water into F1.

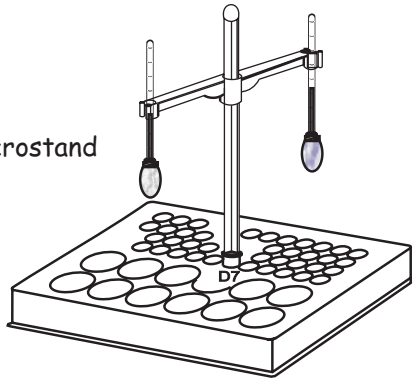
STEP 4



Dip the cotton wool of one thermometer in methylated spirits and that of the other in the water at the same time.

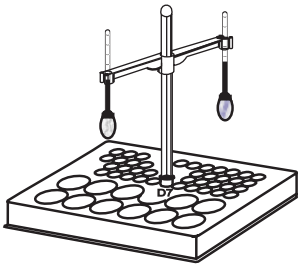
STEP 5

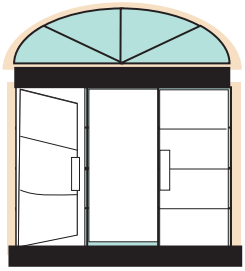
Fit the microstand into D7.



Fit the thermometers in the arms of the microstand and turn the thermometers in such a way that the markings on the thermometers can be read.

STEP 6





Place the comboplate close to an open window to allow free circulation of air.

STEP 7

Observe for several minutes what happens to both themometer readings and record your findings on the table that follows.

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Table (a)

time /min	temperature of water dipped cotton wool/ ^{0}C	temperature of methylated spirits dipped cotton wool/^{0}C
initial time		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Q2 What are the temperatures of the two pieces of cotton wool after 5 minutes?

Q3 Describe the changes in temperature of the two pieces of cotton wool.

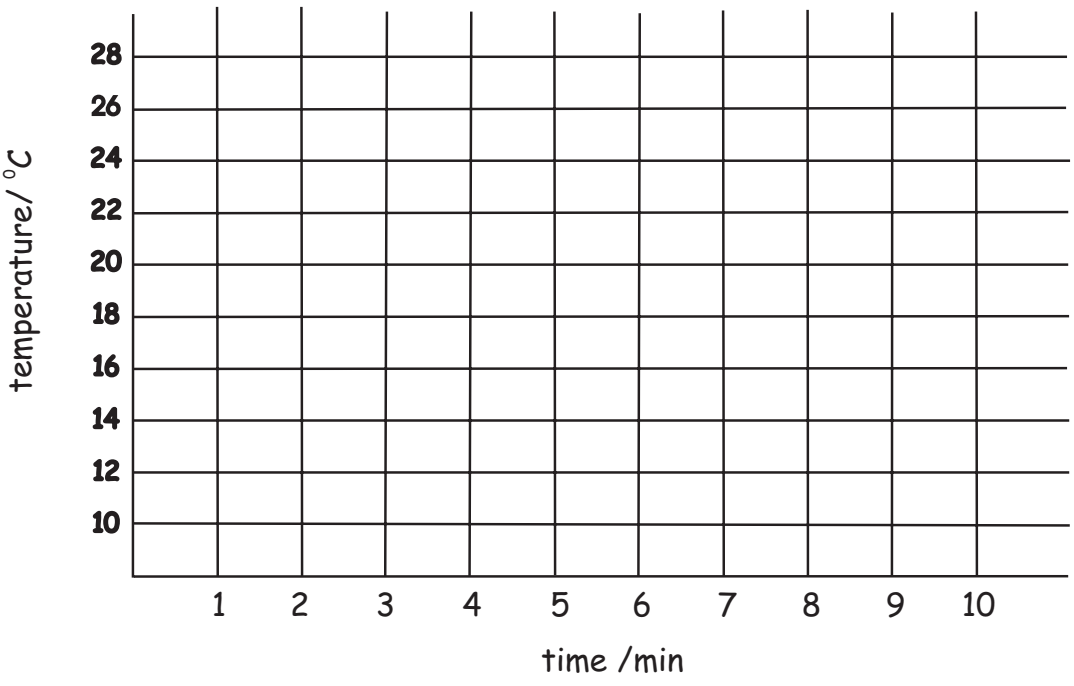
Q4 How is temperature drop related to evaporation?

Q5 Which liquid, water or methylated spirits, evaporates faster?

Q6 Why was the comboplate placed close to an open window in step 6?

Q7 What happens to the temperature of the surface on which evaporation is happening?

Q8 Plot the findings reflected in table (a) in the following graph.



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Activity 2.9 THE STATES OF WATER

Focus question: Can water exist in different forms or states?

You will need:

- 1 comboplate
- 1 large sample vial with lid (size 4)
- tap water
- a freezer

MAKING ICE FOR THIS EXPERIMENT:

- Fill the large wells of a comboplate with tap water.
- Put the comboplate into the freezer. You may need to leave it there for a day.
  Just before you do this experiment, turn the comboplate upside down and shake it to remove the pieces of ice.

Step 1 Take the lid off the large sample vial and then half fill it with tap water.

Step 2 Put 2 or 3 pieces of ice into the large sample vial. Close the vial with the lid.

Questions

Q1 Do the ice cubes float or not?

Q2 Where have you seen ice floating before?

Q3 Look at the water in the sample vial.

(a) How many states of water can you see?

(b) Give the names of the various states of water.

Q4 What do you think will happen to the ice after a while?

Q5 How do you know that ice is water?

Q6 Feel the outside of the sample vial. Does the vial feel dry or wet?

Q7 Is the water on the outside of the vial a liquid, a solid or a gas?

Q8 Where does the water on the outside come from?

Q9 Can you see water in the air around you?

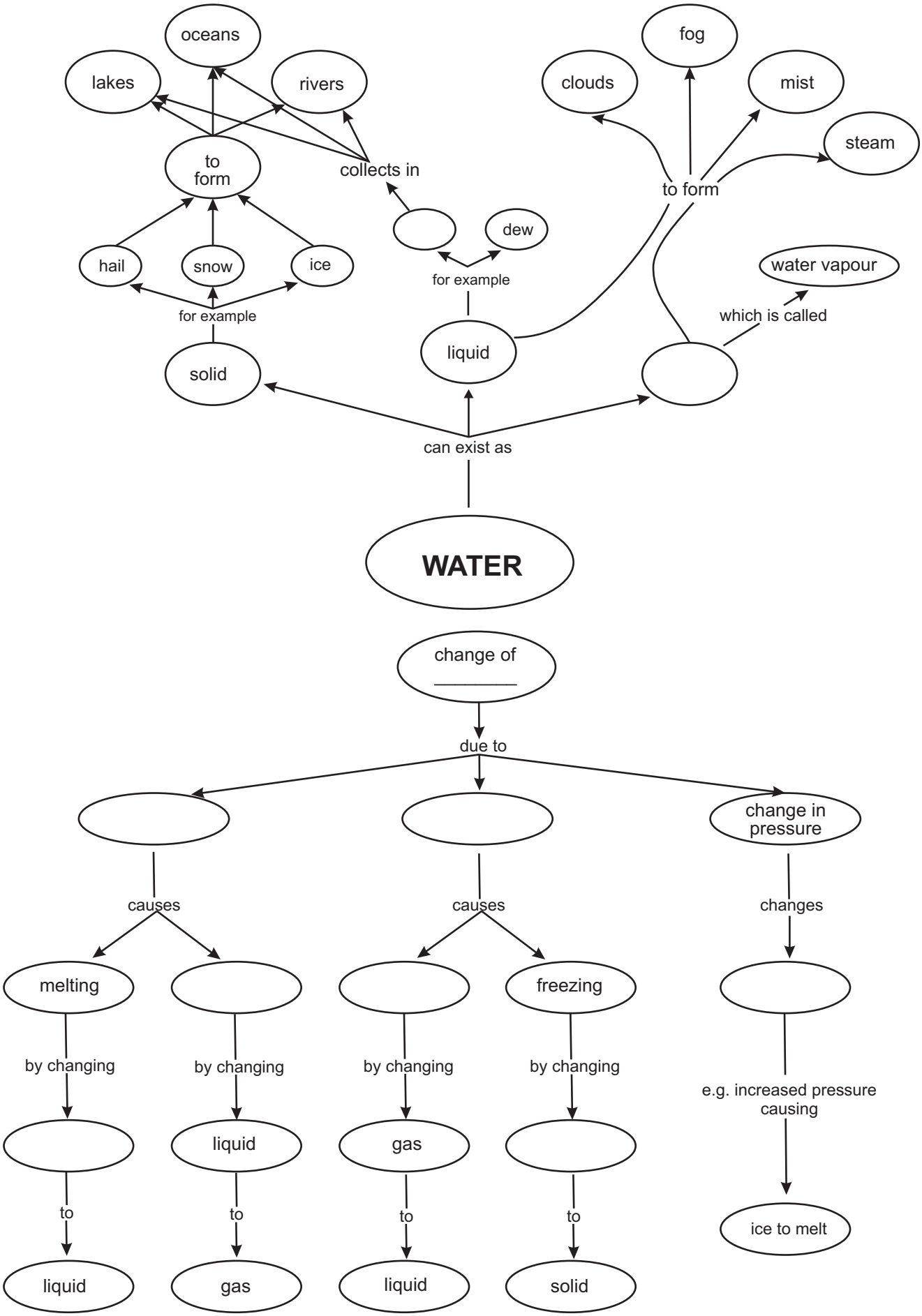
Q10 In how many states can we find water?

Q11 Can you see all the states of water?

Q12 Complete the concept map on the next page by filling the empty spaces.

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CONCEPT MAP OF PROPERTIES OF WATER



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Activity 2.10 HOW CAN WE KNOW THAT IT IS WATER?

Focus Question: How can we test for water?

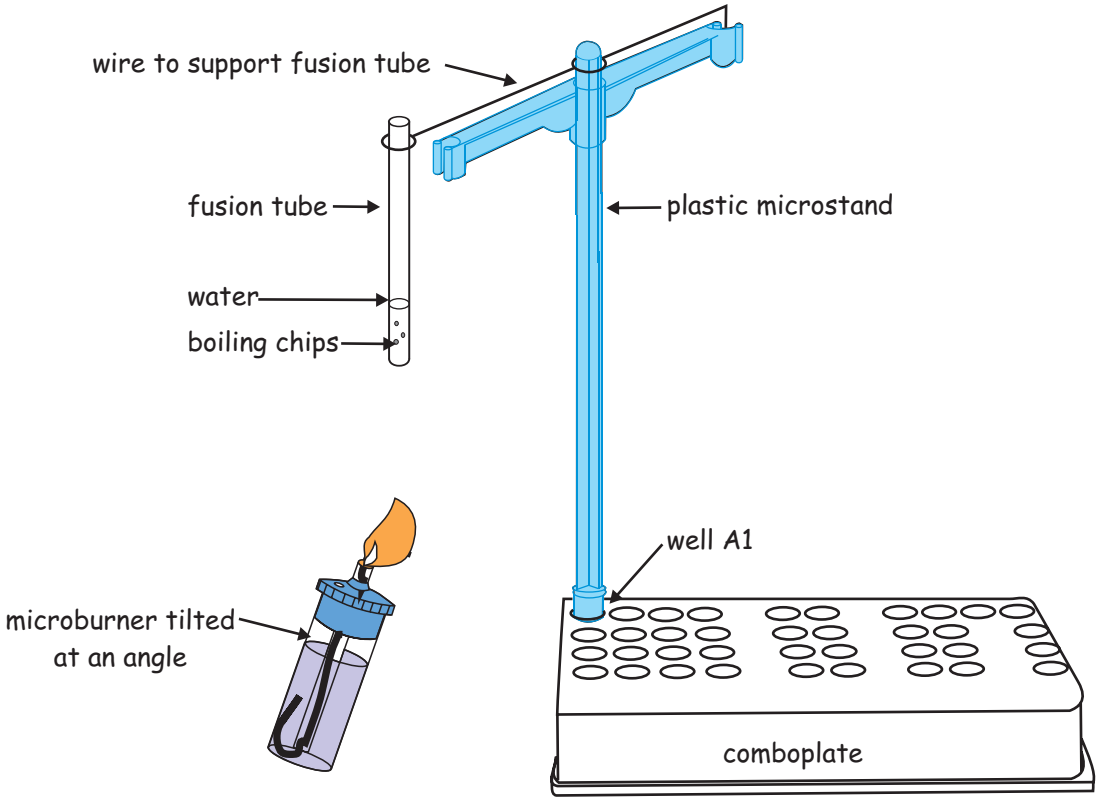
You will need:

- a large glass sample vial
- a small glass sample vial
- 1 microburner
- 2 microspatulas
- 2 propettes
- 1 microstand
- 1 metal tube holder
- 1 metal stirrer
- matches
- 1 rimmed glass fusion tube
- blue copper sulphate crystals
- water
- paraffin

Step 1 Light the microburner. Be careful not to burn yourself.

Step 2 Put 2 microspatulas of blue copper sulphate crystals into the glass fusion tube.

Step 3 Put the fusion tube into the metal tube holder so that the holder is at the top of the tube (look at the drawing below).



Step 4 Heat the fusion tube in the flame for about one minute. Move the flame in and out under the tube.

Step 5 Look at the solid in the tube while you are heating it. You should see

(a) a clear liquid on the inside of the top of the tube

(b) that the blue solid goes grey-white. We call this grey-white powder ANHYDROUS COPPER SULPHATE.

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Step 6 Keep heating the tube until all the clear liquid disappears.

Step 7 Stop heating the fusion tube when all the clear liquid has disappeared.

Step 8 When the tube is cool, use the metal stirrer to break the grey-white solid in the fusion tube into very small pieces.

Step 9 If some of the solid in the fusion tube is still blue, heat the fusion tube again.

Step 10 Keep heating the solid in the fusion tube until all the powder is grey-white and until all the clear liquid has disappeared.

Step 11 When the tube is cool, take two to three microspatulas of grey-white powder out of the tube. Keep this for the next activity.

Step 12 Put about half of the remaining grey-white powder into the small sample vial. Put the rest of the powder into the large sample vial.

Step 13 Use the propette to put 5 drops of water onto the grey-white powder in the small sample vial. Watch carefully as you do this.

Q1 What happens to the colour of the grey-white powder when you do this?

Step 14 Use another propette to put 5 drops of paraffin onto the grey-white powder in the large sample vial. Watch carefully as you do this.

Q2 What happens to the colour of the grey-white powder when you do this?

Q3 Why should you **NEVER** taste a liquid to see if it is water?

Q4 Fill in the missing word in the sentence below:

In this experiment the only liquid which turns anhydrous copper sulphate blue is .....

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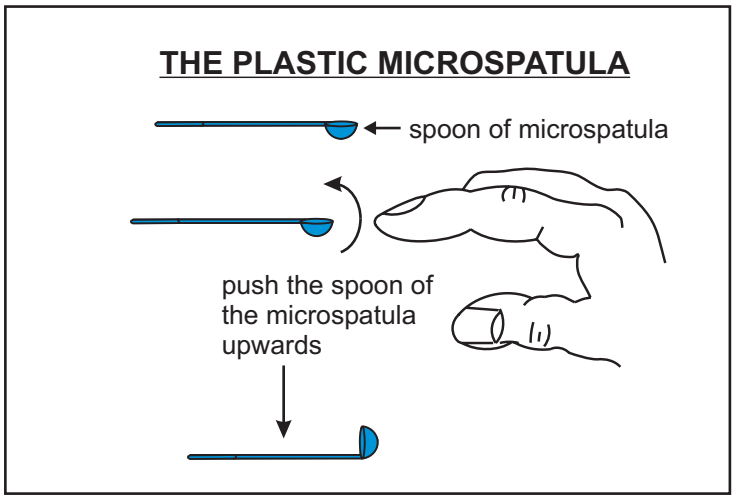
Activity 2.11 ABOUT WATER VAPOUR

Focus question: Can water become invisible and yet still exist?

You will need:

1 microburner 2 micro spatulas 1 propette 1 large sample vial
anhydrous copper sulphate (from Activity 2.10) cold and hot water Prestik

Step 1 Heat the spatula over the microburner. Bend the spoon end of the microspatula upwards (look at the drawing).



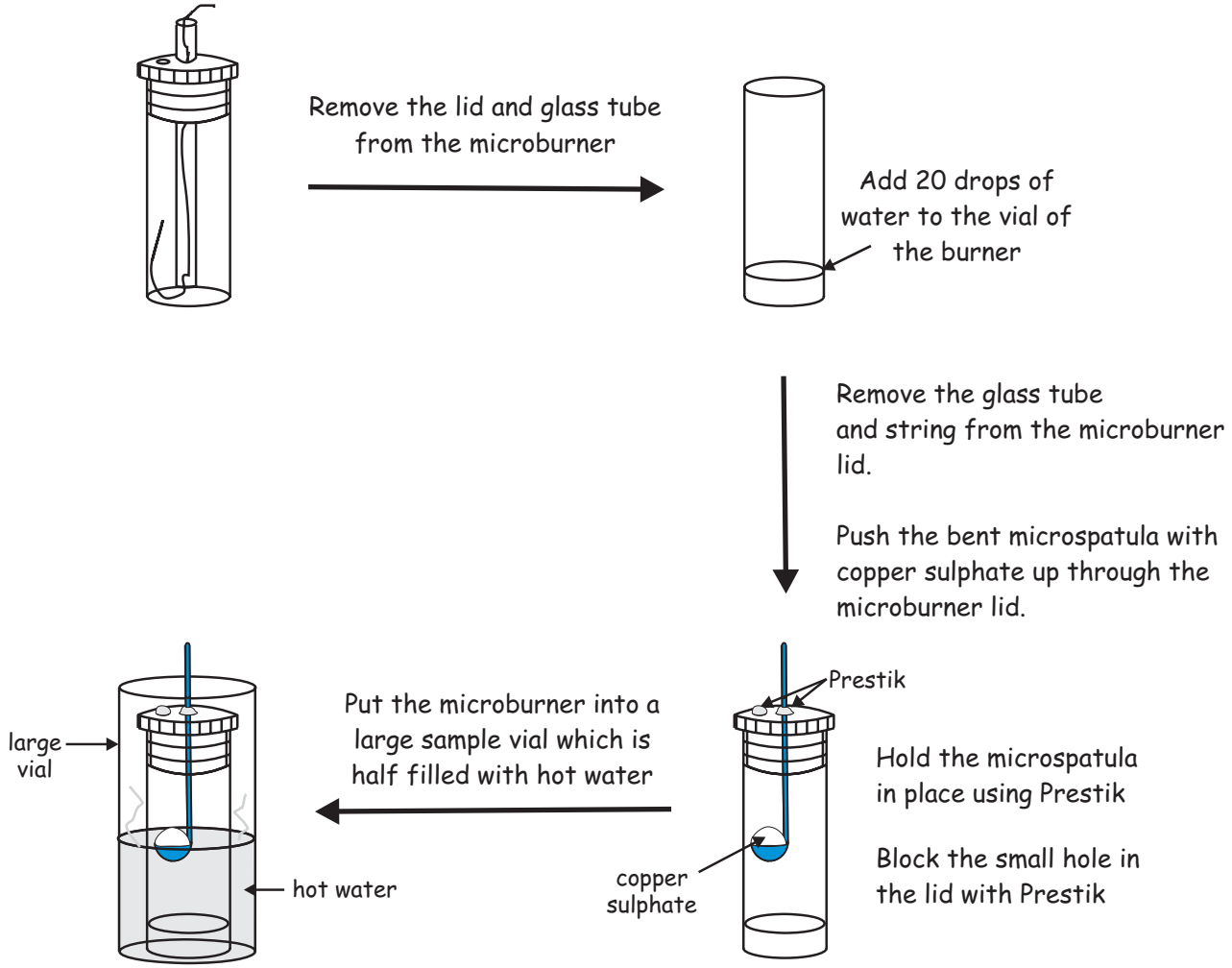
Step2 Fill the microspatula spoon with anhydrous copper sulphate (if necessary repeat Activity 2.10 to make more anhydrous copper sulphate).

Step 3 Follow the instructions in the drawing on the following page and use the microburner and large sample vial as shown.

Step 4 Half fill the large sample vial with hot water.

Step 5 Put the microburner into the water in the large sample vial and wait for 5 minutes.

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Q1 What happened to the colour of the anhydrous copper sulphate?

Step 6 When you have seen what has happened, clean everything first and then start again.

Follow ALL the instructions on the drawing above again, ONLY this time, DO NOT ADD TWENTY DROPS OF WATER TO THE MICROBURNER VIAL.

Q2 What happened to the colour of the anhydrous copper sulphate in this second experiment?

Q3 The grey-white colour of anhydrous copper sulphate will only change to blue in the presence of .....

Q4 Did the colour of the anhydrous copper sulphate change when:

(a) there was water in the microburner vial?

(b) there was no water in the microburner vial?

Q5 (a) Did you see the water which changed the colour of the grey-white anhydrous copper sulphate to blue?

(b) Where did the water come from?

Q6 Can water become invisible?

Q7 Where do you think you will find the most water in the air:

(a) at the sea?

(b) in the mountains?

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Activity 2.12 THE WATER CYCLE

Focus question: What do we mean by the 'water cycle'?

You will need:

- 1 large sample vial
- 1 marking pen
- 1 syringe (2 ml)
- tap water
- 1 square of aluminium foil (5 cm x 5 cm)

Step 1 Take the lid off a large sample vial.

Step 2 Use the syringe to put 2 ml of tap water into the sample vial and put the lid back on.

Step 3 Wrap the square of aluminium foil around the lid and top of the sample vial so that about a quarter of the vial is covered with foil.

Step 4 Mark the initial level of the water with the marking pen.

Step 5 Put the sample vial in the sun and wait a couple of hours before you answer the questions below.

Q1 What happens to the water level in the sample vial after a while?

Q2 (a) What do you see on the inside walls of the sample vial?

(b) Where do you think this substance comes from? Explain.

Q3 (a) What is the name of the process during which gaseous water changes to liquid water?

(b) What is the name of the process during which water in the liquid state changes into water in the gaseous state?

Q4 How are your observations related to the 'water cycle'? Explain what 'the water cycle' is.

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Activity 2.13 WIND AND EVAPORATION

Focus question: How does the wind affect evaporation?

You will need:

- 2 large sample vials
- tap water
- 1 marking pen (permanent)
- 1 syringe (2 ml)

Step 1 Mark down a scale on one of the large sample vials. See illustration below to do this:

(a) Take off the lid

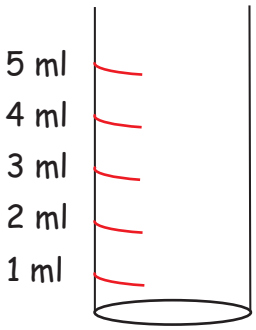
(b) Draw 1 ml of water into the syringe

(c) Push the plunger of the syringe to put all the water into the vial

(d) Mark the level of the water in the vial

(e) Label this water level 1 ml

(f) Repeat b, c, d and e several times. Your scale should look like the example:



You should have about 17 markings on the sample vial.

Step 2 Repeat step l(a) to (f) with the other large sample vial using the same syringe.

Step 3 Make sure that the last marking in both vials is exactly the same. Fill both vials up to the last marking, e.g. if the last marking is 17 ml, then the water level should be at 17 ml in both sample vials.

Step 4 Use the marking pen to label the sample vials: A and B.

Step 5 Place sample vial A in a windy, shady place (e.g. on the shelf near an open window) and sample vial B in a non-windy, shady place (e.g. on the shelf away from the open window).

Step 6 Write down the volume of water (in ml) in each sample vial in the table which follows.

Step 7 Read the volume of water in sample vials A and B at least once a day for two or three days.

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Table A

WHEN DID YOU READ THE VOLUMES?	VOLUME OF WATER IN SAMPLE VIAL A (ml) - IN A WINDY PLACE	VOLUME OF WATER IN SAMPLE VIAL B (ml) - IN A NON-WINDY PLACE
First day at:		
First day at:		
Second day at:		
Second day at:		

Q1 After one day the volume of water in sample vial A:

(a) is higher (b) is lower (c) stays the same

Q2 After one day the volume of water in sample vial B:

(a) is higher (b) is lower (c) stays the same

Q3 Is there any time at which there is LESS water in sample vial A than in sample vial B?

Q4 Is there any time at which there is LESS water in sample vial B than in sample vial A?

Q5 Why does the quantity of water in the vials become less?

Q6 In which sample vial, A or B, does the water level fall more quickly?

Q7 What is different about the place where we put sample vial A and the place where we put sample vial B?

Q8 Does the wind make evaporation happen

(a) slower?

(b) quicker?

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Activity 2.14 EVAPORATION AND TEMPERATURE

Focus question: Does evaporation happen faster in a warm place or in a cool place?

You will need:

- 2 large sample vials
- tap water
- 1 marking pen (permanent)
- 1 syringe (2 ml)

Step 1 Use the sample vials A and B you used in Activity 2.13. Fill these with water, using the syringe, in the same way as in step 1 before.

Step 2 Put sample vial A in a warm place and sample vial B in a cool place.

Step 3 Write down the volume of water (in ml) in each sample vial in the table below. Read the volume of water in sample vials A and B at least once a day for two or three days.

WHEN DID YOU READ THE VOLUMES?	VOLUME OF WATER IN SAMPLE VIAL A (ml) - IN A WARM PLACE	VOLUME OF WATER IN SAMPLE VIAL B (ml) - IN A COOL PLACE
First day at:		
First day at:		
Second day at:		
Second day at:		

Q1 Does the volume of water

(a) get less in A and B? (b) get less in A only? (c) get less in B only?

Q2 Take a look at the water in your sample vials during the second day. Which sample vial has less water: A or B?

Q3 In which vial, A or B, does the water evaporate faster?

Q4 In what way is the place where we put sample vial A different to the place where we put sample vial B?

Q5 Where will wet clothes dry quicker: in the sun or in the shade?

Q6 Cross out the wrong word in the following sentence:

Evaporation happens **faster/slower** in hot places than in cooler places.

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Activity 2.15 EVAPORATION AND SURFACE AREA

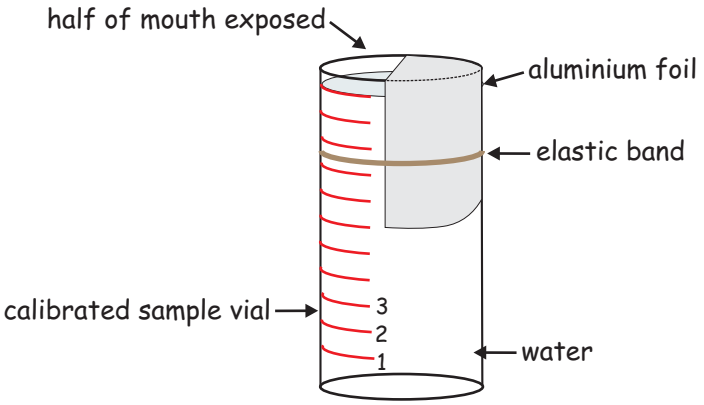
Focus question: Does evaporation happen faster from a big surface or from a small surface?

You will need:

- 2 large sample vials
- 1 elastic band
- 1 marking pen (permanent)
- tap water
- 1 syringe
- 1 strip of aluminium foil (6,5 cm x 1,5 cm)

Step 1 Use sample vials A and B from Activity 2.13. Use the syringe to fill sample vials A and B with water. (Both vials should have about 17 ml of water.)

Step 2 Put the aluminium foil over half of the mouth of sample vial B. Hold the foil in place with an elastic band. Look at the drawing below to see how to do this. Be careful not to put the elastic band or the foil over the numbers on the sample vial.



Step 3 Put both vials (A and B) in the same place i.e. both in the sun or both in the shade.

Step 4 Write down the volume of water (in ml) in each sample vial in the table below.

Step 5 Read the volume of water in sample vials A and B at least once a day for two or three days.

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WHEN DID YOU READ THE VOLUMES?	VOLUME OF WATER IN LARGE SAMPLE VIAL A (ml)	VOLUME OF WATER IN LARGE SAMPLE VIAL B (ml)
First day at:		
First day at:		
Second day at:		
Second day at:		

Q1 After one day does the volume of water in both sample vials:

(a) stay the same? (b) become bigger? (c) become smaller?

Q2 Where does evaporation take place - from the surface of the water or from the water at the bottom of the vial?

Q3 Compare the two water volumes each time you take a measurement. Are they the same? If not, which one is more (more water)?

Q4 Which vial, A or B, contains LESS water at the end of the experiment?

Q5 Which water surface is bigger: A or B?

Q6 1 teaspoon of water is put into a saucer; 1 teaspoon of water is put into a large sample vial. The saucer and the vial are put in the sun. Would you expect the water to evaporate faster from the vial or from the saucer?

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Activity 2.16 IS THERE WATER IN PLANT LEAVES?

Focus question: Can we get drinking water from plants?

No need to die of thirst!

Imagine that you are in the middle of a desert without water. There are no rivers and no lakes in the desert. This experiment will tell you what you can do in order to survive your outdoor venture. Remember: some of the items used in this experiment may not be available to you outdoors and you may need to think of other similar ways to collect water if you were in this situation.

You will need:

- 1 small sample vial with lid (without holes)
- 1 succulent plant leaf (Xerophytes work best)
- 2 microspatulas
- Prestik
- 1 pair of scissors
- anhydrous copper sulphate

Step 1 Use the pair of scissors to cut the leaf into small squares about 1 cm wide and long. If the leaf has thorns or prickly hairs, be careful not to hurt yourself.

Step 2 Remove the lid from the sample vial.

Step 3 Put the leaf cuttings in the vial.

Step 4 Put the lid back onto the sample vial.

Step 5 Put the vial in the sun for about 30 - 45 min.

Q1 Describe what you see on the sides of the sample vial.

Step 6 Open the sample vial. Use the spooned end of the microspatula to remove some of the colourless liquid.

Step 7 Use another microspatula to add a few grains of anhydrous copper sulphate to this colourless liquid. (Activity 2.10 tells you how to make anhydrous copper sulphate).

Q2 What happened to the white anhydrous copper sulphate when it was added to the colourless liquid?

Q3 What is the name of the colourless liquid that was formed in the sample vial?

Q4 Where does this water come from?

Q5 Would the quantity of leaf cuttings be sufficient to fill the sample vial with water?

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Activity 2.17 IS IT STILL THE WATER I KNOW?

Focus question: Why does the water in the pot become less as it boils?

You will need:

- 1 comboplate
- 1 microstand
- 1 microspatula
- 1 microburner
- boiling chips
- 1 rimmed glass fusion tube
- 1 metal tube holder
- Prestik
- methylated spirits
- 1 box of matches
- crushed ice

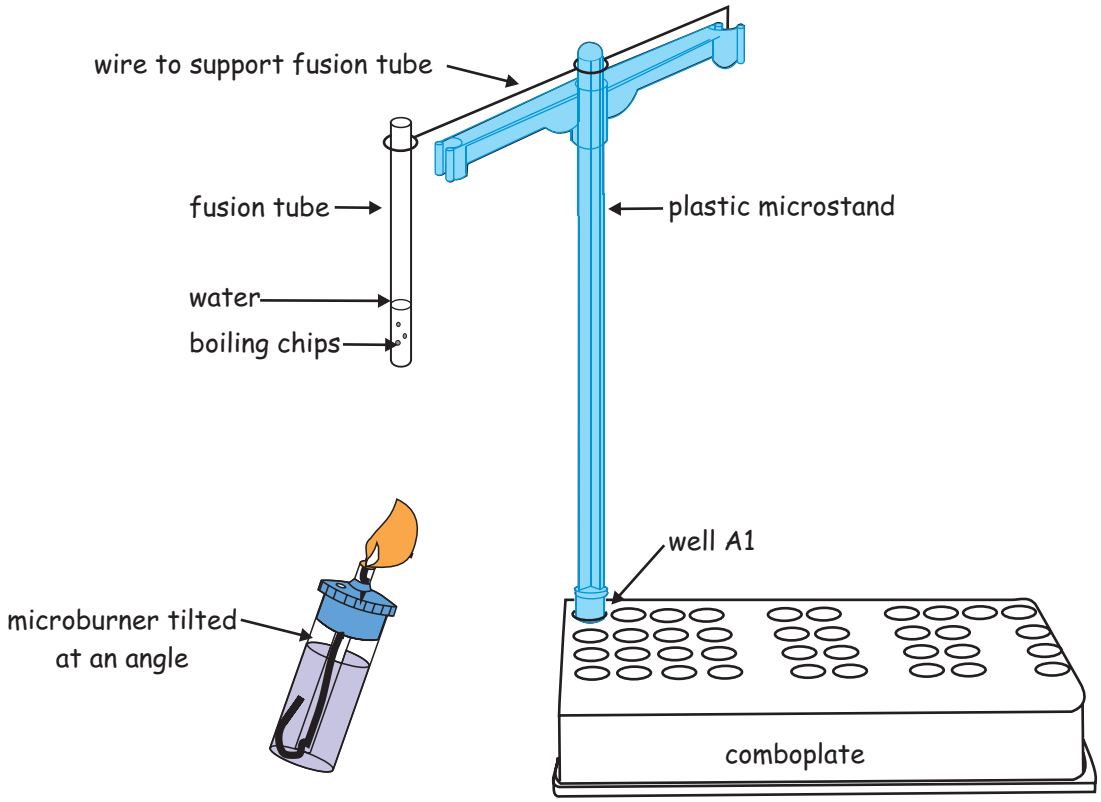
Step 1 Place the microstand in well A1.

Step 2 Put the metal tube holder (wire to support the fusion tube) over the plastic microstand.

Step 3 Fill the rimmed glass fusion tube one quarter full with crushed ice.

Step 4 Place the fusion tube into the metal tube holder so that it is held at the rim of the tube.

Step 5 Light the microburner and keep the flame about 3 cm from the bottom of the fusion tube.



Step 6 Carefully heat the fusion tube and its contents for about two minutes. Now take the microburner away and let the fusion tube cool. Do not blow the flame out, but be careful not to burn yourself.

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Q1 In what state of water (solid, liquid or gas) was the crushed ice when you put it in the fusion tube?

Q2 After heating the tube for two minutes was the ice still in the same state? What happened?

a) If nothing happens while heating the tube for about 2-3 minutes, raise the position of the microburner until you do observe something happening. Continue with the experiment.

b) If hot water begins to squirt out of the tube, lower the position of the microburner. Continue with the experiment.

Step 7 Add 3 boiling chips to the contents of the fusion tube.

Step 8 Heat the fusion tube and contents again by keeping the flame about 3 cm from the bottom of the tube.

Step 9 Continue to heat until there is no more water in the fusion tube. This may take about ten minutes.

Q3 In what state (solid, liquid or gas) was the water in the fusion tube before you started heating it?

Q4 What happens to the water after heating it for about 2 minutes?

Q5 What is it called when water bubbles while being heated vigorously?

Q6 Does the quantity of water in the fusion tube stay the same as you heat it?

Q7 Where did the 'missing' water go to when you heated the fusion tube?

Q8 In what state (solid, liquid or gas) was the water that went 'missing'?

Q9 What was needed to change water from ice into gaseous water?

Q10 What would you do to change gaseous water into solid water?

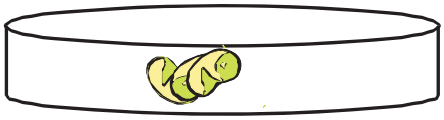
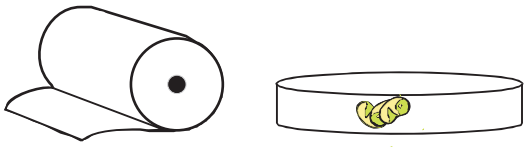
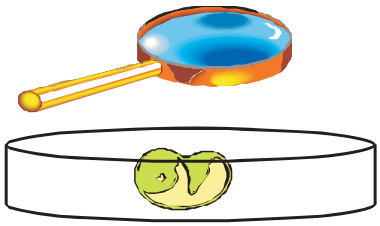
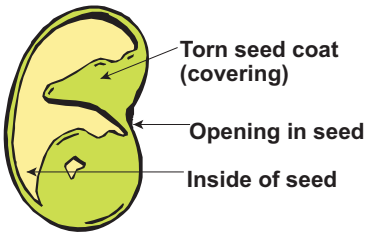
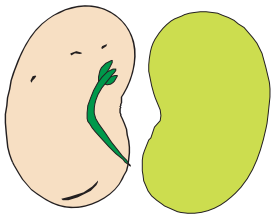
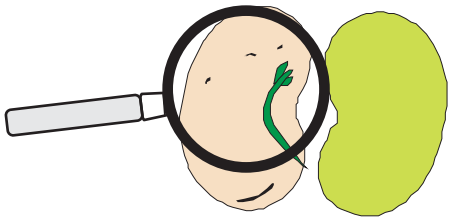
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ACTIVITY 2.18 WHAT DOES A SEED LOOK LIKE?

Introduction: Many plants produce seeds. These seeds grow into new plants.

To study a seed you need:

- petri dish
- a few dry bean seeds and pea seeds/lentil seeds
- water
- forceps
- hand lens
- paper towel

1 First soak the bean seeds in water in the petri dish for about a day. 	2 Remove the seeds, dry the dish and replace the seeds in the dried dish. 
3 Use the hand lens to look at one of the seeds. 	4 Find the labelled structures on your own seed. 
5 Use forceps to remove the torn seed coat. The seed breaks into two halves. 	6 Use the hand lens to look at the baby plant inside the seed 

Q1 Make a drawing of the baby plant to show the young root and the young stem.

Q2 Repeat steps 1 to 6 with pea seeds and /or lentil seeds. Make your own drawings of these seeds.

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ACTIVITY 2.19 GROWING A NEW PLANT

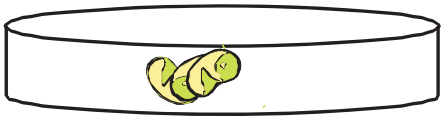
INTRODUCTION

New plants grow from seeds. You have seen that there is a baby plant inside a seed. Now you can grow your own plant from a seed.

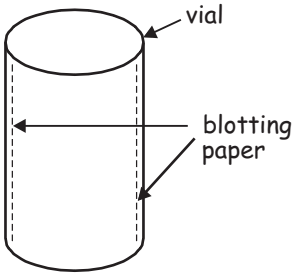
To grow a plant from a seed you need:

- vial
- petri dish
- a few sunflower seeds or bean seeds
- blotting paper
- water
- paper towel
- ruler
- string

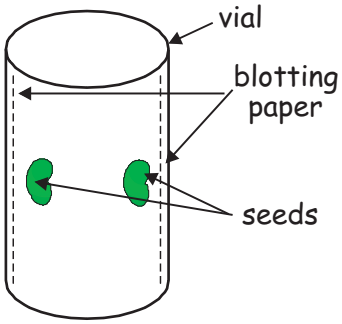
1 First soak the seeds in water in the petri dish for about a day.



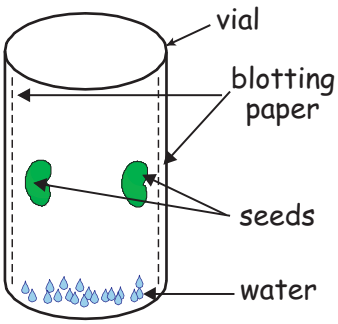
2 Line the vial with blotting paper.



3 Place a few seeds between the blotting paper and the vial.



4 Fill the vial with crumpled paper towel and add water to the bottom of the vial so that the blotting paper becomes damp.



Put the vial in a warm (not hot) place, out of direct sunlight. Check to make sure that the blotting paper is always damp. Add more water to the bottom of the vial if necessary.

Look at the seeds every day for a week. Answer the following questions in your notebook.

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QUESTIONS

Q1 Which part of the young plant grows out of the seed first? Is it the young root or the young shoot?

Q2 In which direction does the young root grow?

Q3 In which direction does the young shoot grow?

Do not take the young plant out of the vial. Use a piece of string and a ruler to measure the length of the young root every day for about 10 days.

Q4 Write your results in a table like the one below.

Day	Length of young root in mm	Length of young shoot in mm
1	0	0
2		
3	2	0
4		
5		
etc.	5	2

Q5 Do the same with the young shoot and also write your results in the table.

Q6 Draw a picture of the young plant on days 1, 5 and 9.

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ACTIVITY 2.20 DO SEEDS NEED WATER TO GROW INTO NEW PLANTS?

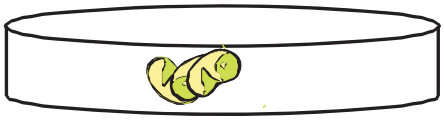
INTRODUCTION

You have seen that new plants grow from seeds. Now we need to find out what seeds need to grow into new plants.

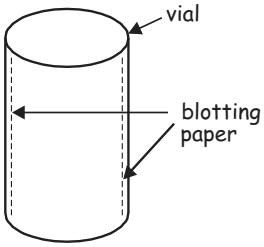
To grow a plant from a seed you need:

- 2 vials
- blotting paper
- petri dish
- paper towel
- a few sunflower seeds or bean seeds
- water

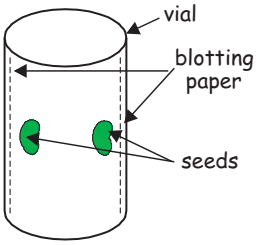
1 First soak half of the seeds in water in the petri dish for about a day.



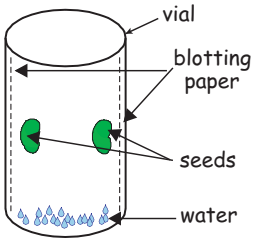
2 Line 2 vials each with a sheet of blotting paper.



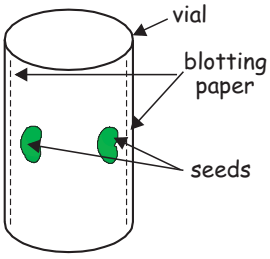
3 Place a few soaked seeds between the blotting paper and the wall of one vial.



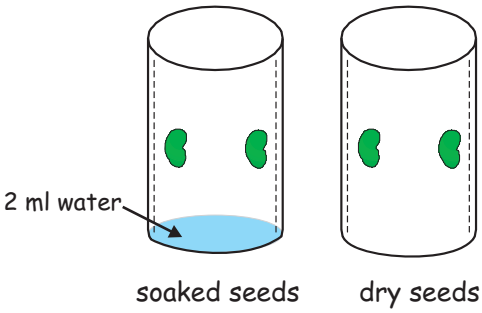
4 Then place a few dry seeds of the same sort between the blotting paper and the wall of the other vial.



5 Fill the vials with crumpled paper towel.



6 Add 2 ml water only to the vial with the soaked seeds. Put both vials in the same place.



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Look at the seeds every day for a week. Make sure that the vial that started out wet remains wet by adding more water as necessary.

Answer the following questions in your notebook.

Q1 Which young plants grew out of the seeds first? The soaked ones or the dry ones?

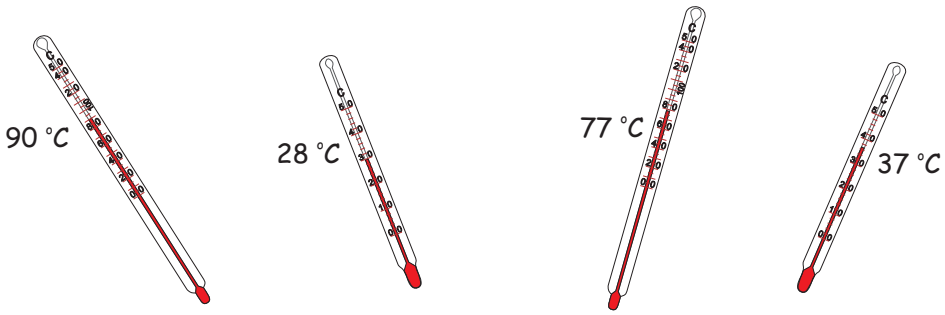
Q2 Do seeds need water to grow?

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ACTIVITY 2.21 DO SEEDS START TO GROW IN ALL TEMPERATURES?

INTRODUCTION

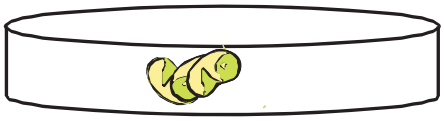
You have seen that new plants grow from seeds if they have enough water. Now we need to find out what else seeds need to grow into healthy new plants. Work in groups so that each group uses a place with a different temperature. Afterwards, you will compare your results with the results of other groups.



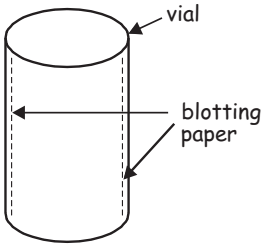
Each group needs:

- vial
- petri dish
- a few sunflower seeds or bean seeds
- blotting paper
- water
- paper towel
- thermometer

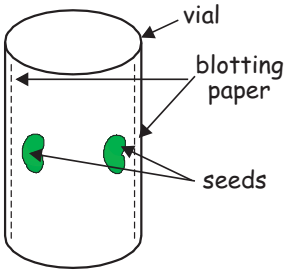
1 First soak the seeds in water in the petri dish for about a day.



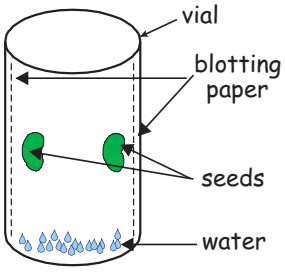
2 Line the vial with blotting paper.



3 Place a few seeds between the blotting paper and the vial.



4 Fill the vial with crumpled paper towel and add 2 ml water to the bottom of the vial.



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Step 5

Choose a place out of direct sunlight for your vial and seeds. Some suitable places could be:

- ✓ the refrigerator.
- ✓ the deep freezer.
- ✓ a stone floor.
- ✓ windowsills facing different directions like north, west etc.
- ✓ different parts of your school - cloakroom, the classroom and so on.
- ✓ a very hot place near a heater or cooker.

Step 6

Place the thermometer beside the vial.

Step 7

Add water to the vial as necessary.

Step 8

Record the temperature reading on the thermometer each day for at least one week, using a table like the one below.

Day	Temp in °C	When I saw the new plant
1		
2		

Step 9

Look at the seeds every day. Record the day that you first see the baby plant.

Step 10

Work out the **average temperature** of the place you chose. The example underneath shows how to do this.

Day	Temp in °C
1	20
2	18
3	21
4	18
5	17

Add all the temperatures = 20 + 18 + 21 + 18 + 17 = 94 °C

Divide by the number of days 94/5 = 18.8 °C.

This is the **average temperature**.

Compare your results with the results of other groups.

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Q1 Why did we use seeds of the same type?

Q2 What was the average temperature of the place where the young plant took the shortest time to start to grow?

Q3 What was the average temperature of the place where the young plant took the longest time to start to grow?

Q4 Were there any places where the seeds did not start to grow at all?

Q5 Copy and complete the following sentence:

We found that with (type)..... seeds, they started to grow fastest, at (temp)..... and slowest at (temp).....

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Activity 2.22 NEW PLANTS FROM PARTS OF PLANTS

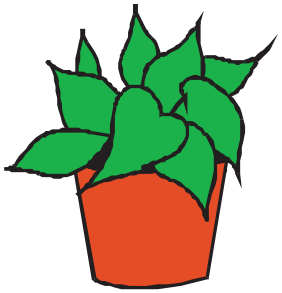
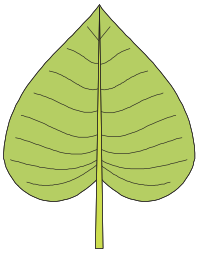
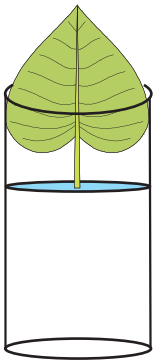
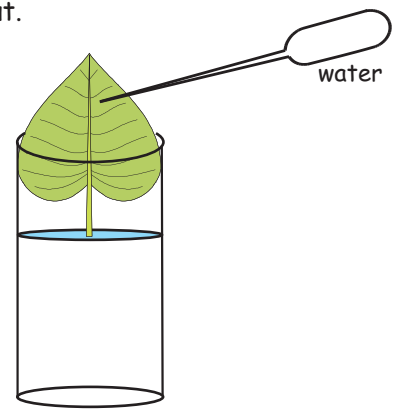
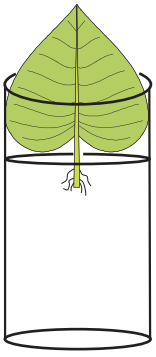
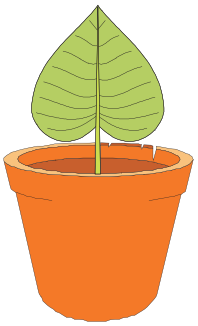
PART ONE

INTRODUCTION

You have seen that new plants grow from seeds. New plants also grow from parts of plants.

To grow a new plant from a part of a plant you need:

- a Geranium or African violet or Begonia plant in a pot or garden
- soil
- plant pot
- scissors
- water
- vial
- propette

1 Choose a healthy, well watered plant. 	2 Take a leaf with its stalk from the plant. 
3 Put the leaf in a vial of water and leave it for several days. 	4 Use a propette to add water to the vial from time to time so that the leaf does not dry out. 
5 After about 10 days, the leaf stalk will grow roots. 	6 After a further week, you can plant the leaf in a plant pot with soil. 

Water the leaf in the pot. It will grow into a new plant with its own roots, stems and leaves. If you wait long enough, it may even grow flowers. You can give the new plant to somebody for a present.

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NEW PLANTS FROM PARTS OF PLANTS

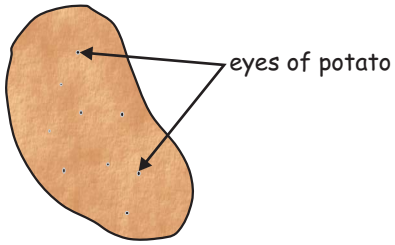
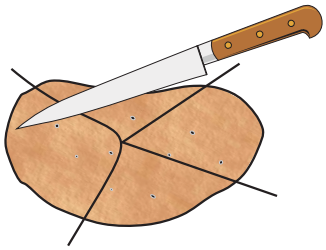
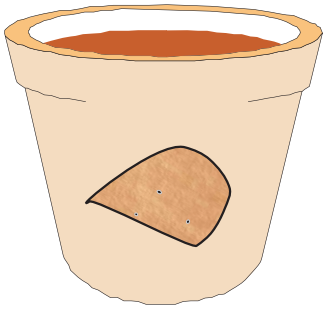
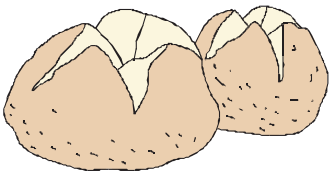
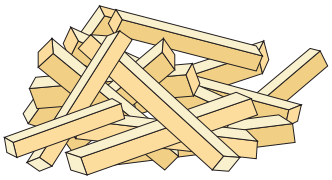
PART TWO

INTRODUCTION

You have seen that new plants can grow from leaves. New plants can also grow from other parts.

To grow potatoes from pieces of potato you need:

- potato
- knife
- plant pot
- soil

1 First collect a potato which has "eyes" .  	2 Cut the potato into pieces, so that each piece has one or two "eyes" 
3 Plant each potato piece in a plant pot with soil. 	4 After a few months, each potato piece will grow into a whole potato plant. 
5 You can cook and eat your own potatoes.  or 	

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CHAPTER 3

CHAPTER 3

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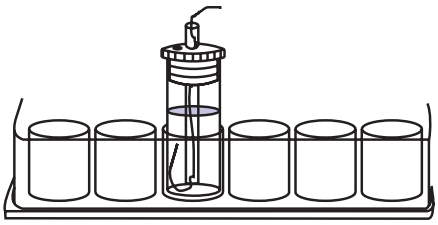
Activity 3.1 EVEN FLAMES NEED AIR TO KEEP GOING

Focus question: Why do veld fires become so uncontrollable during windy days?

You will need:

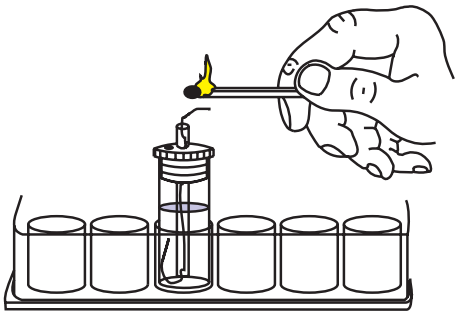
- 1 comboplate
- 1 microburner
- 1 sample vial
- matches

STEP 1



Assemble the microburner and put it into one of the large wells.

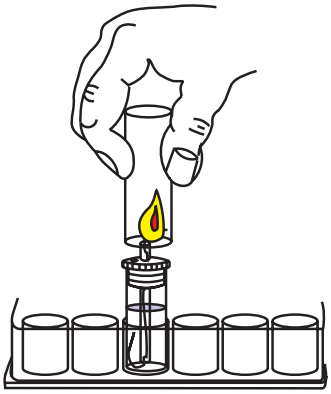
STEP 2



Light the microburner.

STEP 3

Cover the microburner with an inverted sample vial.



Answer the following questions :

Q1 What do you observe?

Q2 What was in the sample vial when you first placed it over the burner?

Q3 What causes things to burn?

Q4 What are you actually cutting out when you put the inverted sample vial over the microburner?

Q5 What things do you need to start a fire?

Q6 When making a fire for a 'braai', we normally use things like cardboard to fan the fire to resuscitate it. Why is this?

Q7 During windy days, veld fires are normally not easy to control. Why do you think this is the case?

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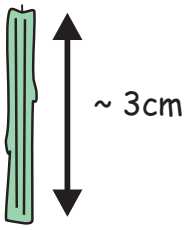
Activity 3.2 IS ALL THE AIR USED IN BURNING?

Focus question: Is it the whole part of air which is responsible for burning or is it some special part of air?

You will need:

- 1 Petri dish
- 1 large sample vial
- 1 birthday candle
- matches
- lime water (calcium hydroxide solution)

STEP 1



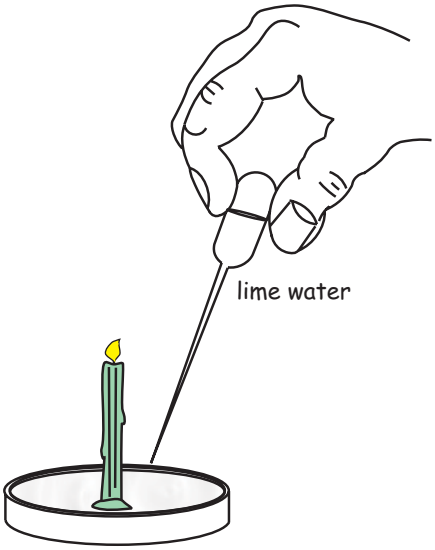
Shorten a birthday candle so that it is about 2.5 - 3 cm long.

STEP 2



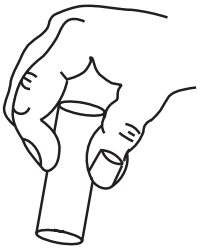
Light the candle and let some wax fall into the bottom of the Petri dish. Push the base of the candle into the wax to support it in the Petri dish.

STEP 3



Fill the Petri dish almost to the rim with lime water.

STEP 4



Put the sample vial over the burning candle into the lime water. Note what happens.



Q1 Describe what happens.

Q2 Why does the candle stop burning?

Q3 Why does the water rise in the vial?

Q4 Where does the space which the water fills come from?

Q5 The water does not keep rising until the vial is filled. What stops the water from doing that?

Q6 What was in the vial before inverting it over the burning candle?

Q7 What does the colour of the lime water in the vial tell us?

Q8 Name three gases which are involved in this activity.

Q9 What roles are these gases playing in this activity?

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Activity 3.3 STUDYING MY BREATH

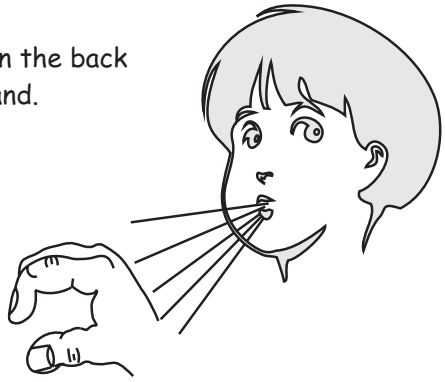
Focus question: Name things which are found in your breath

You will need:

- 1 comboplate
- 1 sample vial
- 1 straw (per 4 kits)
- 1 marker/pen
- 1 propette
- lime water
- a pair of scissors

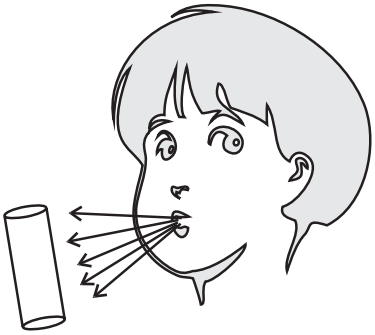
STEP 1

Breathe on the back of your hand.



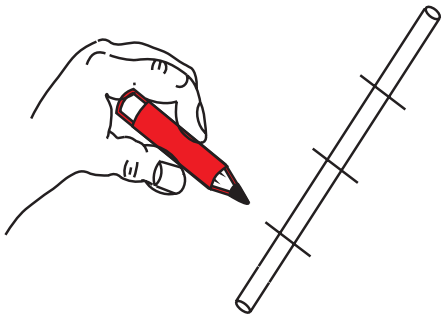
Q1 Explain how it feels.
Q2 Is your breath cold or warm?
Q3 Why is this?

STEP 2



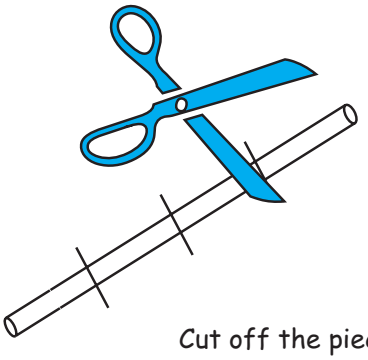
Take a sample vial and breathe onto its surface.
Q4 What do you see?
Q5 Is there water in your breath?

STEP 3



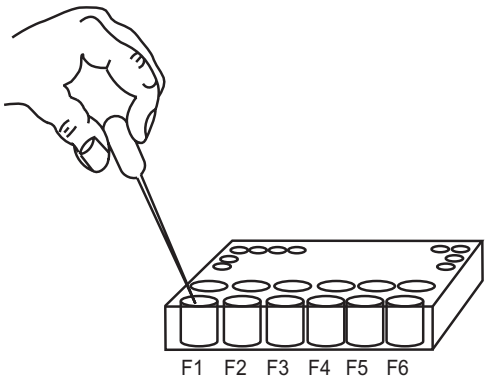
Share a straw with three of your friends by dividing the straw into 4 equal pieces using a marker (pen).

STEP 4



Cut off the pieces.

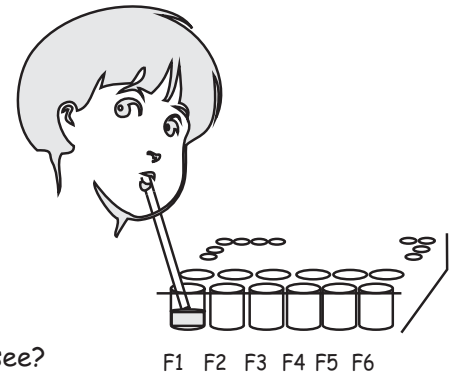
STEP 5



Half fill a large well of the comboplate with clear lime water.

STEP 6

Insert the piece of straw into the lime water and gently blow into it with your mouth.



Q6 What do you see?
Q7 Is your breath a mixture of gases or is it a liquid? Why?
Q8 What colour is the lime water after breathing into it?
Q9 Name four things you have noted about your breath in this activity.

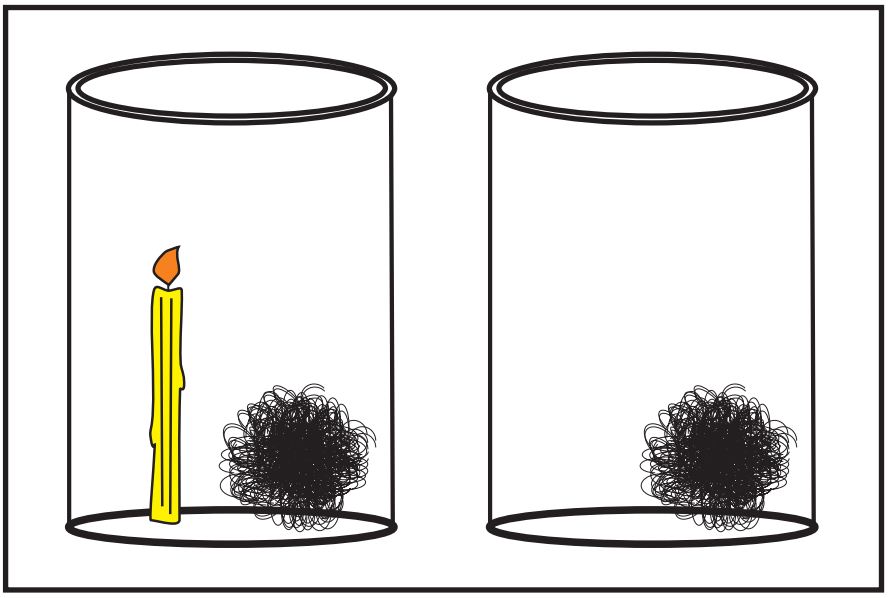
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Activity 3.4 RUSTING AWAY

Focus Question: What causes rusting?

You will need:

- 1 propette
- matches
- 1 steel wool ball
- 1 birthday candle
- 2 glass containers with lids (e.g. jam jars)
- water



STEP 1

Wet the steel wool ball by spraying with water from the propette.

STEP 2

Divide the steel wool ball into two equal balls.

STEP 3

Light the birthday candle and use the melted wax drops to stick the candle inside the floor (towards the side) of one of the glass containers.

STEP 4

Place one steel wool ball inside this container and the other inside the other container.

STEP 5

Light the candle and seal both containers with their lids.

STEP 6

This candle will eventually go out.

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STEP 7

Observe what happens to the two steel wool balls over a period of two days.

Q1 What did you observe?

Q2 Why did this happen?

Q3 What does this activity show about the role of oxygen:

a) in rusting?

b) in combustion?

Q4 What are the similarities and the differences between these two chemical reactions (rusting and combustion)?

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ACTIVITY 3.5 PRODUCTION AND TESTING OF CARBON DIOXIDE ON MY COMBOPLATE

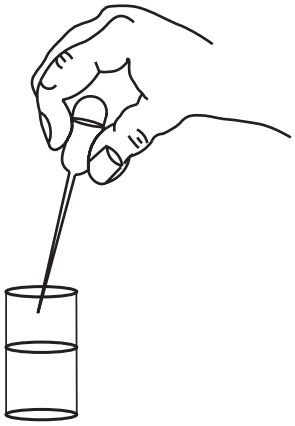
1. Making enough lime water for five.

You will need

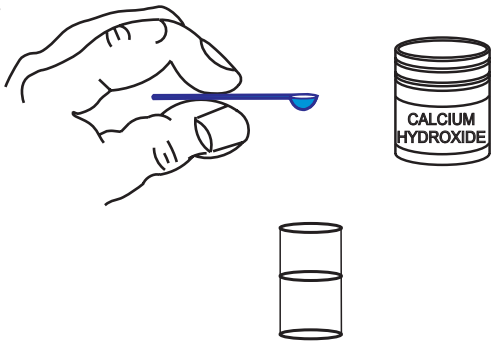
- 2 vials with lids
- propette
- microspatula
- microfunnel
- piece of cotton wool
- calcium hydroxide

STEP 1

Use a propette to fill 2/3 of a sample vial with water.

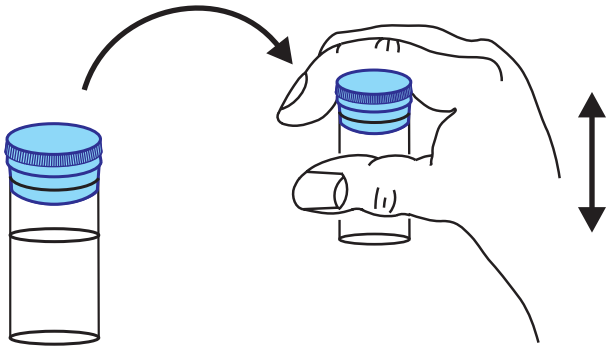


STEP 2



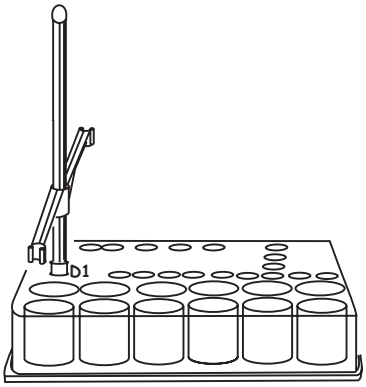
Add 8 microspatulas of calcium hydroxide and stir.

STEP 3



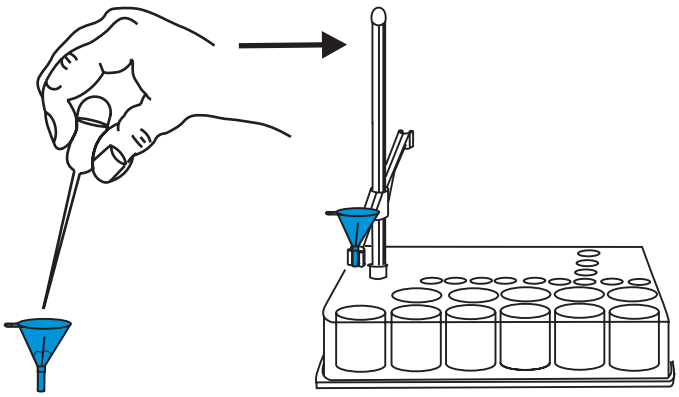
Close the lid and take turns to each give twenty shakes.

STEP 4



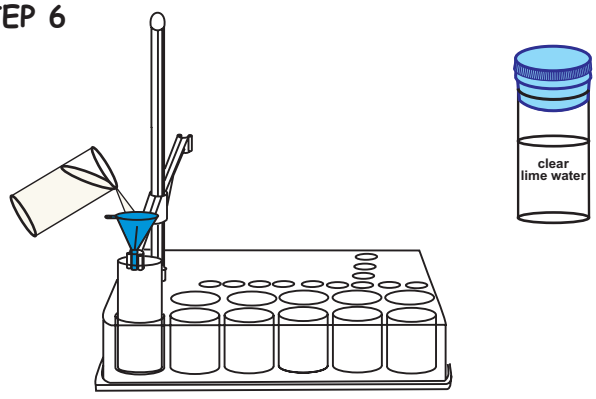
Insert the microstand into well D1 and lower the arm as shown in the picture.

STEP 5



Fit thick pieces of cotton wool into the microfunnel and spray it with few drops of water from a propette to make it wet. Clamp the microfunnel to the microstand arm.

STEP 6



Insert a vial into well F1 and move the microstand arm such that the funnel is directly above the vial. Pour the mixture in the vial carefully into the funnel. When filtration is complete, keep the vial containing the lime water closed.

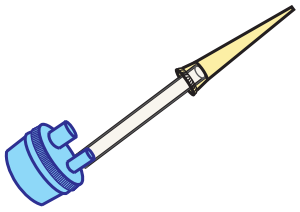
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2. Preparing and testing of carbon dioxide:

You will need:

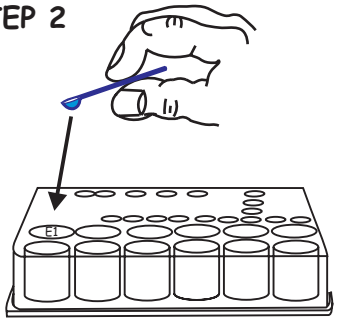
- comboplate
- lid 1
- syringe
- microspatula
- silicone tube
- plastic tip

STEP 1



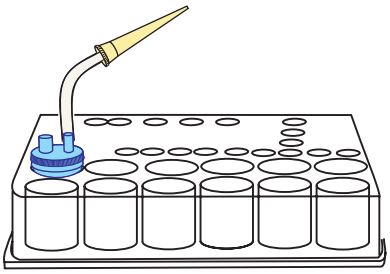
Fit one end of the silicone tube into the plastic tip firmly and the other end to the smaller opening of the lid.

STEP 2



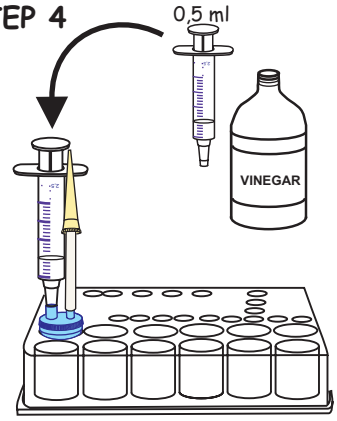
Add 4 microspatulas of sodium bicarbonate into well E1.

STEP 3



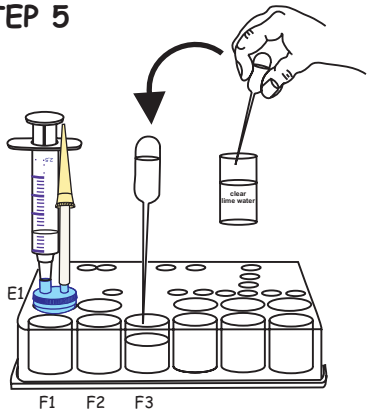
Use the lid in step 1 to close well E1.

STEP 4



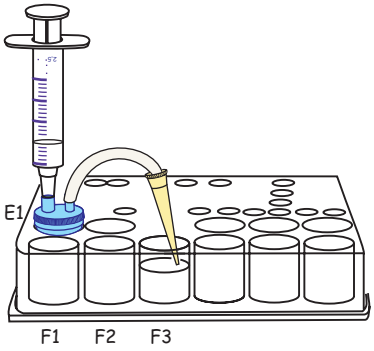
Draw 0.5 ml vinegar into the syringe and fit the syringe carefully into its inlet in the lid on well E1.

STEP 5



Use a propette to 2/3 of well F3 with the clear lime water you prepared.

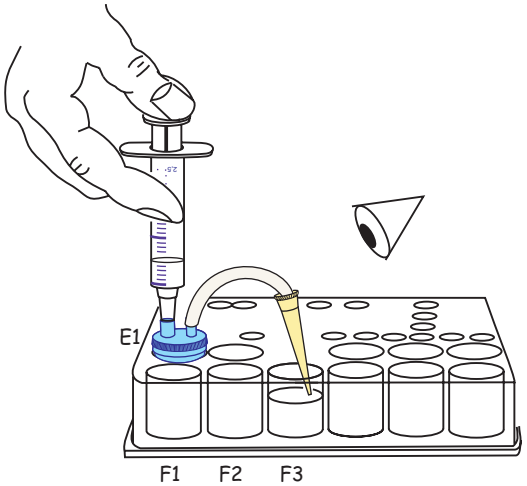
STEP 6



Insert the plastic tip into the lime water in well F3.

STEP 7

Release the vinegar slowly from the syringe making sure that the liquid from well E1 does not flow up the tube. Observe carefully what happens in well F3.



Answer the following questions:

Q1 What do you see?

Q2 What causes the bubbles?

Q3 Which gas causes clear lime water to turn milky?

Q4 What happens when you add vinegar to sodium bicarbonate?

Q5 Why do you think it's important to keep lime water in a closed container?

Q6 Is there carbon dioxide in the air?

Q7 How do we test for carbon dioxide?

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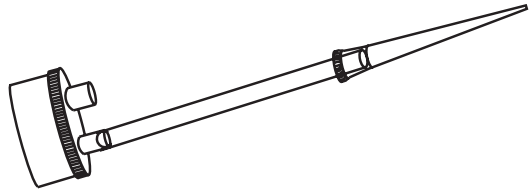
Activity 3.6 MY MICRO FIRE EXTINGUISHER

Focus question: What is inside the fire extinguishers hanging in our buildings?

You will need:

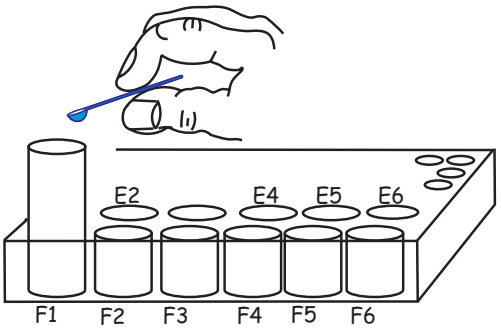
- 1 comboplate
- 1 x lid 1
- 1 syringe
- a plastic tip
- 1 small vial
- 1 microspatula
- 1 x 10 cm silicone tube
- vinegar
- sodium bicarbonate

STEP 1



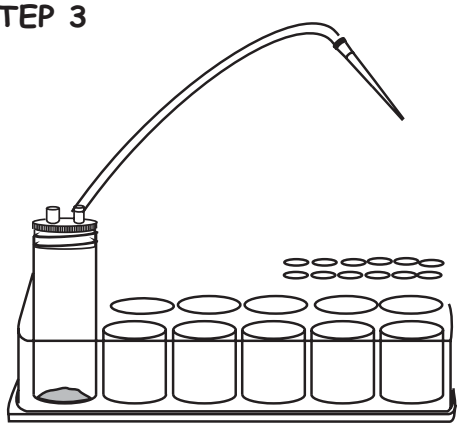
Fit one end of the silicone tube firmly into the plastic tip and the other end to the smaller opening of the lid.

STEP 2



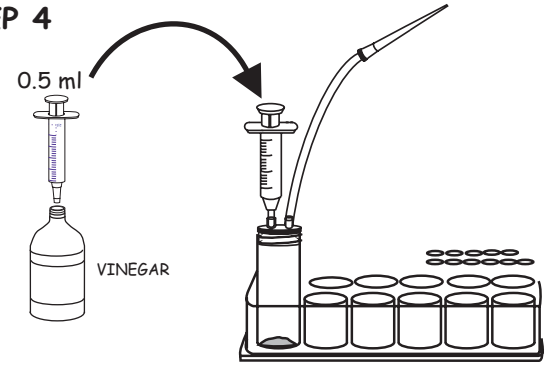
Add 10 microspatulas full of sodium bicarbonate into the vial in well F1.

STEP 3



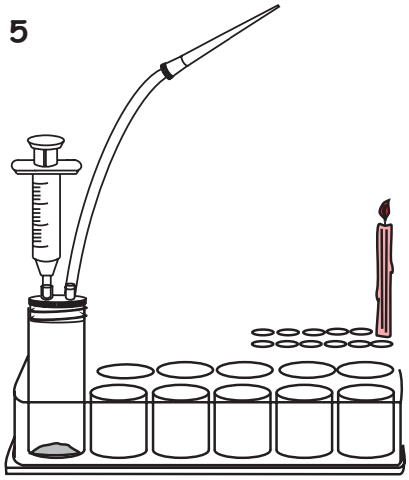
Use the lid in step 1 to close the vial.

STEP 4



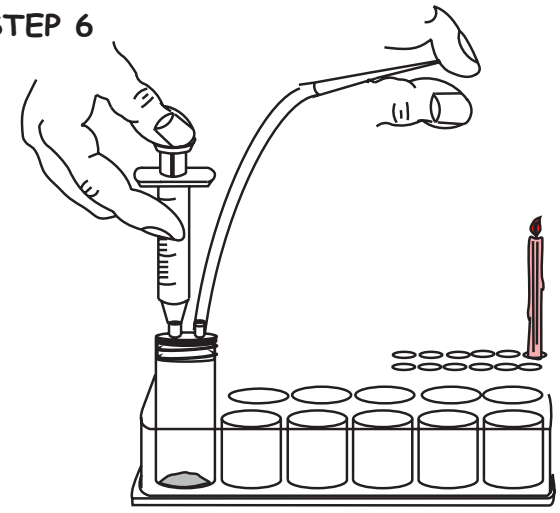
Draw 0.5 ml of vinegar into the syringe and fit the syringe carefully into the syringe inlet (the bigger hole) of the lid on the vial.

STEP 5



Insert a birthday candle into well A12 (small well) of the comboplate and light it. Make sure that the lid in F1 is tightly closed.

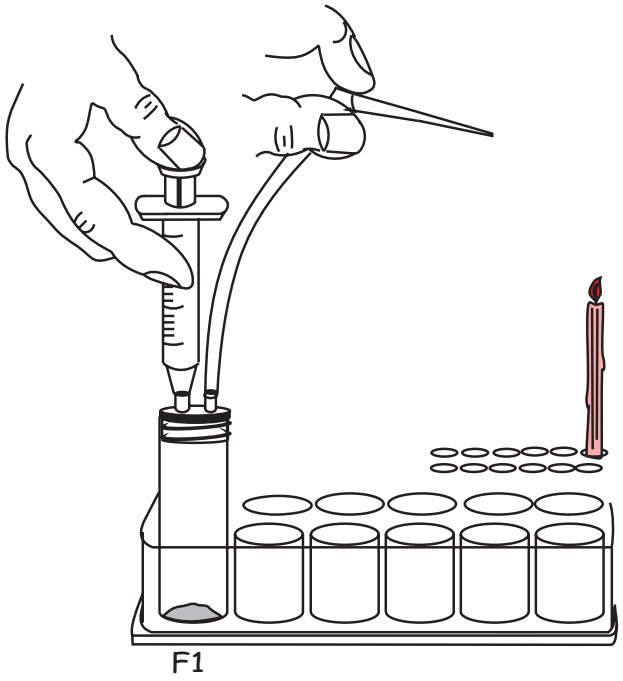
STEP 6

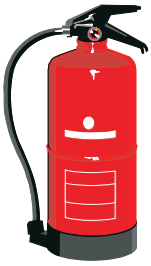


Release the vinegar slowly from the syringe with your left hand while blocking the end of the plastic tip with the index finger of your right hand.

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STEP 7





Point the plastic tip at the candle and remove your finger. (Take care that the tip is never in contact or too close to the flame.)

Q1 What happens?

Q2 What is the name of the gas that is formed when vinegar mixes with sodium bicarbonate?

Q3 What will happen if this gas is bubbled in clear lime water?

Q4 What is an acid and what is a base in this activity?

Q5 Does the gas produced in well F1 support combustion (burning) or not?

Q6 Can the principle behind the extinguisher you have made be used to put out huge fires?

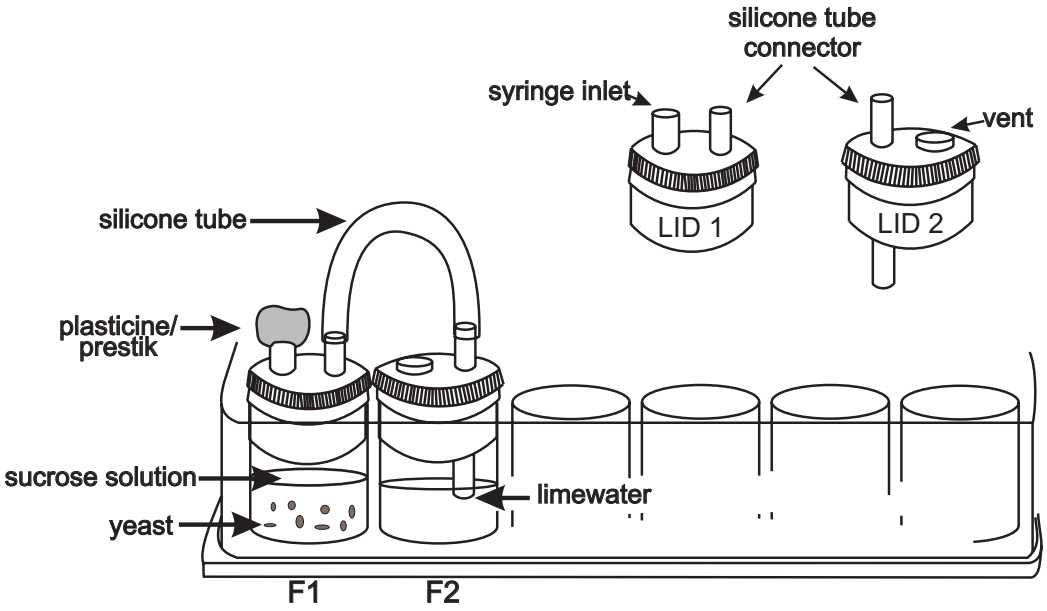
Q7 What do you think is actually inside the fire extinguishers used in our everyday lives?

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Activity 3.7 The Chemical Reactions In Bread Making

You will need:

•1 comboplate •1 syringe •1 propette •1 microspatula •lid 1
•lid 2 •1 silicone tube •sugar •yeast •prestik •warm water



What you need to do:

1. Put 5 microspatula scoops of sugar and 5 of yeast in well F1.
2. Push lid 1 securely into well F1 and attach one of the silicone tubes to the tube connector on the lid.
3. Use a propette to fill well F2 to ¾ with clear limewater and close the well securely with lid 2 as shown on the diagram.
4. Attach the other end of the silicone tube to the tube connector on lid 2.
5. Use a syringe to draw 1 ml of warm water and fit the syringe into lid 1 on well F1.
6. Add the warm water from the syringe into well F1, replace the syringe with a piece of prestik, and leave to stand while observing carefully what happens.

a) What do you observe in well F1?
b) What do you observe in well F2?
c) What does the colour change of the lime water indicate?

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What happened in this activity is what happens in the process of bread making. The yeast respires with oxygen by feeding on the sugars and breaking them down into carbon dioxide and water. In bread making, this causes the dough to rise. Letting the dough stand in a warm place allows fermentation to proceed, therefore resulting in the dough rising. As you bake the bread in an oven, the yeast is killed and carbon dioxide expands, thus giving the bread a spongy texture.

As indicated in the picture below, carbon dioxide has many uses in our everyday lives. Study the pictures below and complete the table that follows.



Object in Picture	How is carbon dioxide involved?
Birthday cake	
Lit candle	
Coke	
Fire extinguisher	
Champagne	

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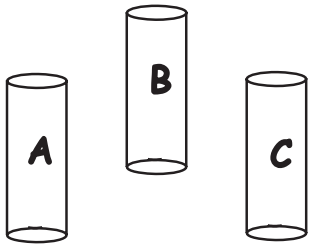
Activity 3.8 THE CASE OF THE DISAPPEARING SUGAR

Focus question: What happens to sand and sugar when mixed with water?

You will need:

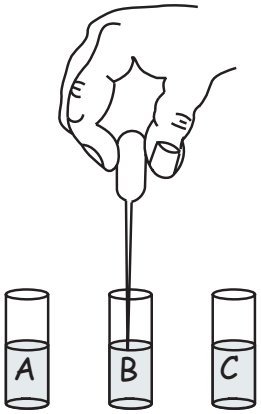
- 3 sample vials
- 2 microspatulas
- sugar
- water
- sand

STEP 1



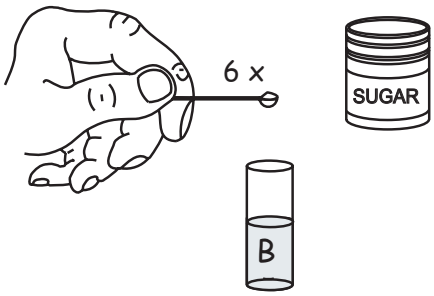
Label the one sample vial A, the second B and the third C.

STEP 2



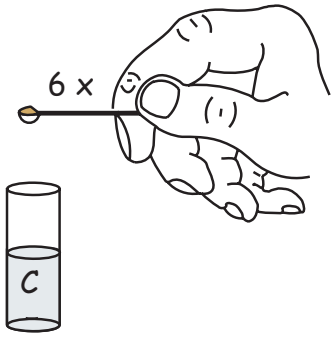
Fill 2/3 of each sample vial with water.

STEP 3



Add six microspatulas full of sugar into vial B and stir.

STEP 4



Add six microspatulas of sand into vial C and stir.

Q1 What has actually happened to the sugar?

Q2 Has the sugar gone or is it still there?

Q3 Can you tell the difference between the contents of vial A and vial B by just looking at them? Give reasons for your answer.

Q4 Has the sugar melted?

Q5 What is the solvent and solute in this activity?

Q6 What do we call the water with dissolved sugar in it?

Q7 What is the difference between sugar and sand in this activity?

Q8 Has the mass of the contents in vial B increased when you added sugar?

Q9 If it is there, is it still sugar or has it formed a new substance with water?

Q10 Which of the three sample vials contains a mixture of different substances?

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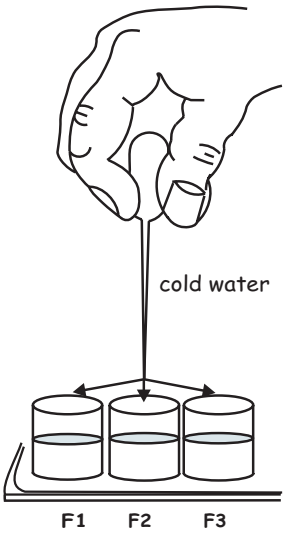
Activity 3.9 MELTING AND DISSOLVING: IS THERE A DIFFERENCE?

Focus question: What happens to the particles when a substance melts and when a substance dissolves?

You will need:

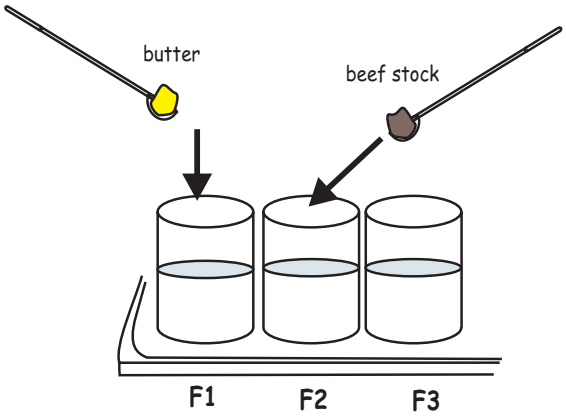
- 1 comboplate
- 1 microspatula
- 3 x pieces of butter
- 3 x pieces of beef stock
- methylated spirits
- hot water
- sugar
- cold water

STEP 1



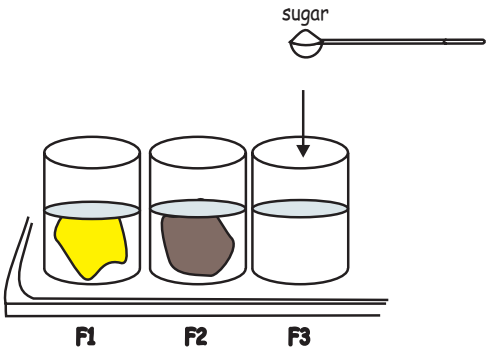
Half fill wells F1, F2 and F3 with cold water.

STEP 2



Use a microspatula to put a piece of butter in well F1 and a piece of beef stock in well F2.

STEP 3



Add a microspatula full of sugar to well F3 and stir.

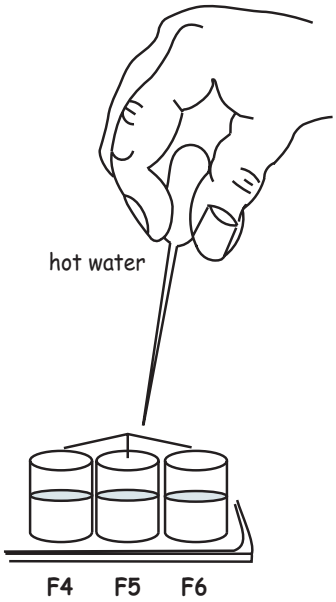
Q1 What do you notice? _____

_____

Q2 Is there a difference? _____

_____

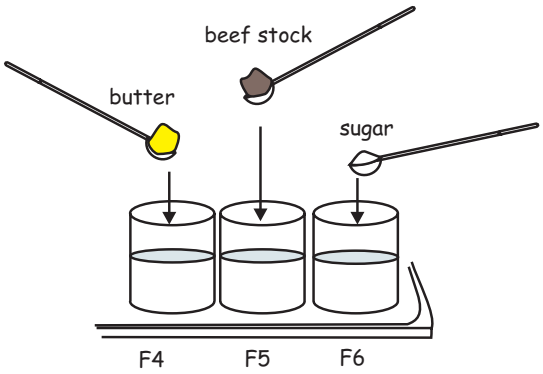
STEP 4



Put equal volumes of hot water in wells F4, F5 and F6.

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STEP 5



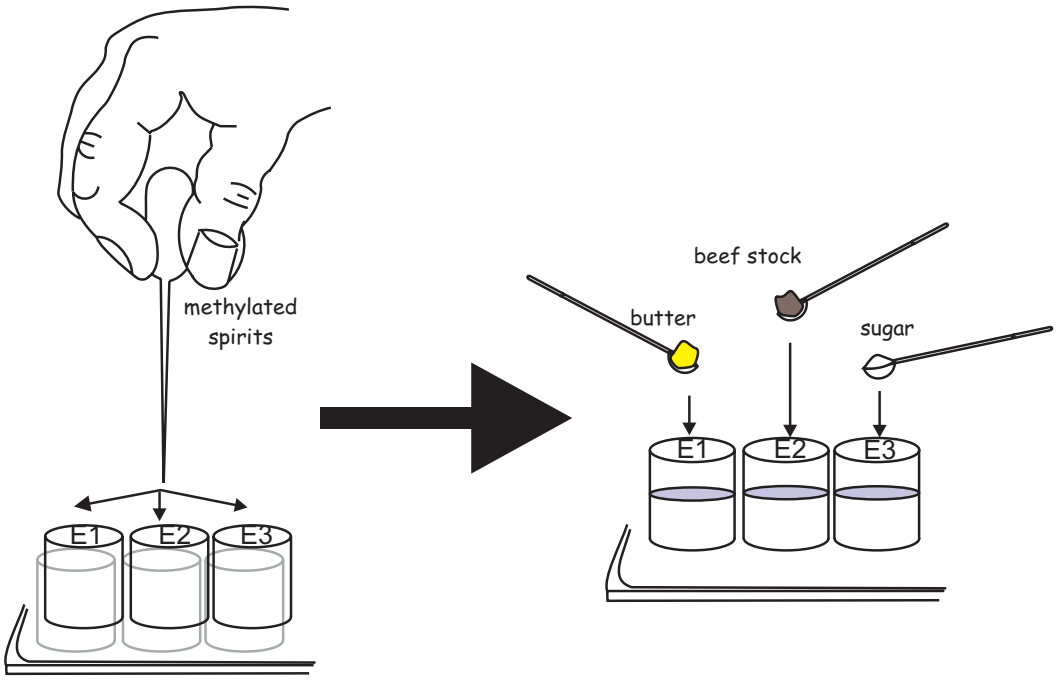
Q3 What happened?

Q4 Why do you think it happened?

Q5 What is the difference in the behaviour of these substances in hot water and cold water?

Repeat steps 2 and 3 with the hot water in wells F4, F5 and F6.

STEP 6



Put equal volumes of methylated spirits in wells E1, E2 and E3 and repeat steps 2 and 3.

Q6 Describe what happened.

Q7 What do you notice when you compare methylated spirits with water?

Q8 Which substance/s dissolved in water?

Q9 Which substances dissolved in the methylated spirits?

Q10 Which substances melted in water?

Q11 Which substances melted in the methylated spirits?

Q12 What happens to the particles when a substance melts, and when a substance dissolves?

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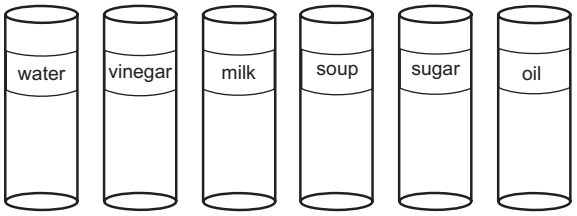
Activity 3.10 What type of a mixture is it?

Focus Question: How can we use light to distinguish between different types of mixtures?

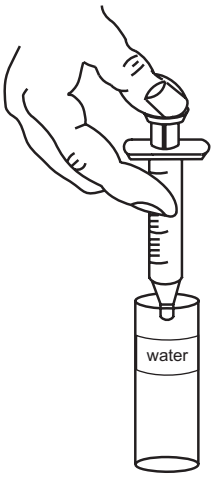
You will need:

- 6 small vials with lids
- 6 small labels
- 6 microspatulas
- syringe
- a small torch
- clean water
- vinegar
- milk
- soup
- sugar
- oil

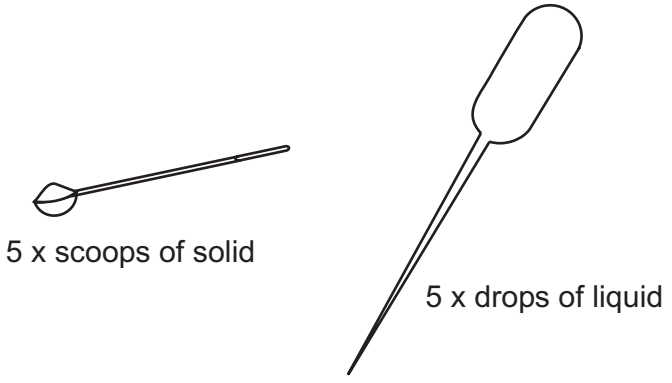
1. Label each vial for one of the following substances: water, vinegar, milk, soup, sugar and oil. Stick the labels towards the top of the vial.



2. Use a syringe to put 4 ml of water into each vial.

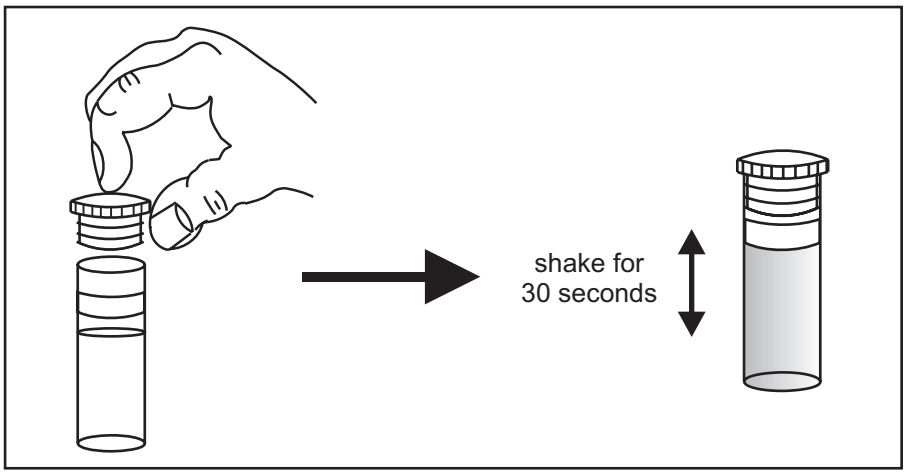


3. Use a clean propette each time to add 5 drops of the liquid substances into the appropriately labeled vial, and a clean microspatula to add 5 scoops of a solid substance to an appropriate vial.

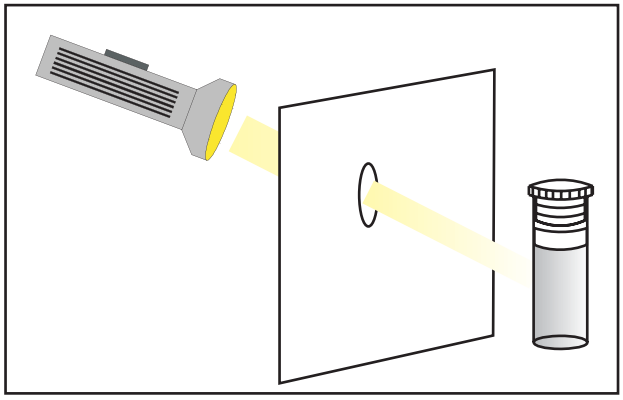


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4. Close each vial with a lid and shake it vigorously for about 30 seconds. Leave until the swirling stops.



5. Without further disturbing, let your partner shine the torch through a hole in a piece of cardboard and through the vial marked "water". Look at the vial from the side. Can you see a beam of light as it passes through the mixture? _____



6. Repeat step 5 with the other mixtures, writing down your observations in the table below.

Mixture (water + ...)	See the light? Yes/No	Type of Mixture
water		
vinegar		
milk		
soup		
sugar		
oil		

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Step 4

Study the figure. Use it as a model and draw your insect's head in detail showing compound eyes, simple eyes, antennae, mouthparts.

II The Thorax

Q10 Look at the ventral (under) surface of the insect. Into how many parts is the thorax divided?

Q11 The legs are attached to the thorax. How many legs does the insect have?

Q12 Are all the legs the same? Answer this question fully.

Q13 Watch the insect for a while. Does it use the legs only for walking or does it use the legs for other things? Answer this question as fully as possible.

Q14 How many wings does the insect have?

Q15 Are the wings all the same? Answer this question as fully as possible.

Q16 In your notebook, draw one leg and one wing of your insect.

III The Abdomen

Q17 Look at the abdomen from the side. You may see little holes on some of the segments. These are the spiracles or breathing holes of the insect. Which segments have spiracles?

Q18 Why do you think we would not see spiracles on all insects?

WHAT THE INSECT DOES

I How the insect moves

Step 5

Watch the insect carefully. Find out which legs are on the ground at the same time when it walks. In other words, does the insect move its first two legs, then the next, then the next; or does it move all the legs on one side and so on?

II How the insect eats

Step 6

Continue to watch the insect carefully.

Q19 What does the insect eat?

Q20 How does food get into the insect's body? Does it use its legs, does it "lap" like a dog and so on?

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Step 1
Write the following names on each of the four labels: sugar, egg, milk, oil.

Step 2
Stick one label towards the top of each of the four vials.

Step 3
Insert one vial in each of the first four F wells of the comboplate.

Step 4
Fill all the four vials to one fourth with oil.

Step 5
Add to each of the four vials 0.5 ml of water, using a syringe.

Step 6
Use a syringe to add 0.5 ml of vinegar to each of the four vials.

Step 7
Close the vials with lids and shake each vigorously for 30 seconds. Leave them to settle and note what happens.

Q2 What do you observe?

Step 8
Use a clean microspatula to put 6 scoops of sugar (sucrose) into the vial labelled **sugar** and repeat the procedure to put mustard flour in the vial labelled **mustard**.

Step 9
Use a clean propette to put 6 drops of egg yolk in the vial labelled **egg** and repeat the step with milk (lactic acid) into the vial labelled **milk**.

Step 10
Close the vials with lids and shake each vial for about 30 seconds. Leave them to stand and observe what happens.

Q3 What do you observe?
Q4 Which of the constituent substances of mayonnaise do you think serves as an emulsifier? Give your reasons.
Q5 Why is mayonnaise said to be an emulsion?
Q6 Which constituent substance of mayonnaise is in greatest proportion?

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Activity 3.12 The Different Colours in a Dot

Part A

Focus Question: Is the ink a mixture or a pure substance?

You will need

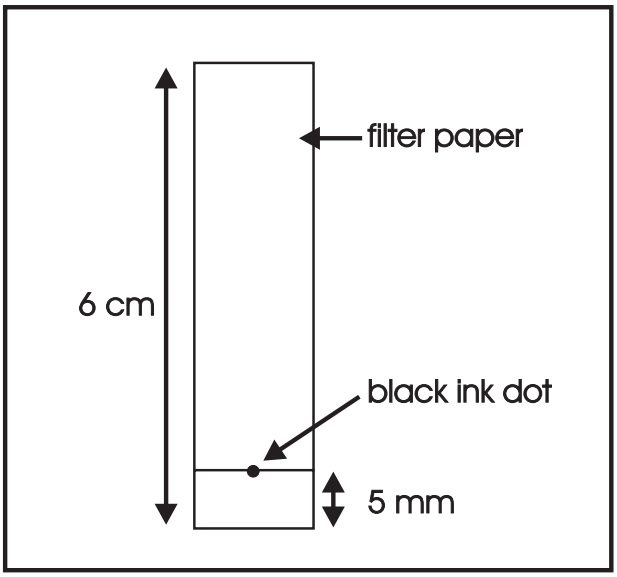
- comboplate
- 6 strips of filter paper (6cm x 1cm)
- Pair of scissors
- 6 different coloured pens*
- 6 small vials
- 1 measuring ruler
- 1 propette
- Methanol

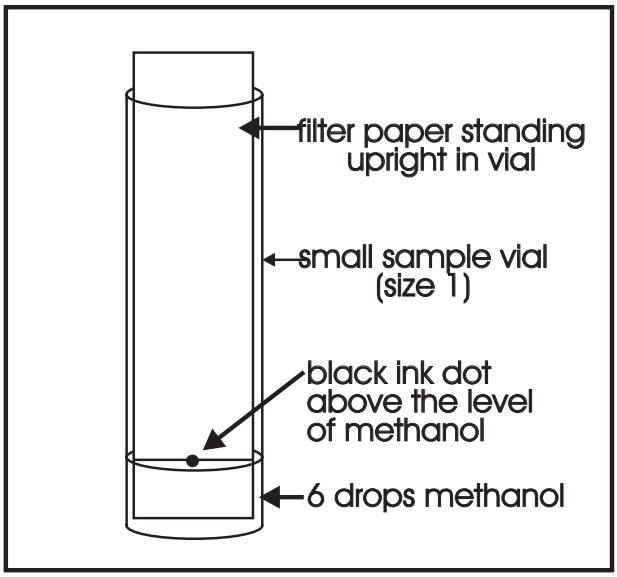
Step 1

Cut out 6 strips of filter paper according to the dimensions: 6 cm x 1 cm.

Step 2

Make a dot on each strip of filter paper with a different coloured marking pen about 5 mm from its bottom, as shown in the diagram below.





Step 3

Place the vials one in each of the six F wells of the comboplate.

Step 4

Use a propette to put 6 drops of methanol into each of the 6 vials. Avoid spilling drops of methanol on the sides of the vials as this will affect the separation.

Step 5

Carefully lower each strip into one of the vials so that the small ink dot on the strip is just above the level of the methanol.

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Step 6

Leave the setup undisturbed for a while, watching carefully what happens.

Q1 Describe what you see.

Q2 Describe what you see on each strip after about 10 to 15 minutes.

Q3 Are the inks mixtures or pure substances? Explain your answer.

Q4 Which component in each of the coloured inks is most soluble in methanol? Explain.

Q5 Which component in each of the coloured inks is the least soluble in methanol? Explain.

Q6 Is the black ink a homogeneous or a heterogeneous mixture? Explain your answer.

Part B

Focus question: Do all manufacturers of black felt-tipped pens use the same mixtures of chemicals to make their black inks?

Step 7

Repeat the above procedures using different black pens made by different manufacturers.

Q7 Explain your findings.

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Activity 3.13 Separating a Mixture of Water and Methylated Spirits

Focus question: Which distinguishing property of the constituent of the mixture is being used for separation in this activity?

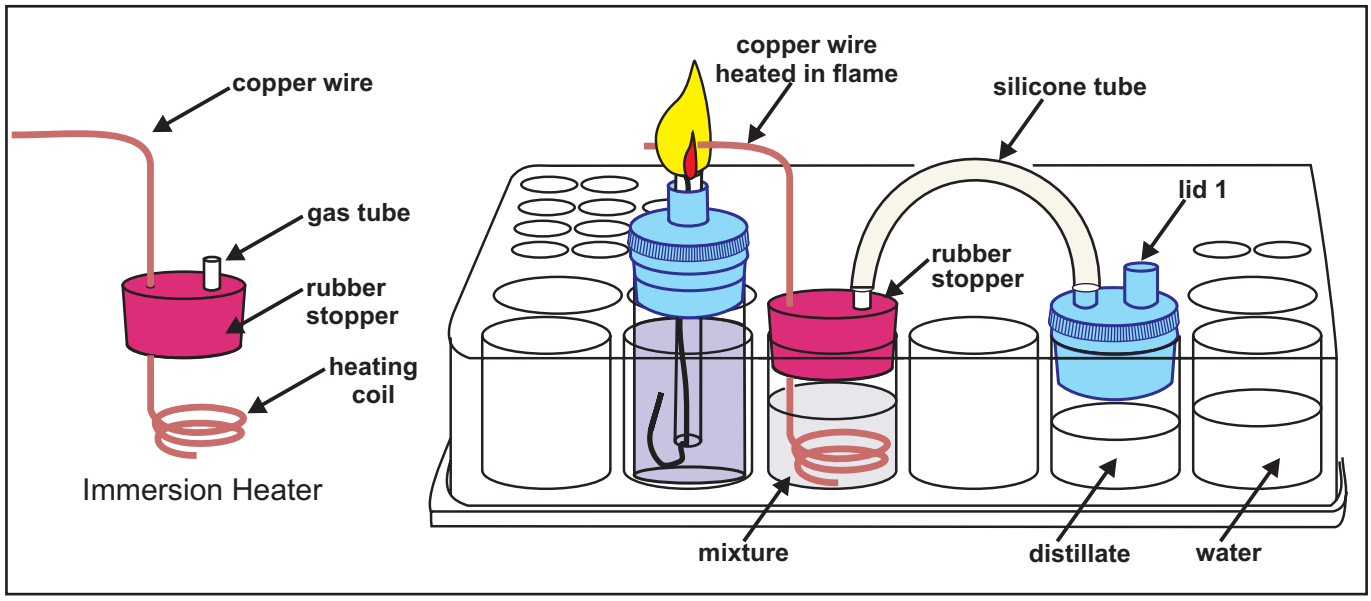
You will need:

- comboplate
- 2 x syringes
- microburner
- silicone tube
- immersion heater
- microspatula
- water
- methylated spirits
- box of matches
- anhydrous copper sulphate
- cobalt chloride paper

What you need to do:

Part 1

1. Study the experimental set-up picture below and use it together with the instructions and the equipment in the kit, to set up and do the experiment.



Using one of the syringes, draw 2 ml of water and place 1 ml in well F3 and the other 1 ml in well F6. The water in well F6 is to help approximate the volume of the distillate, which will be collected in well F5.

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1. Using the other syringe, draw 1 ml of methylated spirits and place in well F3. Use the end of a microspatula to mix the contents in well F3.
2. Seal well F3 with the immersion heater. Make sure the copper wire is over well F2 and that the **coil does not in any way touch the walls or the bottom of well F3**.
3. Fill the microburner with methylated spirits and place it in well F2.
4. Seal well F5 with lid 1 ensuring that the small outlet is facing inward as shown in the diagram.
5. Connect one end of the silicone tube to the protruding glass tube of the immersion heater and the other end to lid 1.
6. Light the burner to commence heating the immersion heater as shown in the diagra. As you heat, observe what happens. Note what happens in the silicone tube.

   Q1 Describe your observations.

   Q2 How long does it take the mixture to start boiling?

7. Make sure that the heating is gentle to avoid the bubbles of boiling liquid rising up the tube. The liquid collecting in well F5 is called a **distillate**.
8. When the volume of distillate is about $\frac{3}{4}$ of the volume of water in well F6, you may stop the heating and wait for everything to cool.

We can determine whether a liquid is water or not, by using anhydrous copper sulphate or a cobalt chloride paper. Water turns the grey anhydrous copper sulphate blue.

Part 2 What is the nature of this liquid distillate?

9. Observe the nature of the liquids in wells F3, F5 and F6. Place 1 microspatula of anhydrous copper sulphate in wells A1, A2 and A3. Use a propette to put 2 drops of the contents of well F3 in well A1.

   Q3 What happens?

10. Use a clean propette to put 2 drops of the contents of well F5 into well A2.

    Q4 What do you observe?

11. Use another clean propette to put 2 drops of the water from well F6 into well A3.

    Q5 What do you note? Explain your observation.

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12. Dip one piece of cobalt chloride paper into each of the liquids (in well F3, F5 and F6).

Q6 Explain your observations.

13. Place a drop of each liquid on a flat piece of paper and observe which one permeates into the paper faster than the others.

Q7 Explain your observations.

14. Light the microburner again. Dip one piece of cotton string into each of the three liquids and expose it to a flame to check as to which will catch fire.

Q8 Explain your findings.

Q9 Do you think you managed to separate the water from the methylated spirit? Use the evidences you got from the four tests you did above to support your response.

Q10 What is the name of this separation method?

Q11 Which distinguishing property of the constituents of the mixture is being used in this separation technique?

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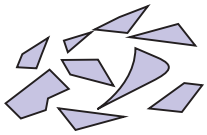
Activity 3.14 THE MAGIC PROPETTE

Focus question: What causes attraction?

You will need:

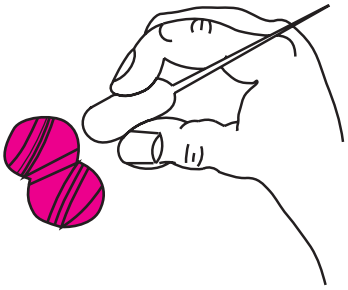
- 1 comboplate
- 1 propette
- 1 microspatula
- 1 tooth pick
- a ball of wool
- sugar
- 1 nail
- 1 glass rod
- 1 ruler(plastic)

STEP 1



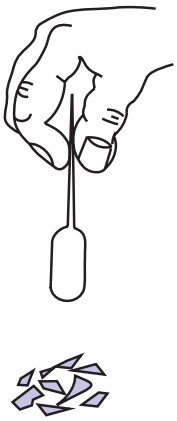
Tear a piece of paper into very small pieces.

STEP 2



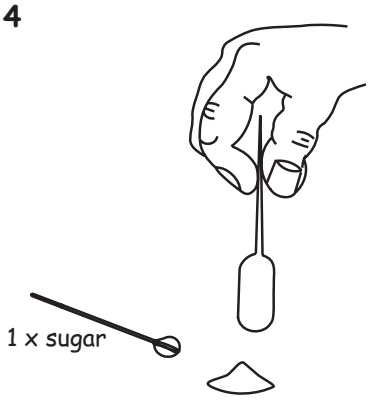
Rub the propette firmly with the ball of wool or on a woollen outfit.

STEP 3



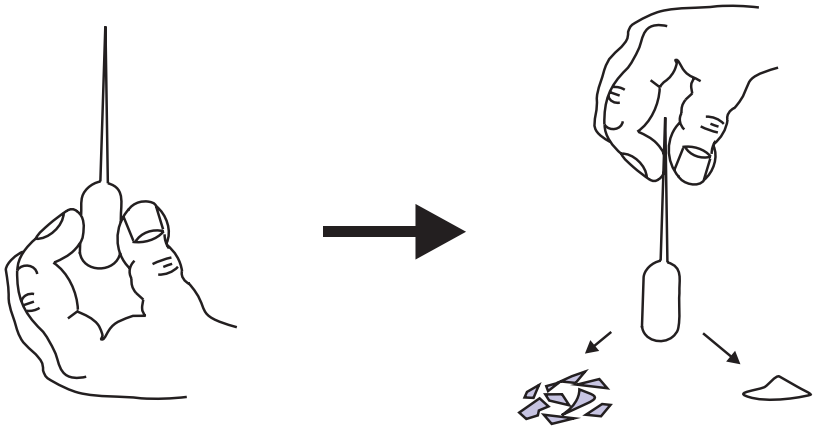
Hold the propette just above the torn up pieces of paper and observe what happens.

STEP 4



Pour one heaped microspatula of sugar on your table and try the rubbed propette on it.

STEP 5



Touch the rubbed area of the propette with your fingers and try the propette on the pieces of paper and the sugar again.

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STEP 6

Rub other objects (a nail, toothpick, ruler, glass rod, microspatula, comboplate) and try them on the pieces of paper and the sugar. Then complete the table below.

OBJECT	MATERIAL	Effects on Paper and Sugar
propette	plastic	
a nail	iron	
toothpick	wood	
ruler	plastic	
glass rod	glass	
microspatula	plastic	
comboplate	plastic	

Answer the following questions:

Q1 What happens when you bring a rubbed propette close to the pieces of paper and sugar?

Q2 What are you actually doing when you rub the propette with wool?

Q3 What is static electricity?

Q4 Where do the charges (which pull the pieces of paper and the sugar) come from?

Q5 Is an electric charge produced on any kind of material we rub?

Q6 What kind of materials get charged with rubbing?

Q7 How can we make a charged object lose its charge?

Q8 Is an electric charge produced only on those parts where the object has been rubbed?

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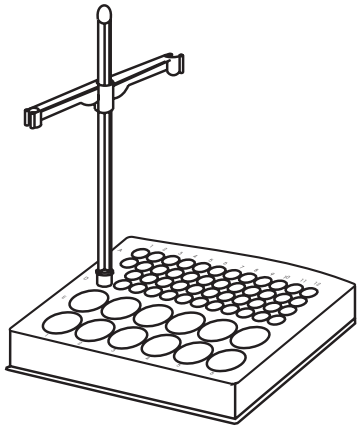
Activity 3.15 THE WIGGLY FALLING WATER

Focus question: What causes the water jet to be drawn towards the propette?

You will need:

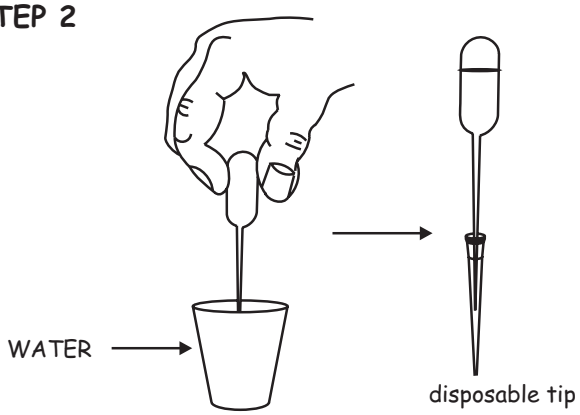
- 1 comboplate
- 2 propettes
- cotton thread
- 1 microstand
- 1 disposable tip
- a ball of wool
- prestik

STEP 1



Insert a microstand into well D1.

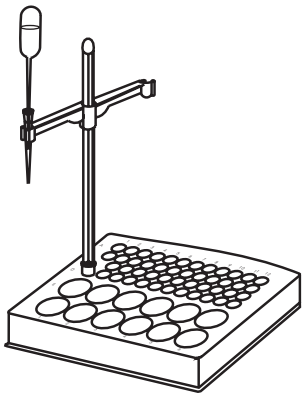
STEP 2



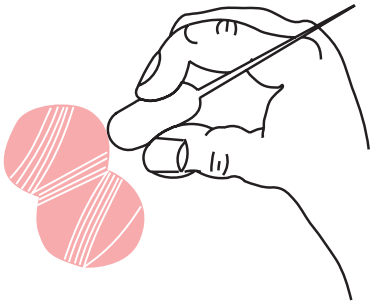
Fill one propette with water and fit the disposable tip over the end of the propette.

STEP 3

Insert the propette into one side arm of the microstand and turn the arm so that the disposable tip is directly above well F1.

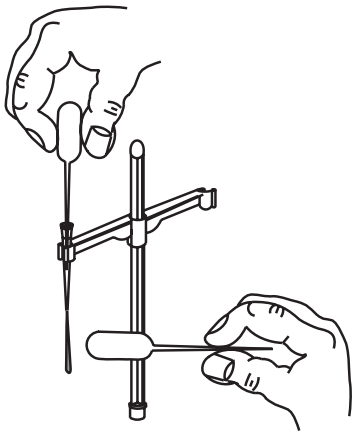


STEP 4



Rub the other propette with wool a number of times.

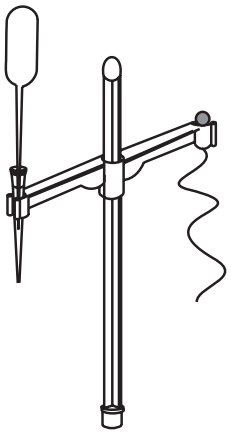
STEP 5



Squeeze the water out of the propette with one hand so that it jets out while holding the charged propette close to the water jet.

Q1 What happens?

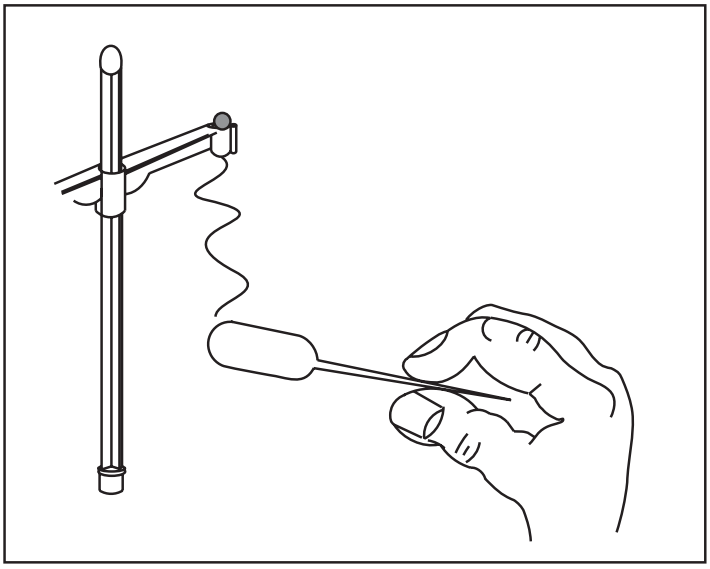
STEP 6



Use a piece of prestik to fix one end of a 6cm long cotton thread to the other side arm of the microstand.

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STEP 7



Hold the charged propette close to one end of the cotton thread.

Q2 What happens?

Q3 What causes the water jet to be drawn towards the propette?

Q4 What causes the cotton thread to become straight?

Q5 Describe how you would put a static charge on something.

Extension Questions

Q6 Is an electron positively or negatively charged?

Q7 What happens to the electrons when you rub a propette with a woollen cloth?

Q8 Why is there a crackling sound sometimes when you undress?

Q9 What is lightning and how is it formed?

Q10 Why is there thunder after a lightning flash?

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Activity 3.16 MY ALUMINIUM STRIP ELECTROSCOPE

Focus question: When and why are the foil strips flying apart?

You will need:

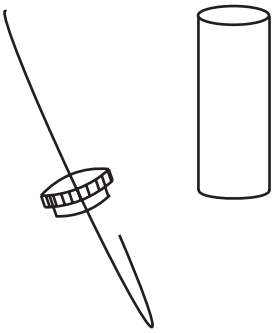
- propette
- 2 strips of aluminium
- ball of wool
- vial (with lid)
- paper clip (electroscope wire)

STEP 1



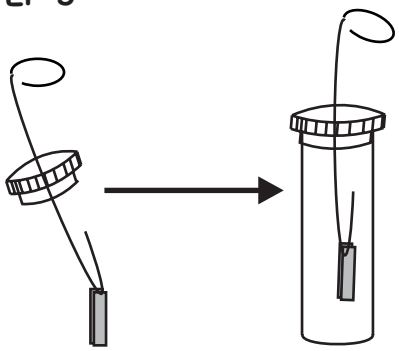
Use a paper clip to make an electrode wire by unwinding it as shown in the picture.

STEP 2



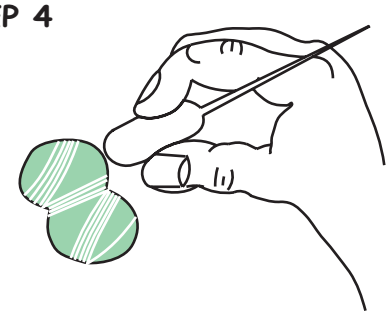
Pierce the lid of a vial with the pointed end of the wire as shown in the picture.

STEP 3



Assemble the electroscope by bending the wire as shown and sliding the two pieces of foil.

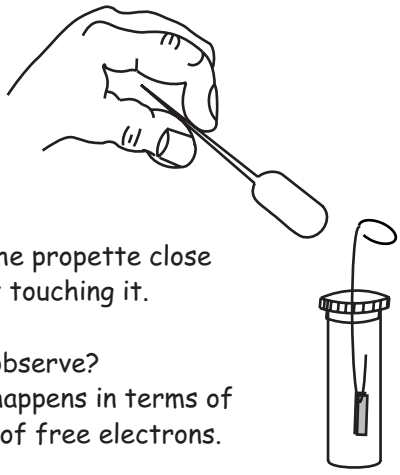
STEP 4



Rub the bulb of the propette firmly with the ball of wool, a cloth or a cotton wool.

Q1. What happens to the bulb as you rub it?

STEP 5

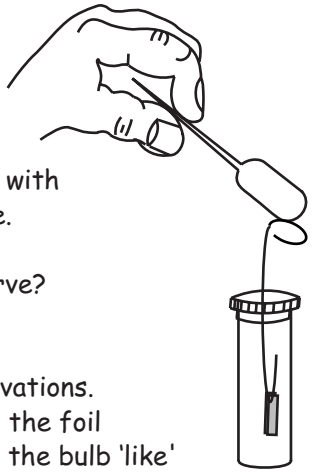


Bring the bulb of the propette close to the wire without touching it.

Q2. What do you observe?

Q3. Explain what happens in terms of the movement of free electrons.

STEP 6



Touch the lid of the vial with the bulb of the propette.

Q4 What do you observe?

Remove the bulb.

Q5 What happens?

Q6 Explain your observations.

Q7 Are the charges on the foil strips and those on the bulb 'like' or 'unlike'?

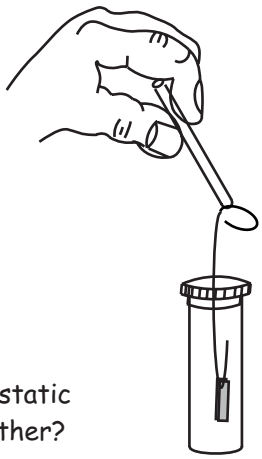
STEP 7

Repeat step 4 to 6 using a glass rod.

Q8 What happens?

Q9 How do you explain your observations?

Q10 When and why are the foil strips flying apart?



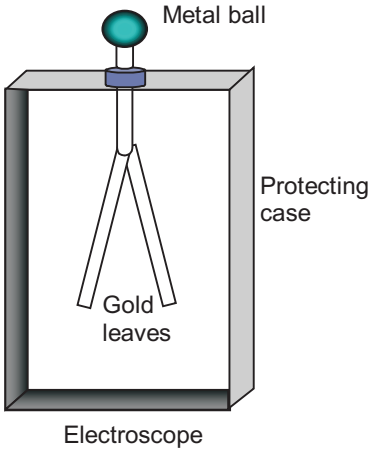
Extension questions

Q11 What is a static electricity detector called?

Q12 Why is it not suitable to try static electricity during humid weather?

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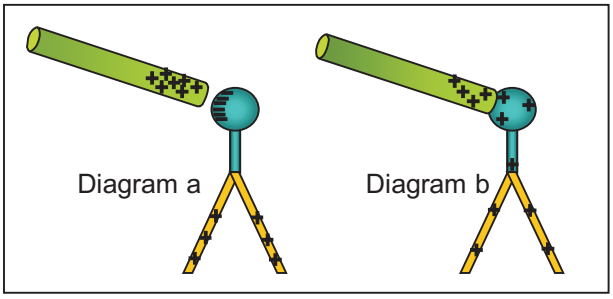
In this activity, you made your own electroscope. An electroscope is a device we use to detect charge. It consists of two metallic movable leaves, which are enclosed in a case to protect them from humidity and air currents. The leaves are usually made of gold. The leaves are connected through a conductor to a metal ball outside the case.



Q13. The two diagrams below show how to charge an electroscope with a charged object.

a) Which diagram shows charging the electroscope by conduction?

b) Which diagram shows charging the electroscope by induction?

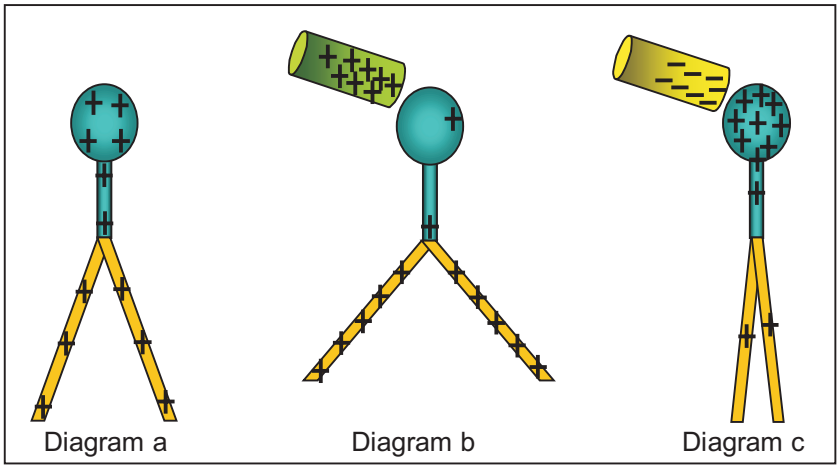


c) Think of the differences between the two methods of charging the electroscope. How do the two methods affect the charge of the electroscope and that of the charged object?

Q14 We can use an electroscope to determine the sign of the charge of an object.
The diagram below shows how to do this.

a) Explain what the diagram describes.

b) Is it necessary for the electroscope to be charged beforehand?



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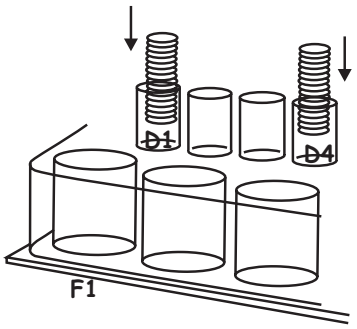
Activity 3.17 THE LIGHT BULB ON MY COMBOPLATE

Focus question: What are the energy transformations taking place in this activity?

You will need:

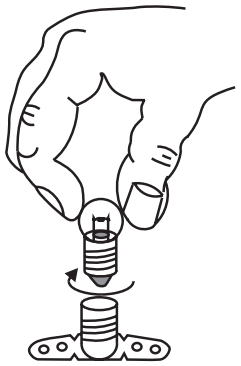
- 1 comboplate
- 2 x springs
- 1 bulb
- 2 x strips of copper
- a bulb holder
- 1.5 V cell

STEP 1



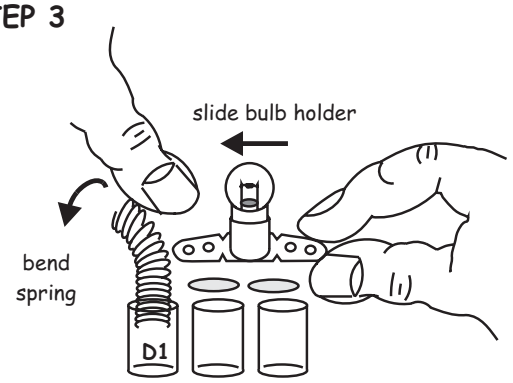
Put one spring into well D1 and the other spring into well D4.

STEP 2



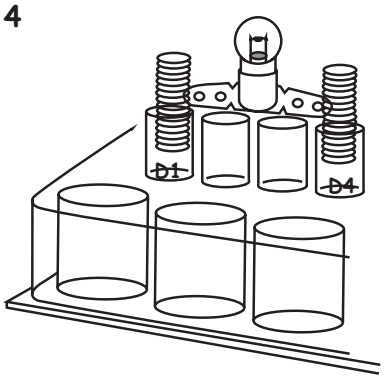
Screw the bulb into the bulb holder.

STEP 3



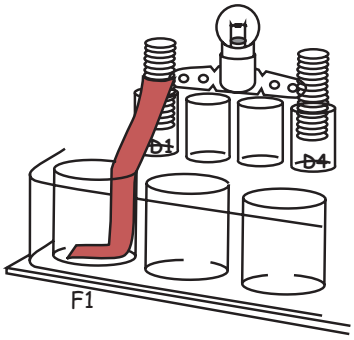
Bend spring D1 to one side and slide one end of the bulb holder into the spring.

STEP 4



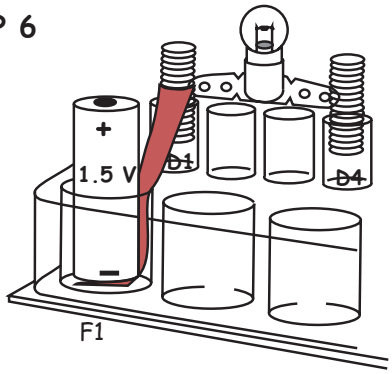
Slide the other end of the bulb holder into spring D4 in the same way.

STEP 5



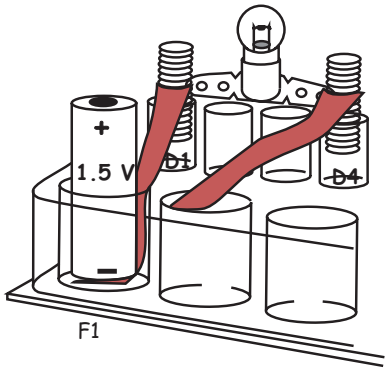
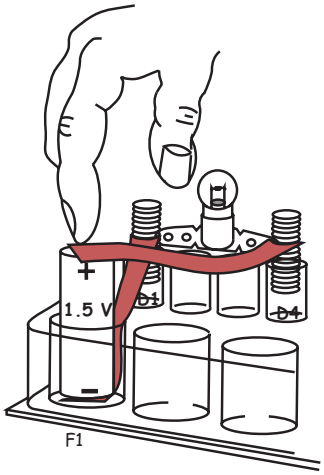
Slide the end of one copper strip into the spring in well D1 and push the other end into well F1.

STEP 6



Put a cell with the negative (-) end down, on top of the copper strip in well F1.

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STEP 7	STEP 8
	
Slide one end of the other copper strip into the spring in well D4.	Touch the loose end of the second strip to the positive (+) end of the cell.

Q1 What happens when you touch the loose end of the second copper strip to the positive end of the cell?

Q2 What happens when you remove the loose end of the strip from the cell?

Q3 Why do you think the light goes on as you touch the positive end of the cell with the strip and goes off when you remove it?

Q4 Where does the energy come from which makes the bulb glow?

Q5 What kind of energy is stored in the cell?

Q6 What are the energy transfers on the comboplate?

Q7 What are the energy transformations on the comboplate?

Q8 What forms a circuit on the comboplate?

Q9 What will happen to the brightness of the light if you replace the strips with longer ones?

Q10 When is the circuit open?

Q11 When is the circuit closed and what happens when it is closed?

Q12 How do you make use of this energy transformation in your home and elsewhere in your life? List them.

Q13 Where does energy, which makes lights, stoves and televisions in our homes work, come from?

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ACTIVITY 3.18 EXPLORING MICRO-ELECTRICITY PIECES

Focus Question: How do the different micro-electricity pieces work?

What you need

- a comboplate
- a bulb
- a bulb holder
- 6 x springs
- LED light emitting diode
- 2 x long copper/zinc strips
- 2 x connecting wires
- 1.5 volt cell
- an A4 sheet of white paper

Part 1

WHY DO WE USE ELECTRIC CIRCUITS?

Q1 We use electric circuits to transfer electrical energy to various electrical devices. These devices transform the electrical energy into other forms of energy, which we find useful!

a Make a list of five devices which you can find at home, or you see in the shops, which work with electricity.

b What are these devices used for?

c What energy transformation/s take place in these devices?

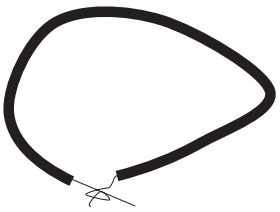
WHAT IS AN ELECTRIC CIRCUIT?

Q2 An electric circuit is a **closed** path or "loop", made out of materials which are good conductors of electricity. But this is not enough!

a Phoka is a learner in your group. He takes a piece of wire. He connects the ends of the wire together. He says: "**This is an electric circuit**!".

Is Phoka right? Is there an electric current in Phoka's wire loop?

Phokas wire-loop



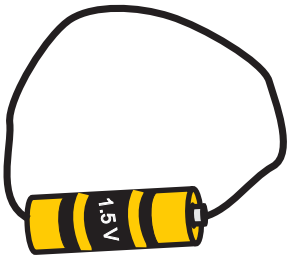
b What must Phoka do to have an electric current in his loop? Explain to him.

c Phoka connects a 1,5 V cell across his wire. Did he make an electric circuit?

d Andile, who is also a learner in your group, has her doubts about Phoka's circuit. She says: "This is the most useless circuit I have ever seen! It is of no use!"

Is Andile right? Is Phoka's circuit a "useless" circuit? Explain.

Phokas second wire-loop



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e So finally, what is an electric circuit and what parts does it need to be made of to make it "useful"?

Part 2

What to do: Work steps 1 to 4 below, individually.

1 Put the A4 sheet of paper flat on your desk in front of you. Put micro-electricity pieces on the A4 paper.

2 Look at the diagram of the electricity pieces. Find the name of each component in the diagram.

3 Divide your components into four parts/categories,

i the power sources and any other accessories which you think go with them.

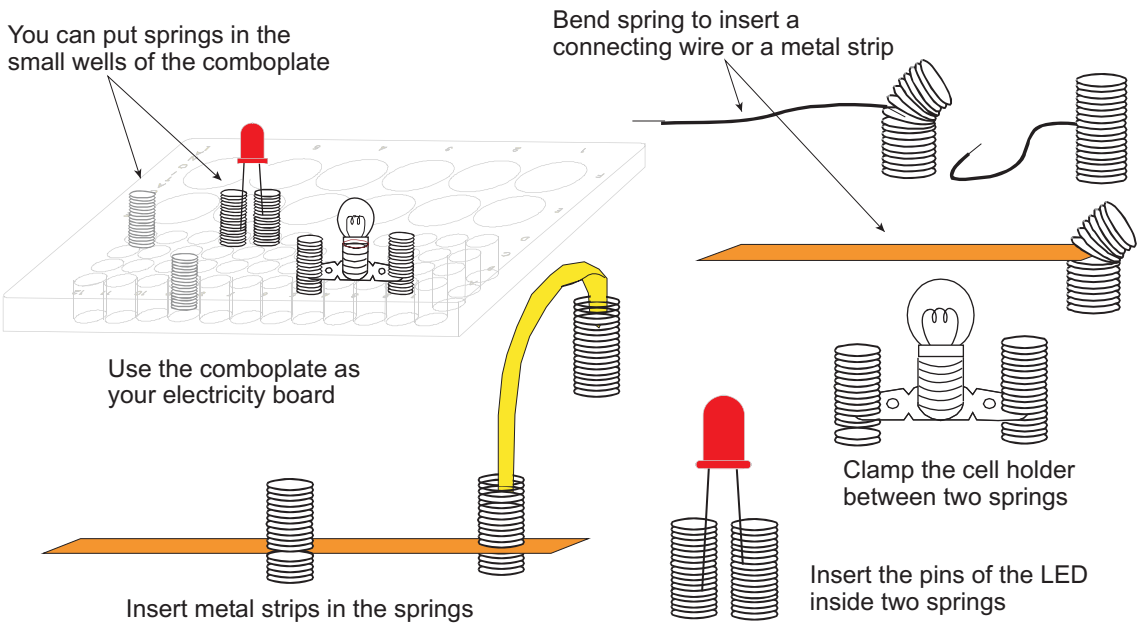
ii the electrical devices, which you think "will do something" when you connect them in a circuit.

iii components which you think you can use for the connections, i.e. which you can use to connect a power source to an electrical device to complete a closed conducting path.

iv components which do not belong in any of the above three categories. Think of ways you can use these components with your kit.

4 Look at how the other members of your group have divided their components. Discuss any differences.

5 Here are some ideas of how to use some of the components in the kit. But of course, you may have better ones. You must try your ideas!

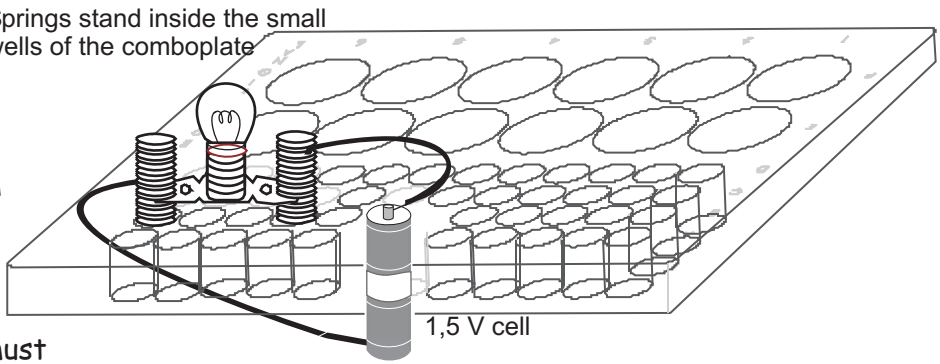


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Part 3

MAKE YOUR OWN CIRCUIT

6 The following diagram, shows a simple electric circuit - for inspiration! Your task is to make a bulb glow, using components from your micro-electricity kit.



Each learner in your group must make a **different** circuit. And each circuit must be different from the one shown in the diagram.

When you have finished, discuss the circuits you and your group have made. Discuss which connections or components you found the easiest to use. Discuss which type of connection/s you found more firm or sturdy.

Part 4

FIND OUT HOW IT WORKS

7 Among the micro-electricity pieces, is a little red bulb, the LED. This is a diode. Diode is a Greek word for "Two-Way".



Your task is to find out how it works. How can you make it glow? Why is it called "Two-Way"?

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ACTIVITY 3.19 LIGHTEN UP, PREDICT AND EXPLORE

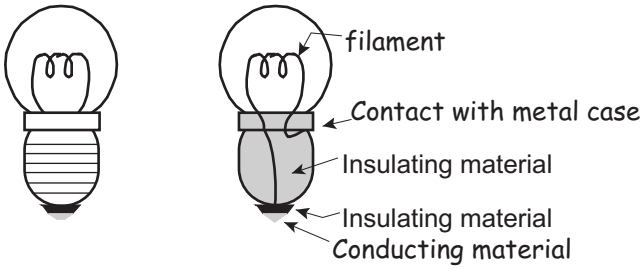
Focus Question: What forms an electric circuit?

What you need

- a bulb
- 1.5 volt cell
- connecting wires

Step 1

The diagram alongside, shows what a bulb looks like inside.

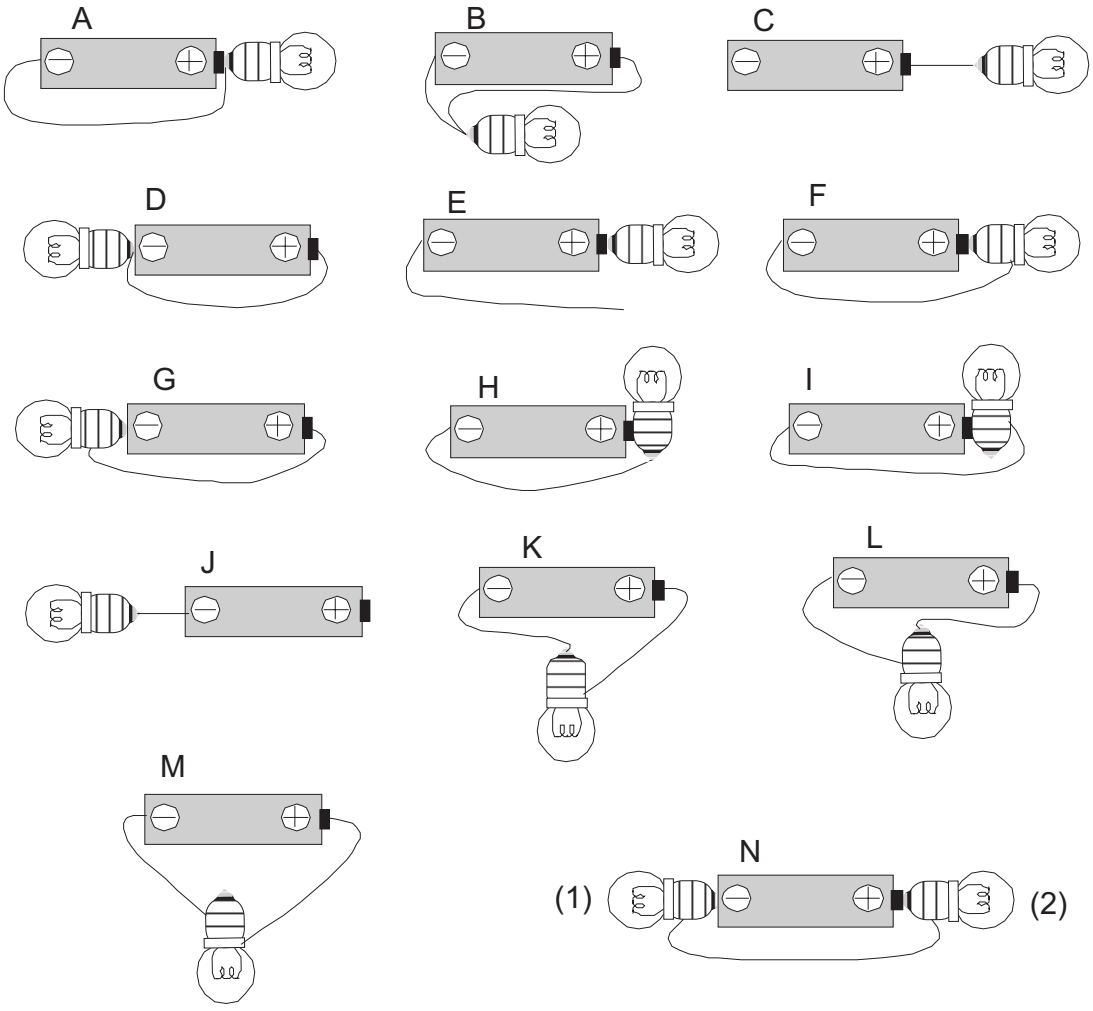


Step 2

Predict which of the bulbs in the following figures will light up.

Work on your own.

Q1 Record your predictions in the table on the next page.



Q2 Compare your predictions with those of other members of your group. Where you differ explain the reason for your prediction. Make a group prediction and record it in the table on the next page.

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Bulb	Your Prediction	Group's Prediction	Observation	Comments
A				
B				
C				
D				
E				
F				
G				
H				
I				
J				
K				
L				
M				
N(1)				
N(2)				

Step 3

Test your group predictions using the micro-electricity kit equipment.

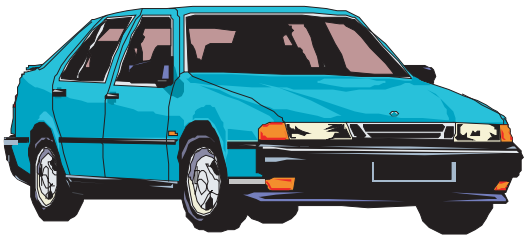
Q3 Record your observations in the table above.

Q4 Compare your observations with your predictions. Explain the results you observe. Add your comments in the table above.

Q5 To conclude, what is necessary to make a bulb light up?

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To use the electrical energy in cells or batteries to make light bulbs glow we need a closed circuit. There are two common types of circuits, the series circuits and the parallel circuits. In a series circuit, all the parts of the circuit are connected, one after the other, so there is only one path for the transfer of electrical energy. In a parallel circuit, the parts are connected so that there is more than one path.



Part 1

Organise yourselves in pairs or groups of three. Select one person to take notes. Discuss the following factors about the main headlights of a car (or taxi):

Q1 during which part of the day are the headlights of a car used?

Q2 the importance of passenger safety when designing car headlights

Q3 what would happen if one of the car headlights was broken for example, by a stone thrown up from another car?



Q4 the electric circuit in a car which connects the car battery to the two headlights.

After you have noted down your answers to the above points, draw a diagram representing an electric circuit which consists of the two headlights of a car, the car battery (source of electrical energy) and the wires that connect the headlights to the car battery.

Part 2

What you need

micro-electricity pieces

What to do

Step 1

Select some of the micro-electricity pieces and set up a circuit to represent your circuit drawing of the headlights of a car.

Step 2

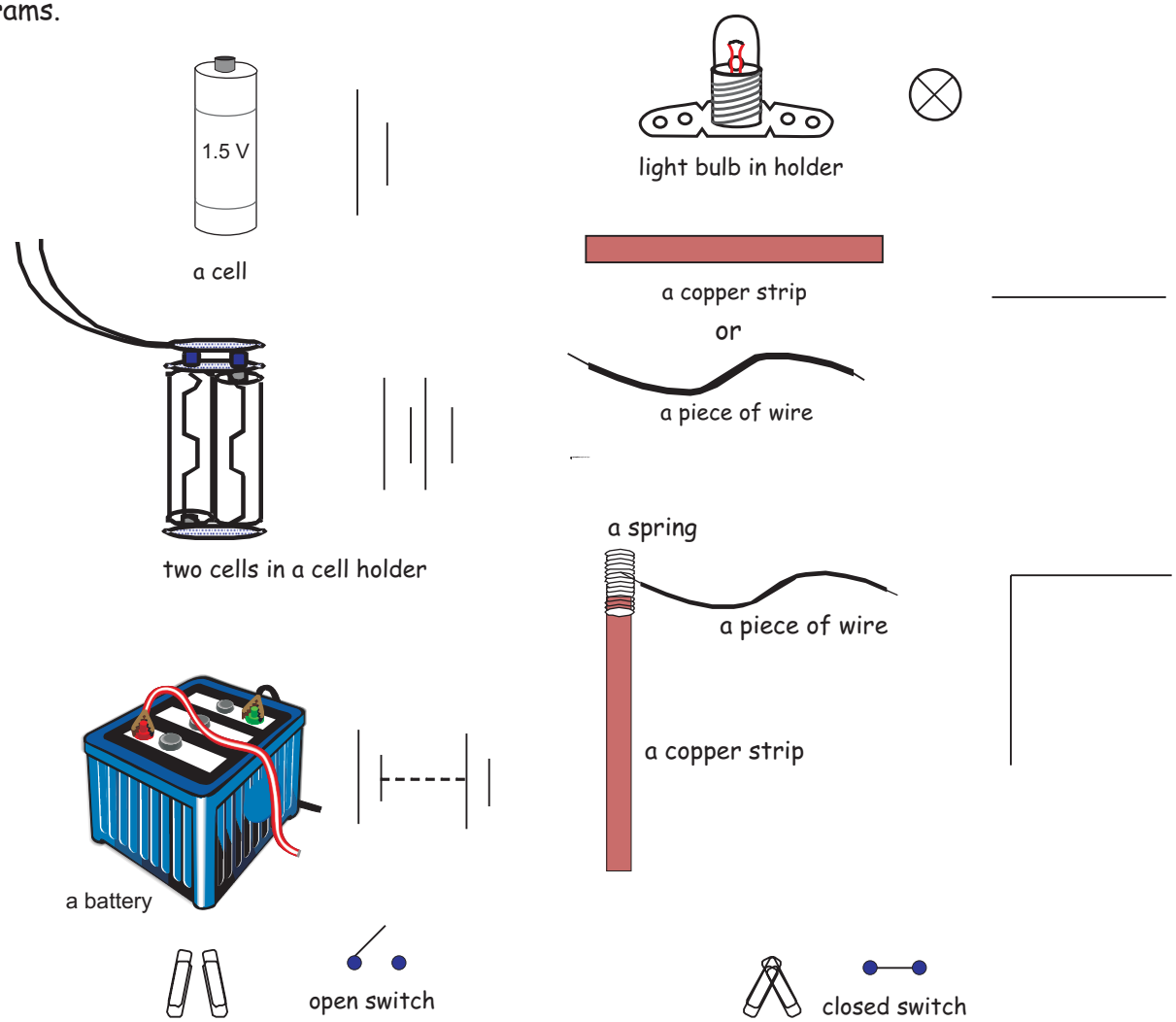
When you have finished the above Activity get together with your group and work through this section.

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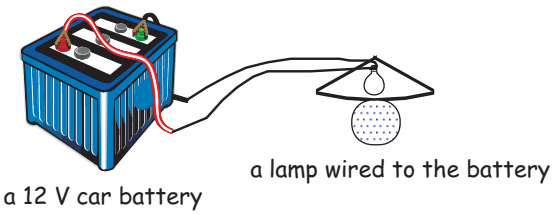
Q5 Which circuit, series or parallel, describes the circuit you have constructed? Explain.

Step 3

You can spend a lot of time drawing the real parts (components) of a circuit. It is much easier to use symbols to represent the components of a circuit. Below are some of the symbols used to draw circuit diagrams.



Use some of the symbols to draw a circuit diagram of the circuit below.



Q6 Use the circuit symbols and draw a circuit diagram to represent your circuit of car headlights.

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Activity 3.21 HOW DO WE FIND OUT IF PLANTS STORE STARCH AND SUGARS?

INTRODUCTION

Plants store food. People eat some of the food that plants store. Plants can store sugars, starch, oil or protein. Plants can store some of these or all of them. It is easy to test for the presence of sugars and starch.

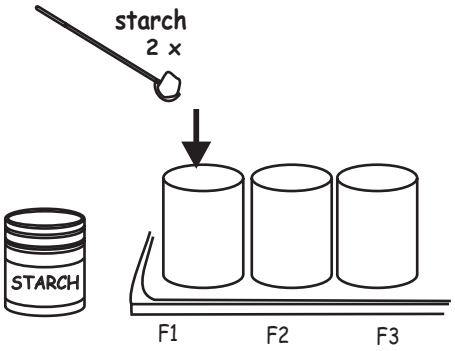
PART 1 STARCH

To test for starch you need:

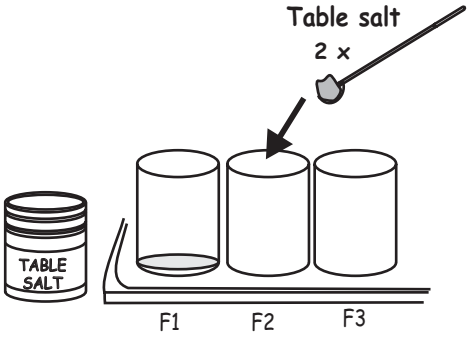
- comboplate
- propette
- laundry starch or other powdered starch
- table salt
- iodine solution

What to do:

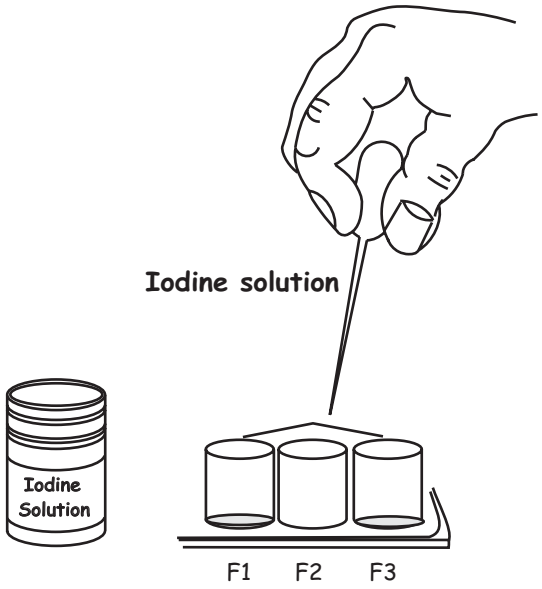
1 First place two microspatulasful of starch in well FI of the comboplate.



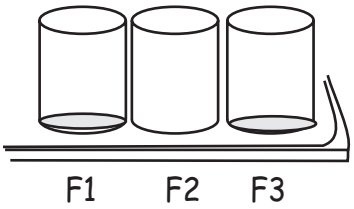
2 Then place two microspatulasful of salt in well F3 of the comboplate.



3 Use the dropper to drop a little iodine solution on the starch in well FI and on the salt in well F3.



4 Observe the colour of the starch and the salt mixture in wells FI and F3.



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Copy and complete the following sentences into your notebook.

Q1 If we add .....to a substance and the mixture turns blue - black, it means that the substance contains .....

Q2 If we add iodine solution to a substance and the substance turns yellowish ....., it means that the substance does not contain .....

Now you can test different fruits and vegetables to find out if they contain starch. Try carrots, potatoes, maize, beans, carrots, oranges, lemons, pumpkins, spinach.

Write down what you found out. You could use a table like the one underneath.

Plant	Does it contain starch?
Mealie	Yes

You can also test foods like bread, milk, fish and pasta.

PART 2 SUGAR (glucose)

INTRODUCTION

You have already tested some plants to find out if they contain starch. Now we will find out which plants store sugars. The sugar we are testing for is called glucose.

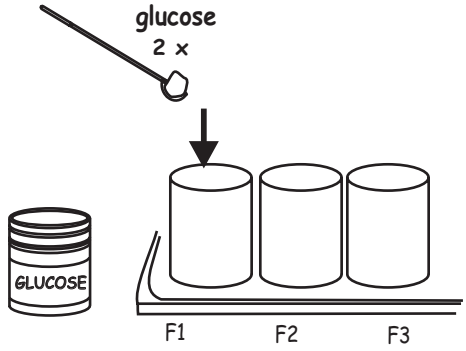
To test for glucose you need:

- comboplate
- microspatulas
- 2 propettes
- glucose powder
- starch powder
- tap water
- hot water
- Benedict's solution
- lunch box

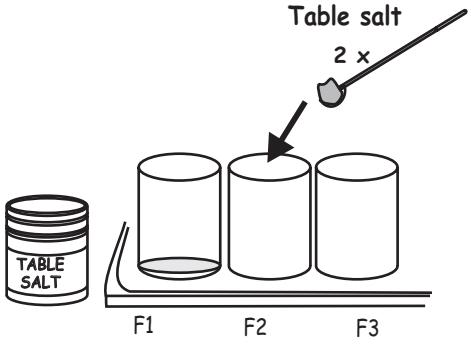
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What to do:

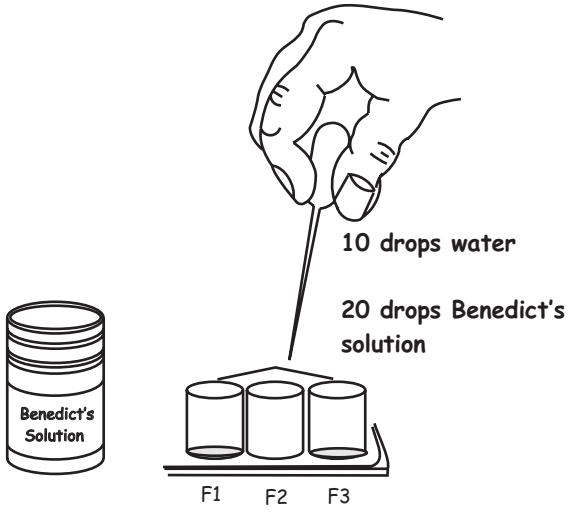
STEP 1
First place two microspatulasful of glucose powder in well F1 of the comboplate.



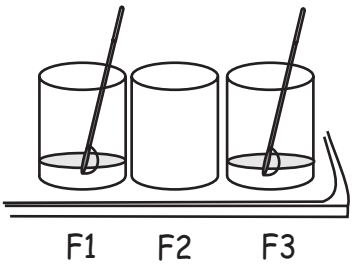
STEP 2
Then place two microspatulas of starch powder in well F3 of the comboplate.



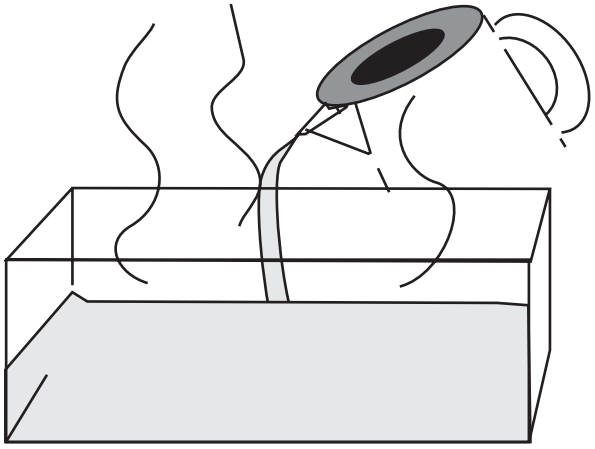
STEP 3
Add 10 drops of water and 20 drops of Benedict's solution to wells F1 and F3.



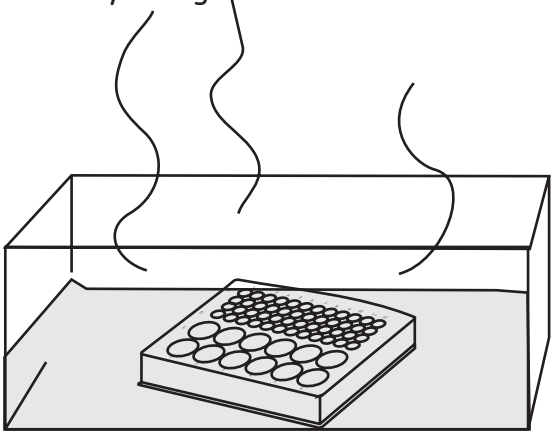
STEP 4
Stir the contents of wells F1 and F3 with clean microspatulas.



STEP 5
Half fill the lunch box with hot water.



STEP 6
Float the comboplate® in the hot water in the lunch box. Observe wells F1 and F3 carefully for about 10 minutes and note any changes.



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Answer the questions below:

Q1 What is the colour of Benedict's solution?

Q2 What is the colour of the mixture in well F1?

Q3 What is the colour of the mixture in well F3?

Q4 Copy and complete the following sentences into your notebook.

If we add ..... to a substance and heat it and the substance turns reddish, it means that the substance contains .....

If we add ..... to a substance and heat it and the substance stays blue, it means that the substance does not contain .....

Now you can test different fruits and vegetables to find out if they contain sugars like glucose.

Q5 Write down what you find out. You could use a table like the one you used for the starch test.

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INTRODUCTION

All living things need food. Humans eat different kinds of food which we take into our mouths. Before we swallow our food, we chew it using our teeth. Humans and other mammals have 4 different types of teeth. These are called:

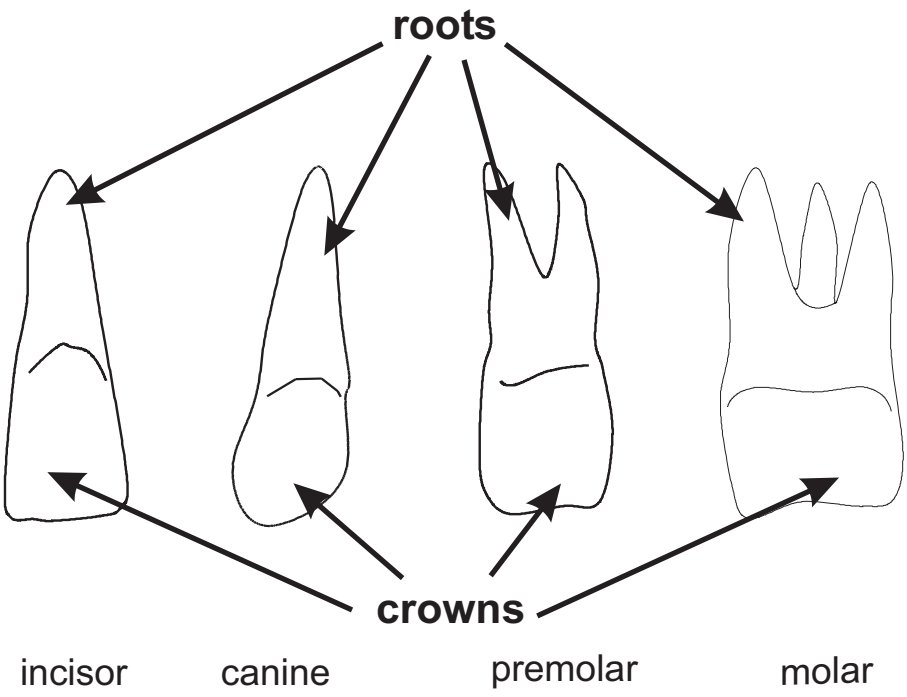
Incisors: They have a sharp cutting edge and they are at the front of the mouth. Humans have 4 incisors in each jaw.

Canines: They have a sharp point and they are next to the incisors. Humans have 2 canines in each jaw. We sometimes call canines "eye-teeth".

Premolars: They are behind the canines and have two bumps or cusps. Adult humans have 4 premolars in each jaw.

Molars: These are behind the premolars and have 4 cusps or bumps. Adult humans have 6 molars in each jaw. The last molars are called "wisdom" teeth. These teeth sometimes cause a lot of pain and have to be removed.

The teeth are anchored in the jaw bones by their roots. The part of the tooth that we see is called the crown.



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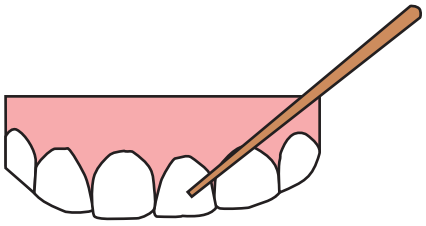
To study your teeth you need: yourself, mirror, toothpick.

What to do:

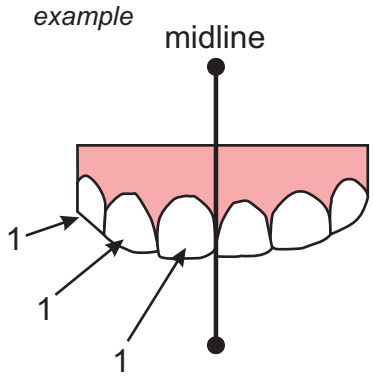
STEP 1
Look at your own teeth in the mirror.



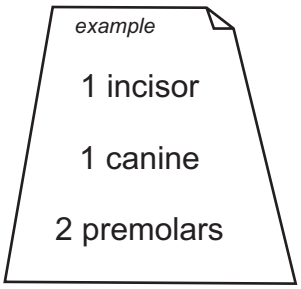
STEP 2
Find the different types of teeth in your mouth.
Use the toothpick to point out each type.



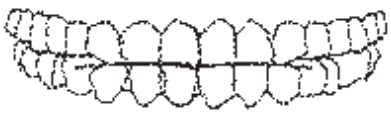
STEP 3
Count how many of each type of tooth you have in the right half of the upper jaw.



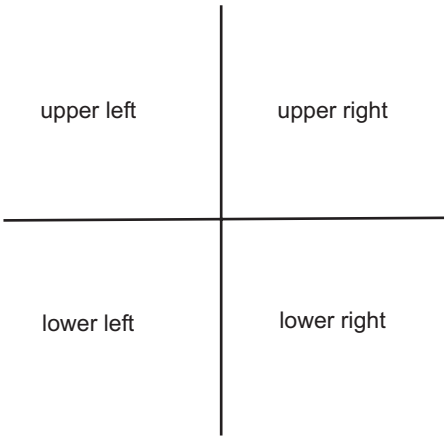
STEP 4
Write down the answer.



STEP 5
Do the same with the left half of the upper jaw and with both halves of the lower jaw.



STEP 6
Write down all the answers.



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Answer the questions below:

Q1 How many molars do you have altogether?

Q2 How many teeth do you have altogether?

Q3 Are there more teeth in your upper jaw or in your lower jaw?

Compare your answer to question 3 with those of the rest of the class. Summarise the information in a table like the one below.

Name	Upper jaw has more teeth	Lower jaw has more teeth

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CHAPTER 4

CHAPTER 4

Acids and Bases in the Home

4.1	Using senses of taste and touch to classify household substances.	127-128
4.2	Some liquids which look like water can kill you.	129-130
4.3	Chemical indicators.	131-132
4.4	Making your own indicators.	133-134
4.5	Acidic liquid and dry sodium bicarbonate.	135-136
4.6	Neutralisation.	137-138
4.7	Treating indigestion.	139-140
4.8	Acids and bases in our daily lives.	141
4.9	The secret message.	142-143
4.10	Using what you know about indicators.	144-145

Heating and Heat Transfer

4.11	Is it a good or a bad conductor of heat?	146-147
4.12	Moving in circles.	148
4.13	Which is the heavy weight: the cold or the hot liquid?	149-150
4.14	Convection, conduction and radiation.	151
4.15	Hot air balloons.	152
4.16	Ventilation system.	153
4.17	Radiation and absorption of heat by black and white surfaces.	154-155
4.18	The magic burning of paper.	156
4.19	Fireproof materials.	157-158

Magnetism

4.20	Magnets have strange powers over some things.	159-160
4.21	The magic of magnets.	161-162
4.22	Making a compass.	163-164
4.23	Just how strong is your magnet?	165-166

Matter and Measurement

4.24	How much water can the large well of my comboplate hold?	167
4.25	Estimating volumes using items with definite known volumes.	168
4.26	What is the volume of the spring in my kit?	169-170

More about Electricity

4.27	The current in a series circuit.	171-172
4.28	Light bulbs in series.	173-174
4.29	Light bulbs in parallel.	175-176
4.30	The electric lemon.	177-178

Variety of Lives

4.31	A mould.	179-180
4.32	A fern plant.	181-183
4.33	Flowering plants: dicotyledon.	184-186
4.34	A monocotyledon flower.	187-188
4.35	A snail zoo.	189-192
4.36	Six jointed legs - Insects.	193-196
4.37	More jointed legs - Spiders.	197-198
4.38	Even more jointed legs - Crustaceans.	199-200
4.39	Many more jointed legs - Millipedes.	201-202

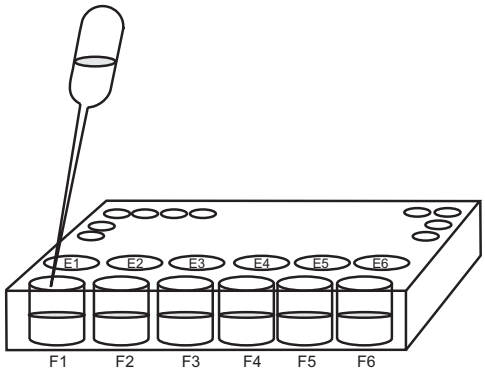
Activity 4.1 USING SENSES OF TASTE AND TOUCH TO CLASSIFY HOUSEHOLD SUBSTANCES

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

You will need:

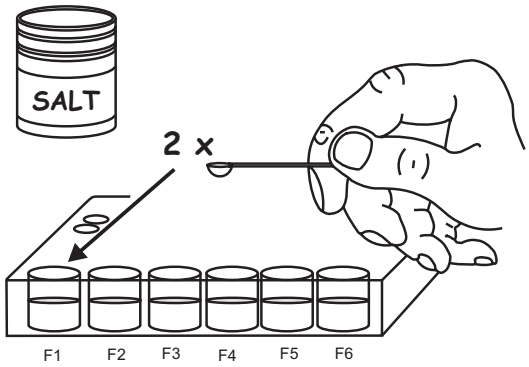
•1 comboplate •1 microspatula •5 x propettes •vinegar •dish washing liquid
•bicarbonate of soda •orange squash •toothpaste •cream of tartar
•universal indicator(dye) •lemon juice •salt •powdered milk •sugar •water

STEP 1



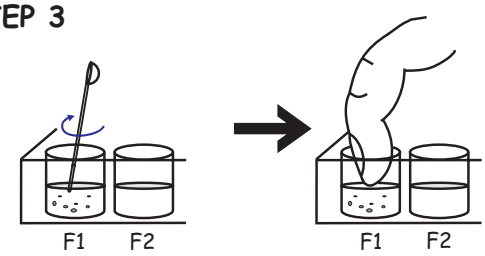
Use a propette to half fill all the large wells of the comboplate with tap water.

STEP 2



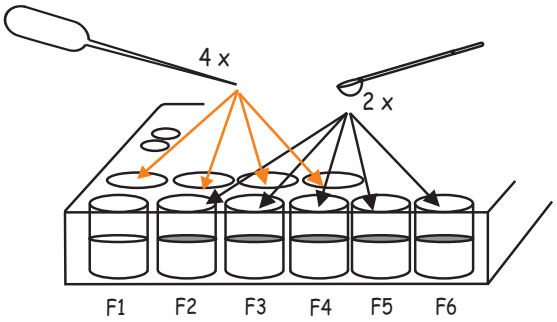
Dissolve 2 microspatulas of salt in well F1.

STEP 3



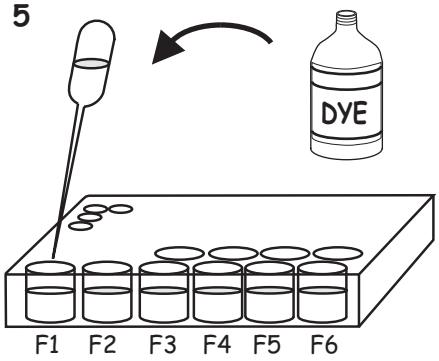
Stir with the end of the microspatula and use your finger to taste and feel.

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).

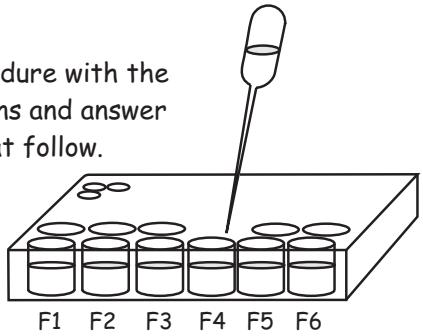
STEP 5



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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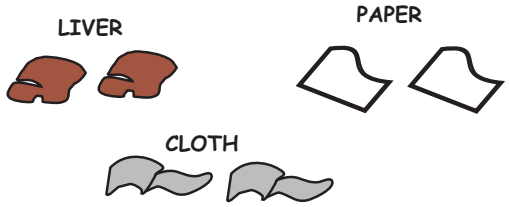
Activity 4.2 SOME LIQUIDS WHICH LOOK LIKE WATER CAN KILL YOU.

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:

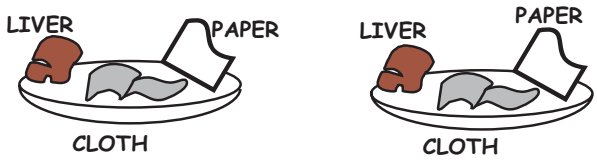
- 2 x propettes
- 1 petri dish
- car battery acid
- a piece of cloth
- a piece of raw liver
- a piece of paper
- water

STEP 1



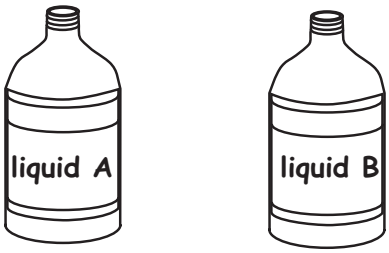
Cut out 2 pieces of liver, 2 pieces of cloth and 2 pieces of paper.

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.

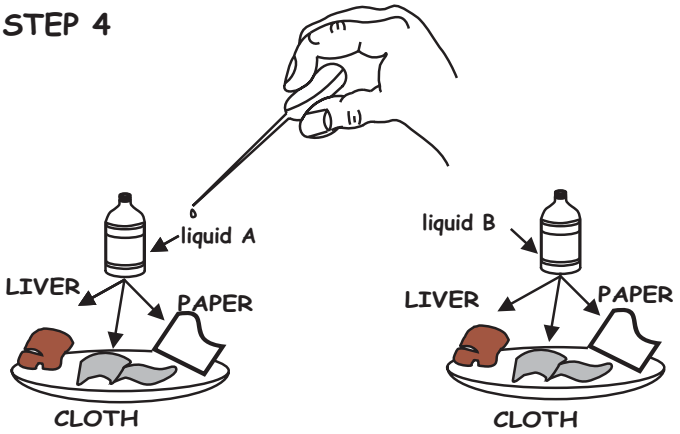
STEP 3



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

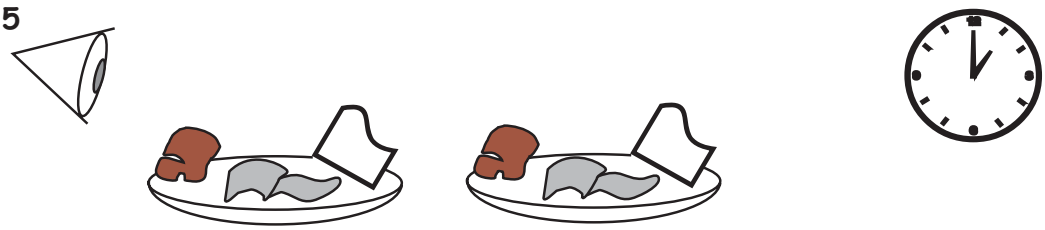
Q1 Can you tell from just looking at the two which liquid is water and which is an acid?

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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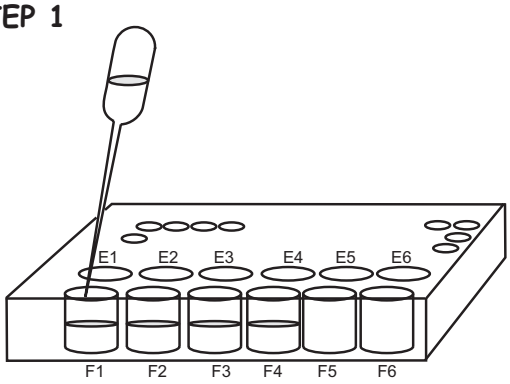
Activity 4.3 CHEMICAL INDICATORS

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:

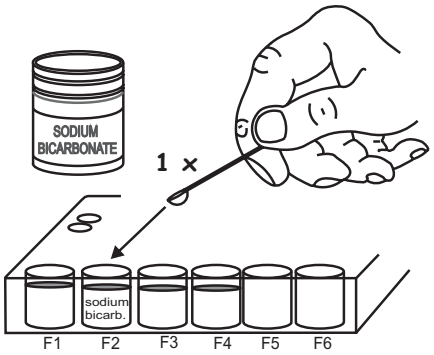
- 1 comboplate®
- 3 x microspatulas
- 3 propettes
- red and blue litmus strips
- bromothymol blue
- tartaric acid
- sodium bicarbonate
- dilute hydrochloric acid
- dilute sodium hydroxide solution
- sugar
- water

STEP 1



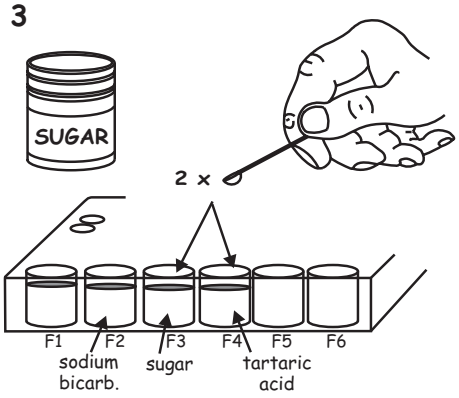
Use a propette to half fill wells F1, F2, F3 and F4 of the comboplate with tap water.

STEP 2



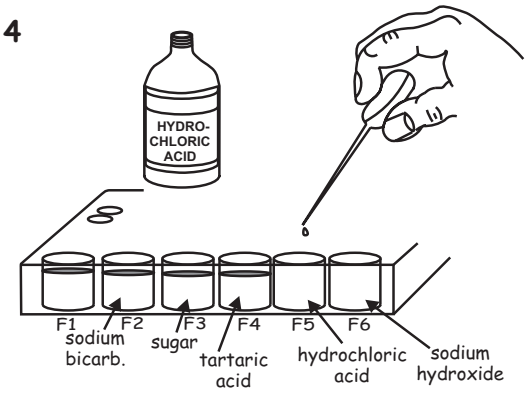
Do not add anything in well F1, but dissolve 1 microspatula of sodium bicarbonate in well F2.

STEP 3



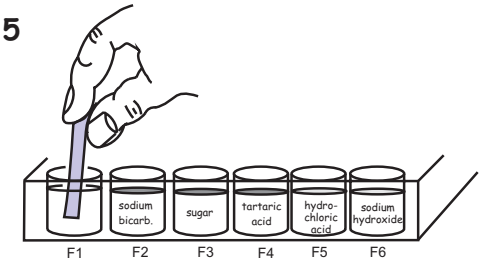
Repeat step 2 using a clean microspatula for sugar in well F3 and tartaric acid in well F4.

STEP 4



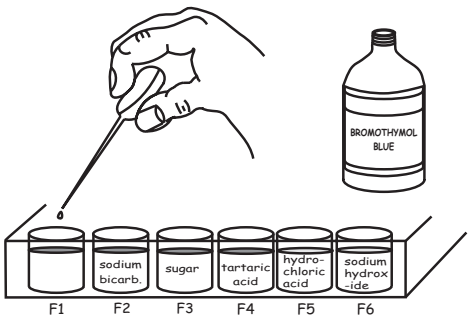
Use a propette to add 20 drops of dilute hydrochloric acid into well F5 and dilute sodium hydroxide into well F6.

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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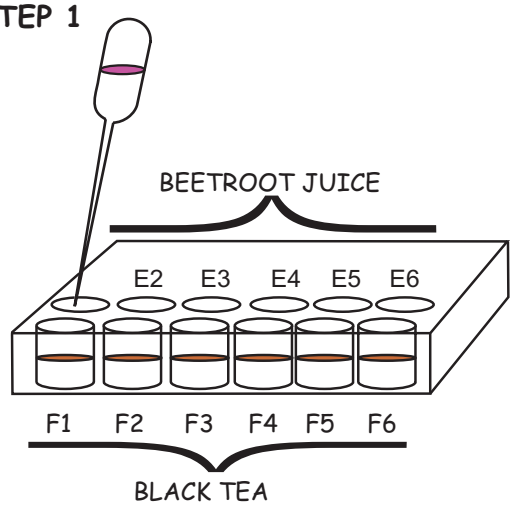
Activity 4.4 MAKING YOUR OWN INDICATORS

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:

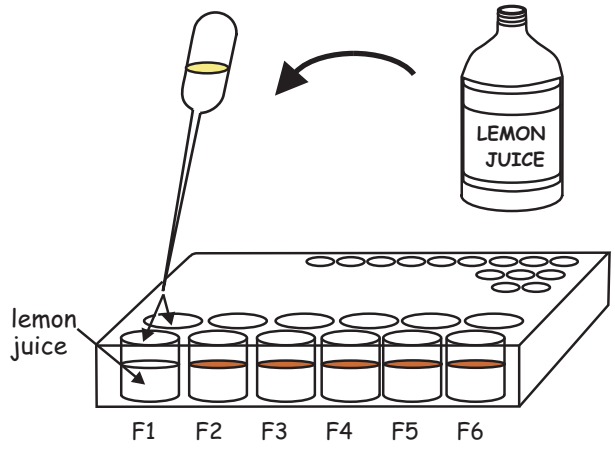
•1 comboplate®	•3 propettes	•cream of tartar	•sugar
•1 microspatula	•beetroot juice	•powdered milk	•salt
•2 sample vials	•black tea	•sodium bicarbonate	•lemon juice

STEP 1



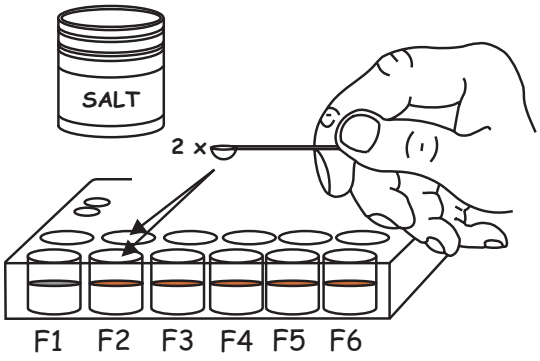
Half fill each of the F wells of the comboplate with black tea, and each of the E wells with beetroot juice.

STEP 2



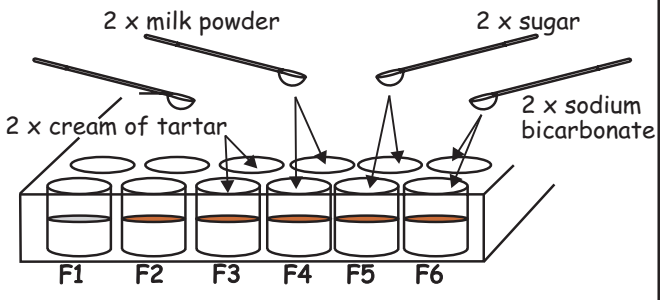
Use a propette to add 3 drops of lemon juice into wells F1 and E1. Record your findings in the table provided.

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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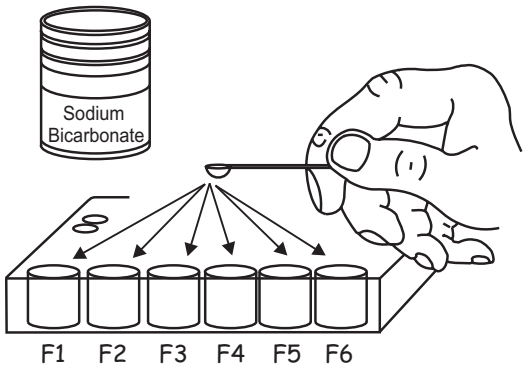
Activity 4.5 ACIDIC LIQUID AND DRY SODIUM BICARBONATE

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

You will need:

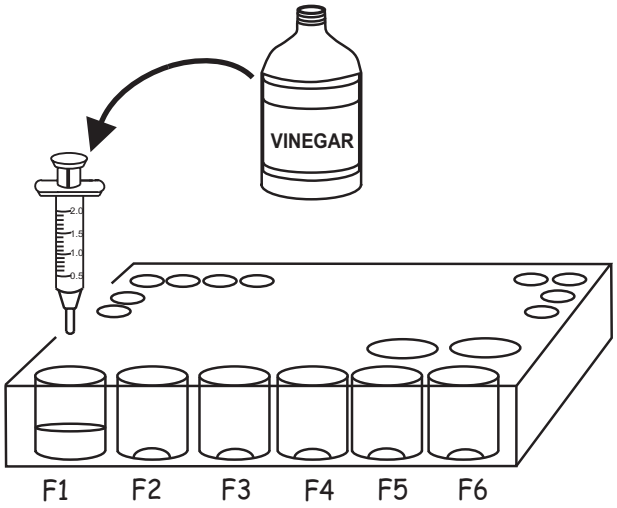
- 1 comboplate®
- 1 microspatula
- 1 syringe
- vinegar
- dilute sodium hydroxide
- lemon juice
- ammonia solution
- milk of magnesia
- dilute hydrochloric acid
- sodium bicarbonate
- water

STEP 1



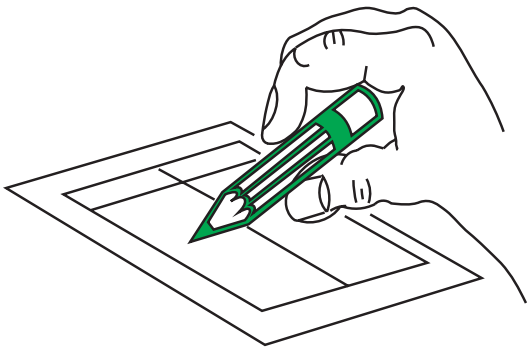
Put 1 microspatula full of sodium bicarbonate into wells F1 to F6.

STEP 2



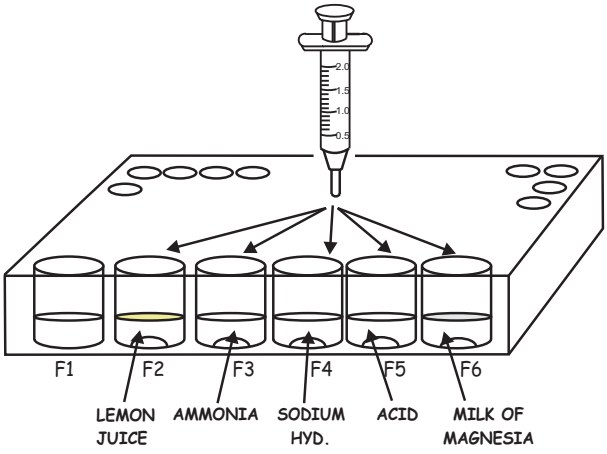
With a syringe put 1 ml of vinegar into well F1 and note what happens.

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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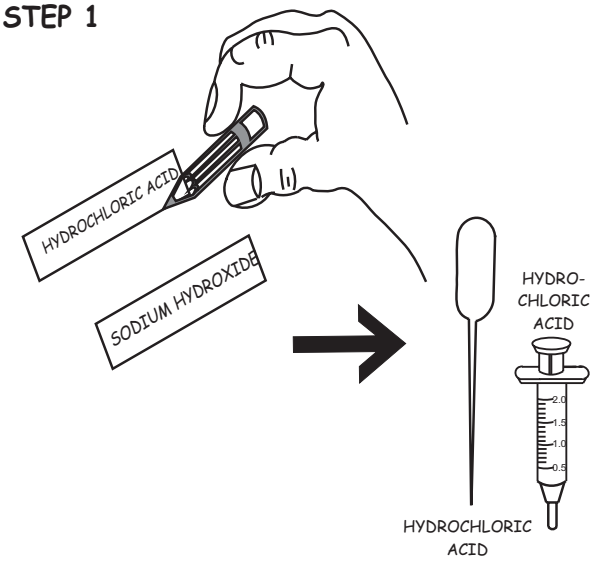
Activity 4.6 NEUTRALISATION

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

You will need:

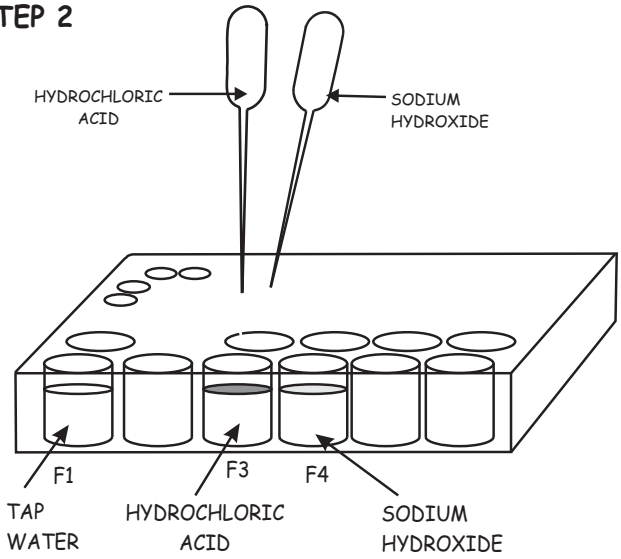
- 1 comboplate®
- 3 x propettes
- 2 x syringes
- 2 x microspatulas
- 0.1 M hydrochloric acid
- 0.1 M sodium hydroxide
- Universal indicator
- water

STEP 1



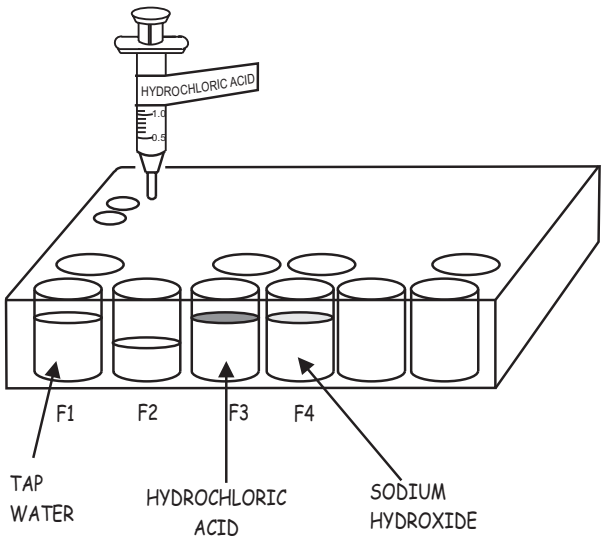
Put a label of hydrochloric acid on a syringe and a propette, and a sodium hydroxide label on another set.

STEP 2



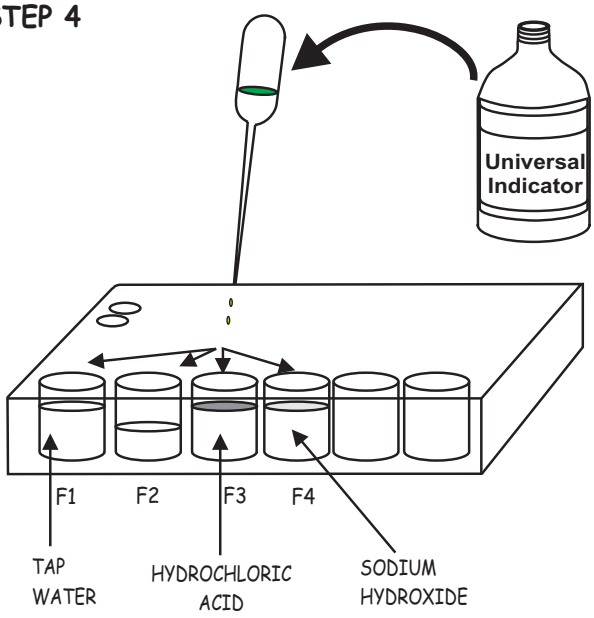
Fill well F1 to 2/3 with tap water, well F3 to 2/3 with hydrochloric acid and well F4 to 2/3 with sodium hydroxide solution.

STEP 3



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

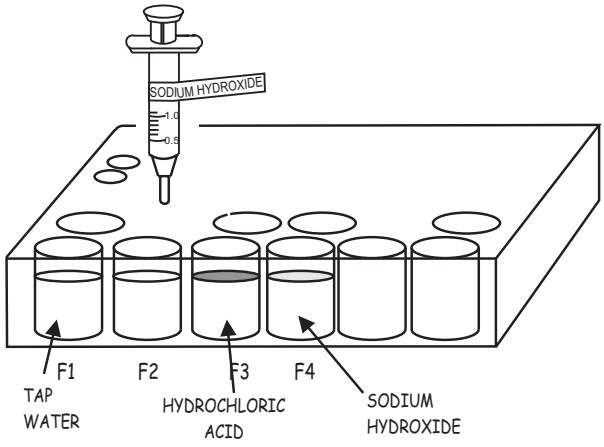
STEP 4



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

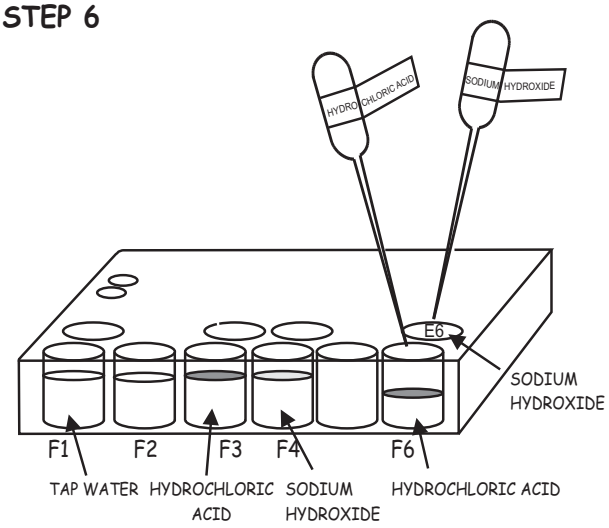
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STEP 5



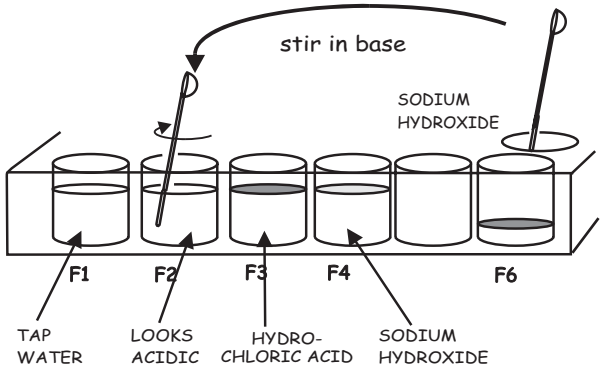
Now use a syringe to add 1 ml of sodium hydroxide to well F2. Stir and note the colour change.

STEP 6



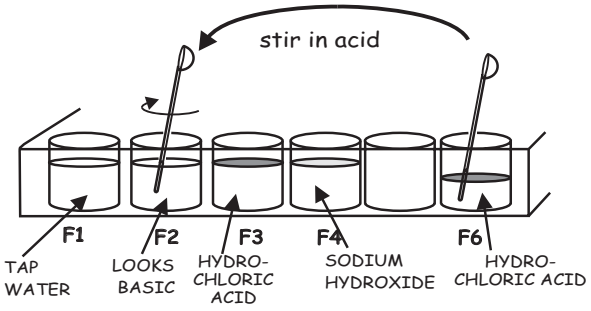
Fill half of well F6 with hydrochloric acid and half of well E6 with sodium hydroxide.

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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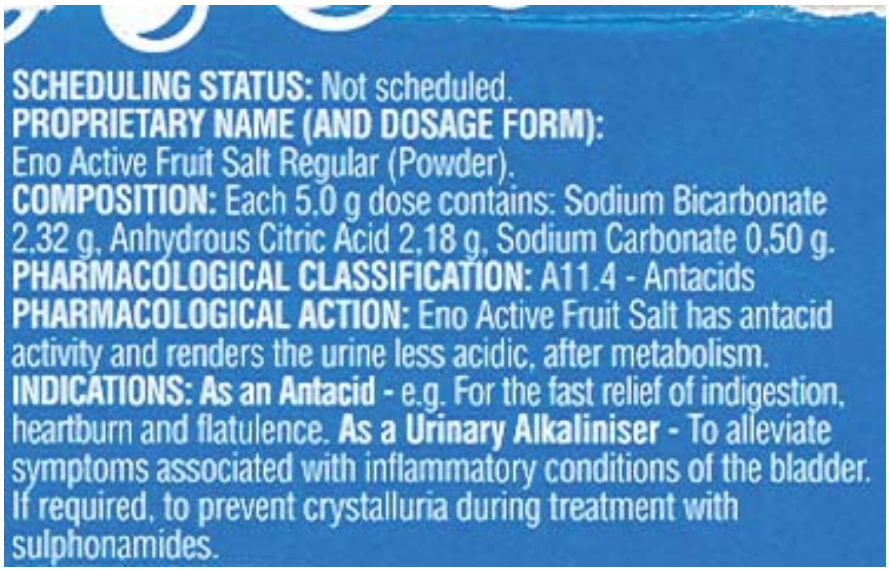
Activity 4.7 Treating Indigestion

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?

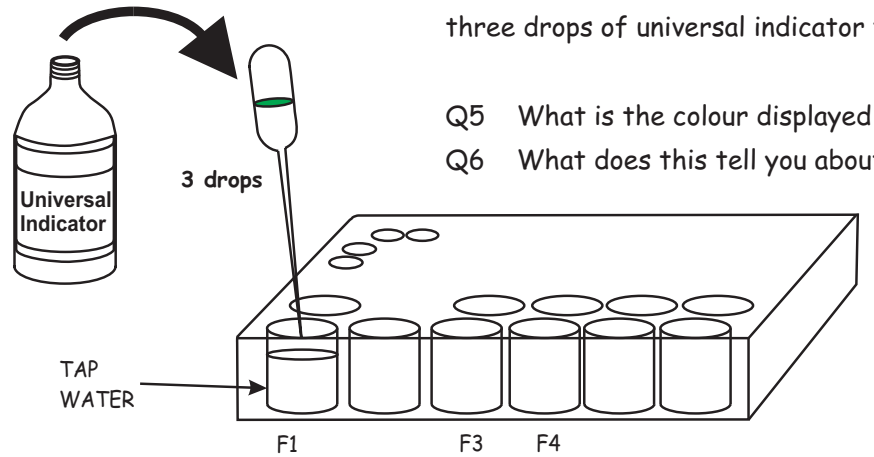
Q4 Explain how ENO alleviates acid indigestion and heartburn.

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.

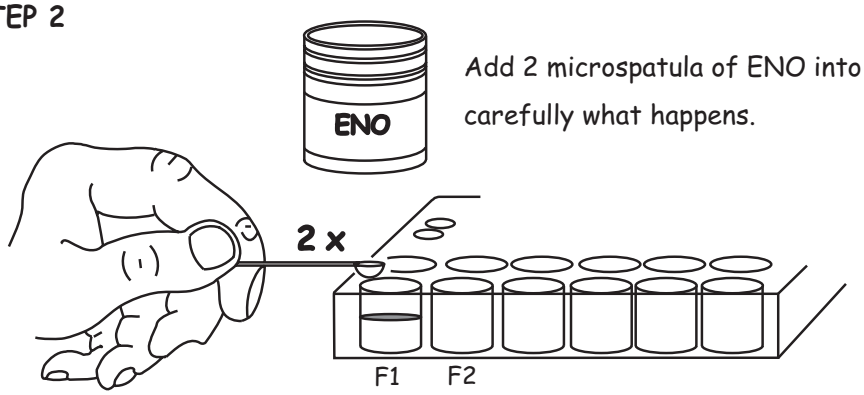
Q5 What is the colour displayed by the universal indicator?

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



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STEP 2

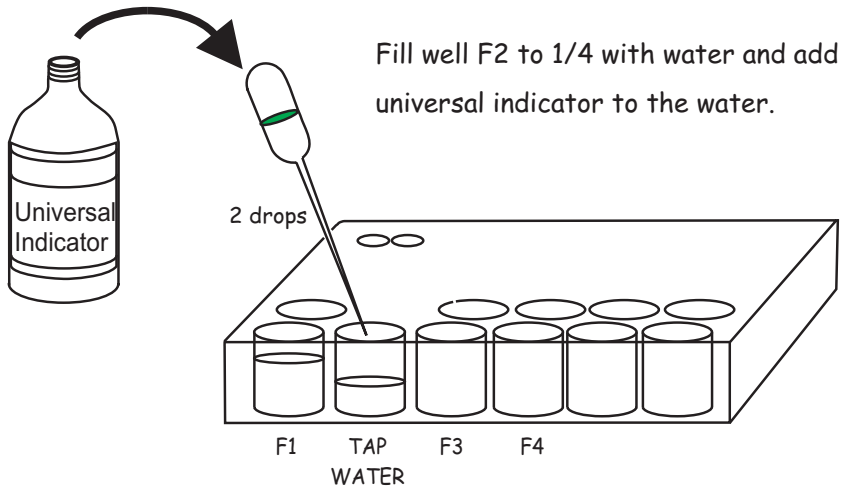


Add 2 microspatula of ENO into well F1 and observe carefully what happens.

Q7 Describe your observations.

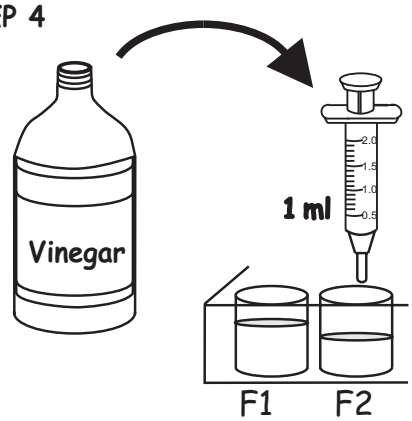
Q8 Why does ENO first appear acidic and then later becomes basic?

STEP 3



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

STEP 4

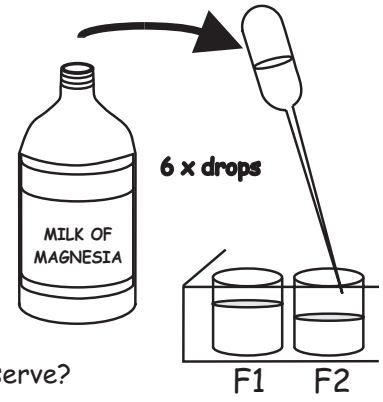


Add 1 ml of vinegar to the mixture in well F2.

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?

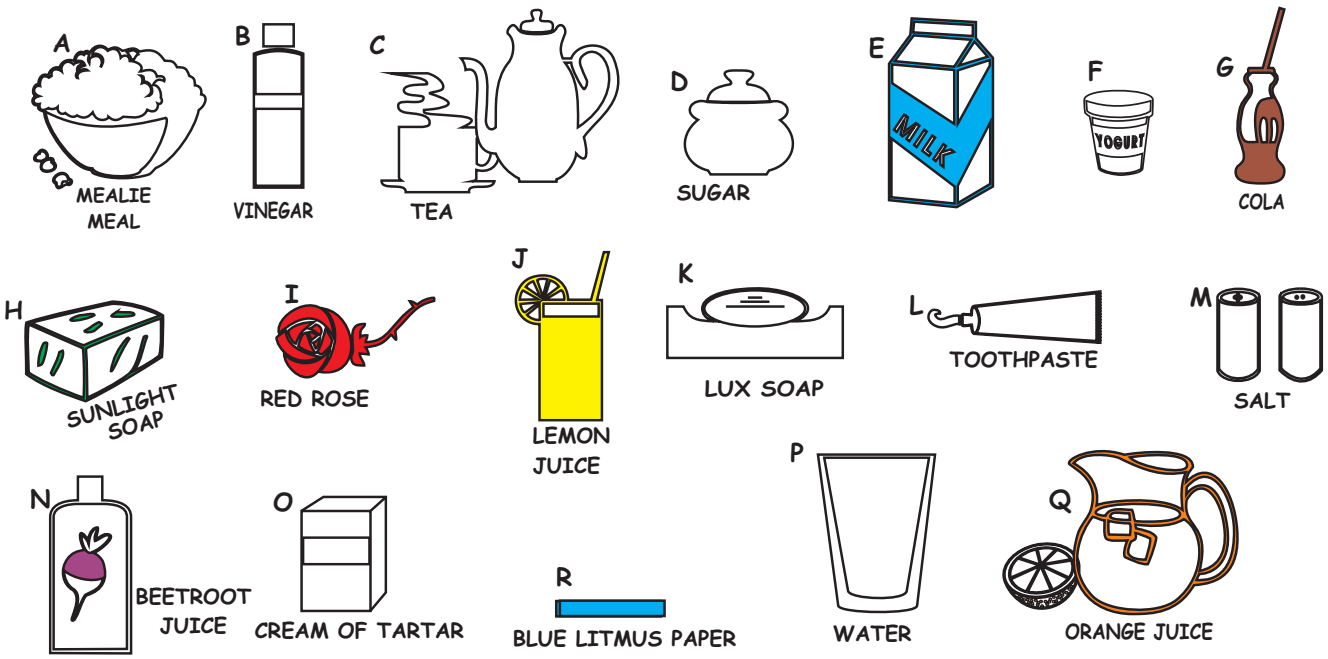
Q10 Which two items can you mix to produce a gas which is responsible for the fizzing in substance G?

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

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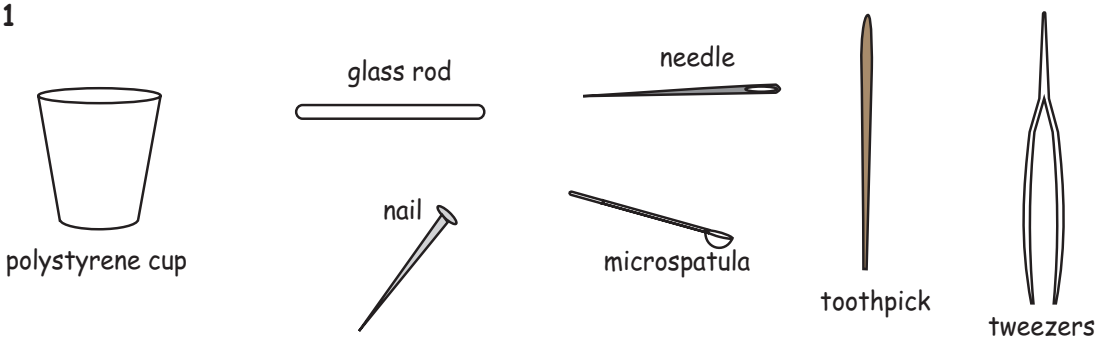
Activity 4.11 IS IT A GOOD OR BAD CONDUCTOR OF HEAT?

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)		

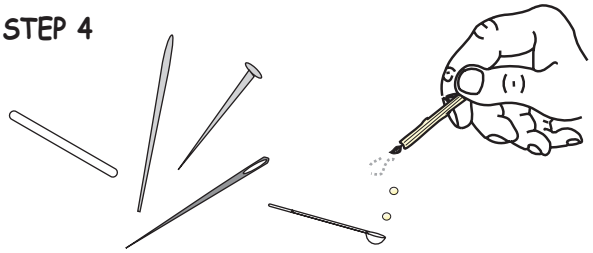
Record your decision on the table above and state the reason for your decision in the last column of the table.

STEP 3

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

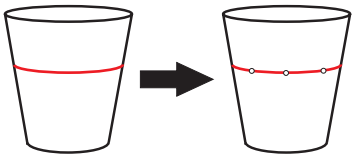
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STEP 4

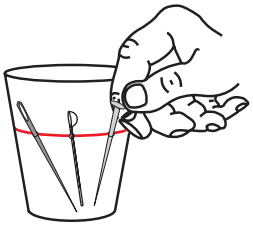


Drop molten wax from a lit candle on a microspatula and repeat the step with a tooth pick, a glass rod, a nail and a needle.

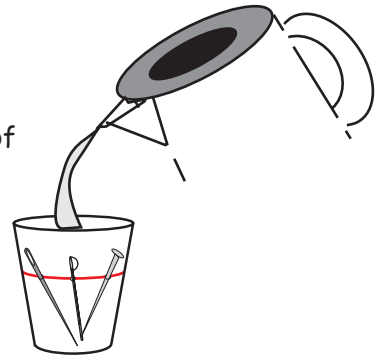
STEP 5



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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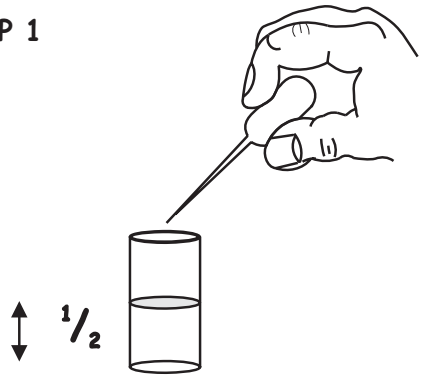
Activity 4.12 MOVING IN CIRCLES

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

You will need:

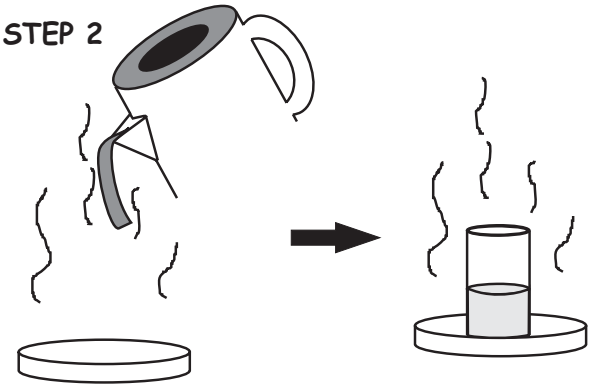
- 1 large sample vial
- 1 propette
- 1 Petri dish
- food colouring
- boiling water
- tap water

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)

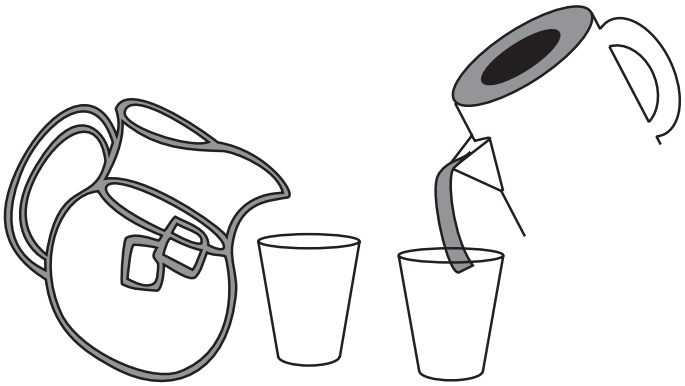
WHICH IS THE HEAVY WEIGHT: THE COLD OR THE HOT LIQUID?

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

You will need:

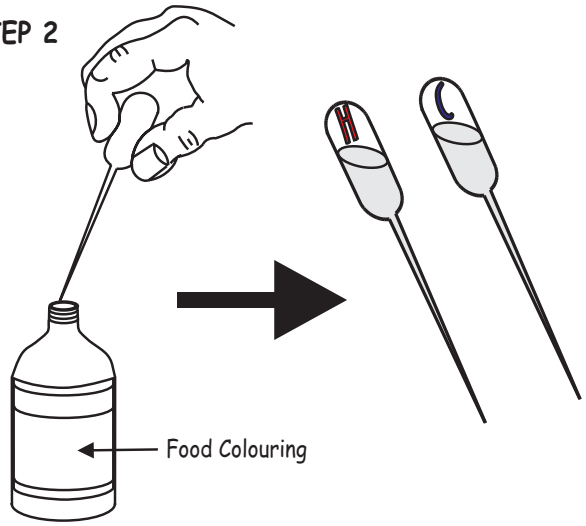
- 1 comboplate®
- 1 microstand
- 2 x polystyrene cups
- 3 x propette
- 2 x microfunnels
- 2 x small vials
- 2 paper clips
- food colouring
- cold water
- hot water

STEP 1



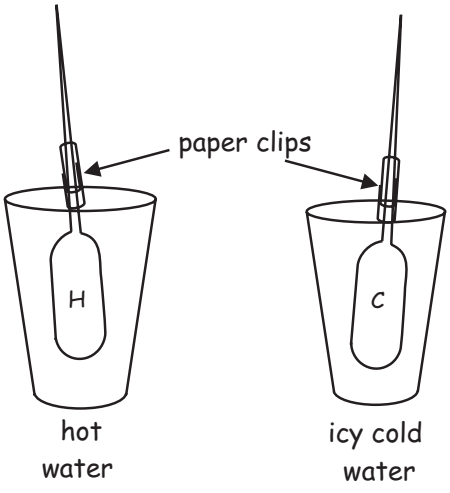
Half fill one polystyrene cup with ice cold water and the other with hot water.

STEP 2



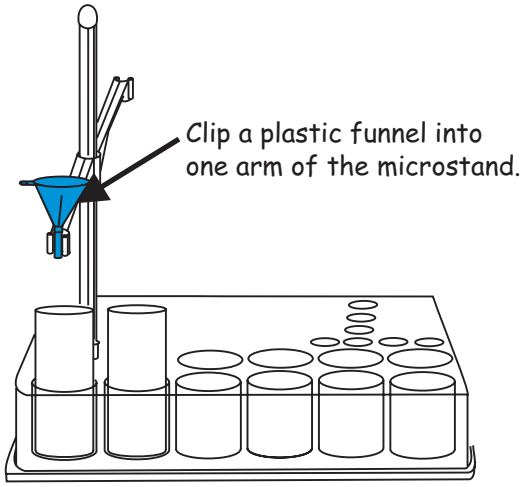
Use a pen to label one propette **H** and the other ***C***. Draw some food colouring into each propette.

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.

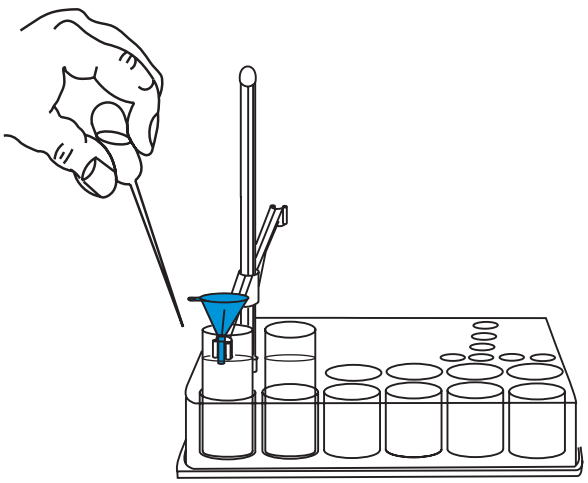
STEP 4



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

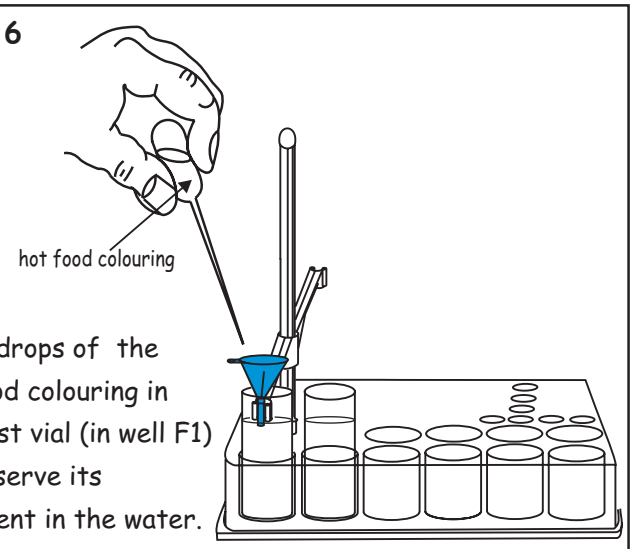
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STEP 5



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.

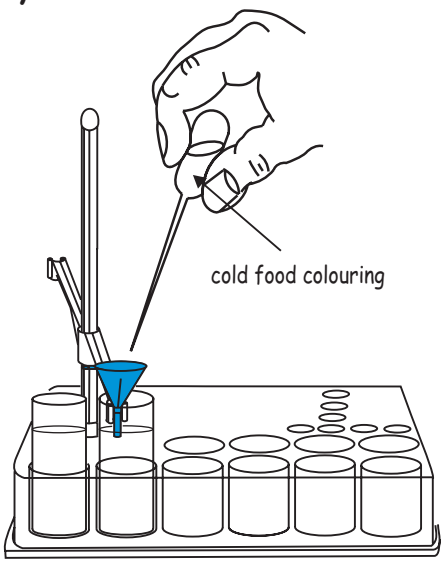
STEP 6



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



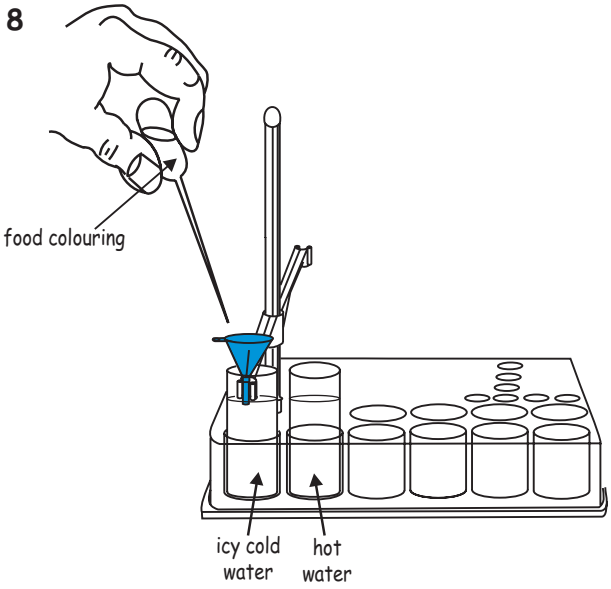
Add 5 drops of the cold food colouring in the second vial (in well F2) and observe its movement in the water.

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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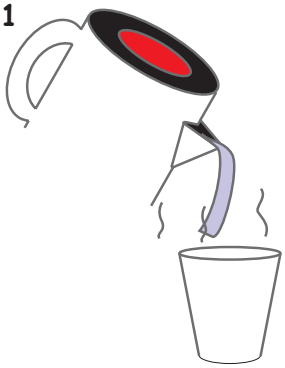
Activity 4.14 CONVECTION, CONDUCTION AND RADIATION

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?

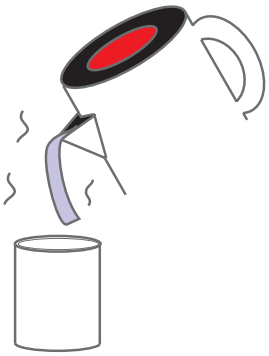
You will need:

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

STEP 1



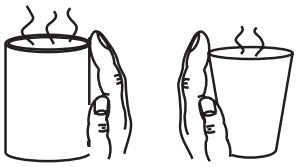
Fill a polystyrene cup and a can with hot water.



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



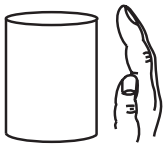
When you touch the sides of the two containers.

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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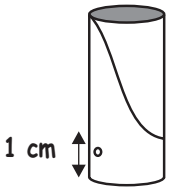
Activity 4.15 HOT AIR BALLOONS

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

You will need:

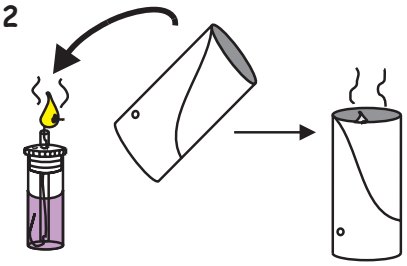
- 1 light weight paper bag
- 1 microburner
- 1 toilet roll tube
- 1 wooden skewer

STEP 1



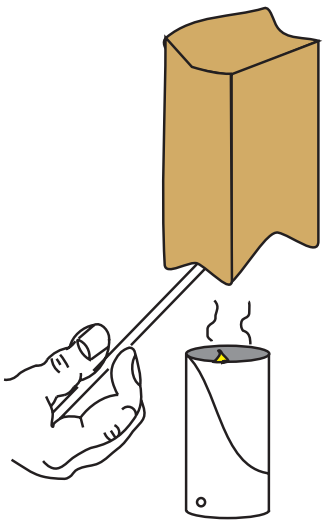
Make a vent hole about 1 cm above the bottom of one end of a toilet roll tube.

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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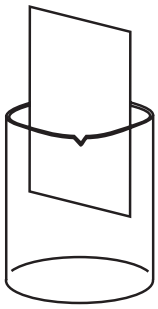
Activity 4.16 VENTILATION SYSTEM (Teacher's demo)

Focus question: How do convection currents cause winds?

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

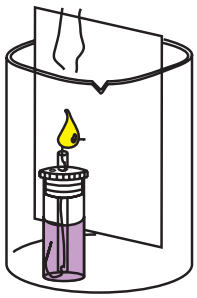
•1 microburner •1 glass beaker •a piece of cardboard •smouldering cloth

STEP 1



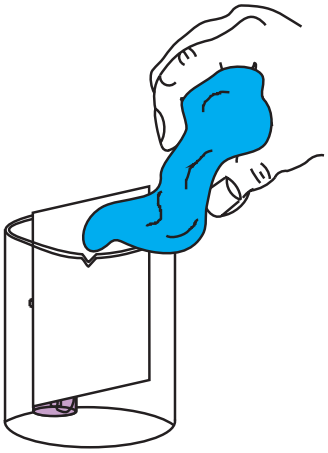
Insert a piece of cardboard into the glass beaker so that it partitions the beaker into two parts.

STEP 2



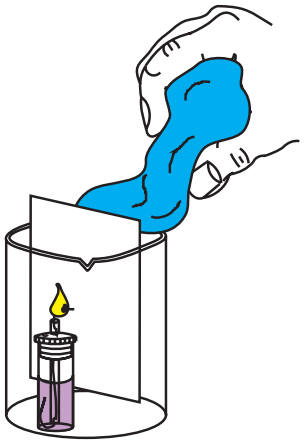
Place a burning microburner inside one part.

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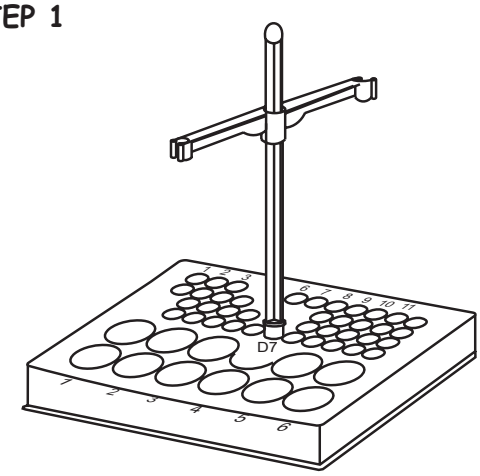
Activity 4.17 RADIATION AND ABSORPTION OF HEAT BY BLACK AND WHITE SURFACES

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

You will need:

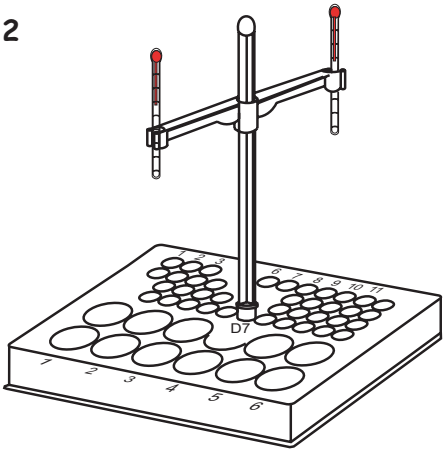
•1 comboplate •1 microstand •1 black sample vial •2 x thermometers
•1 clear sample vial

STEP 1



Fit the microstand into one of the small wells.

STEP 2

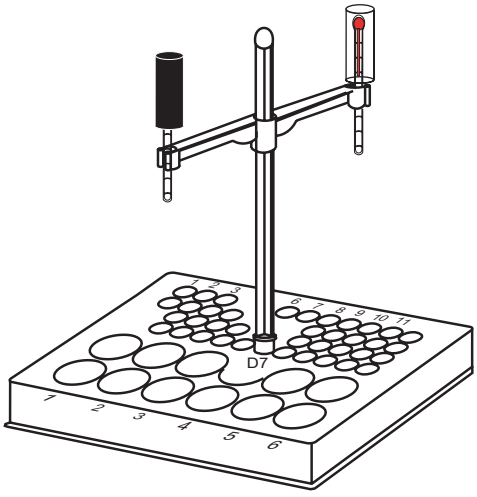


Fit one thermometer in an inverted (upside down) position in one of the arms of the microstand and the other thermometer in the other arm.

STEP 3

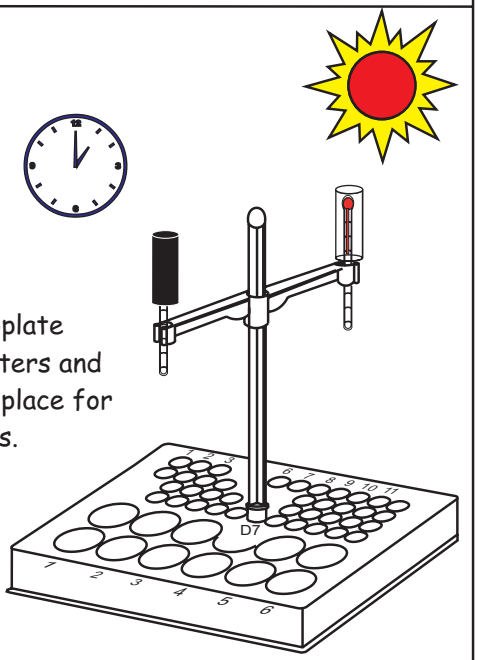
Turn the thermometers in such a way that the markings can be read. Note readings on the two thermometers and record under initial temperature on the table below.

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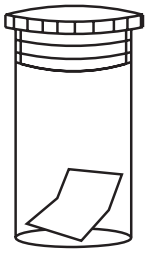
Activity 4.18 THE MAGIC BURNING OF PAPER (do the activity at 12 noon)

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

You will need:

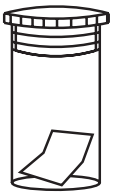
•1 magnifying glass •a piece of paper •1 glass sample vial with lid •sunlight

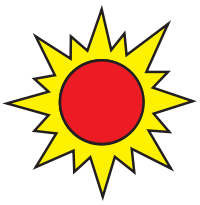
STEP 1



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

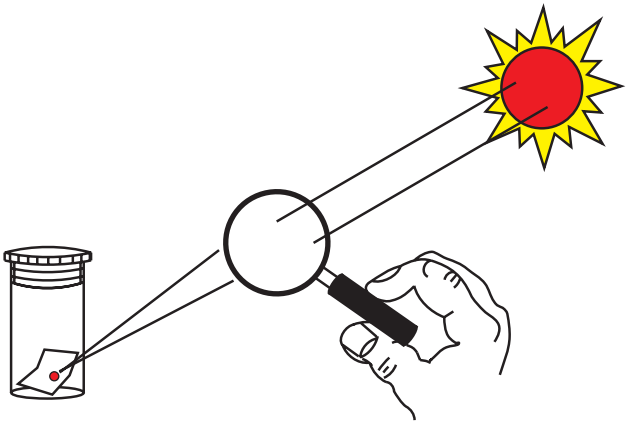
STEP 2





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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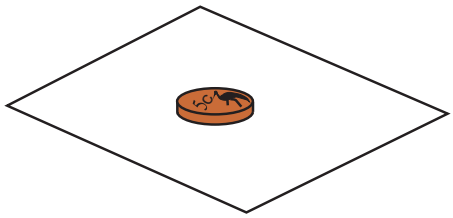
Activity 4.19 FIRE PROOF MATERIALS (Teacher's demo)

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

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

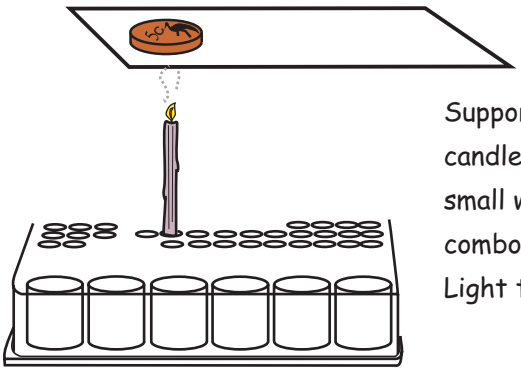
- 1 comboplate®
- 1 birthday candle
- a piece of paper
- a piece of nonsynthetic cloth
- a coin
- prestik

STEP 1



Place a coin on a piece of paper.

STEP 2



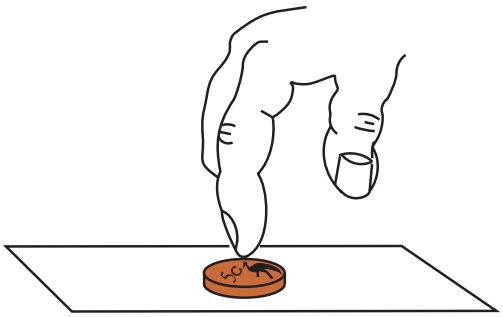
Support a birthday candle in one of the small wells of the comboplate with prestik. Light the candle.

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.

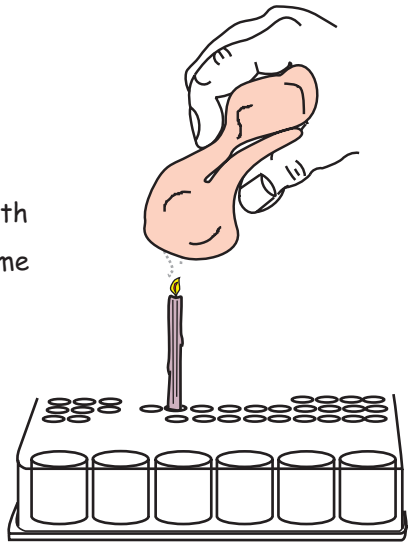
STEP 4



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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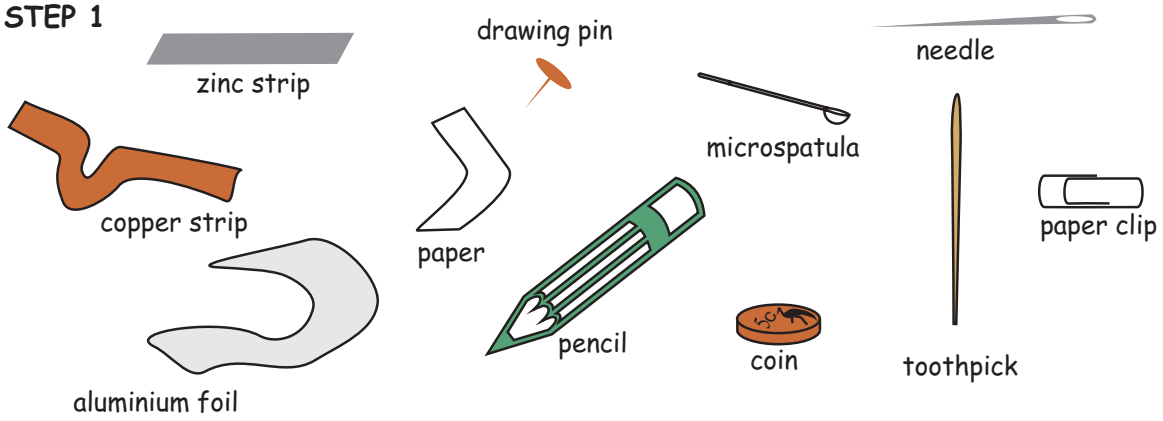
Activity 4.20 MAGNETS HAVE STRANGE POWERS OVER SOME THINGS

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.

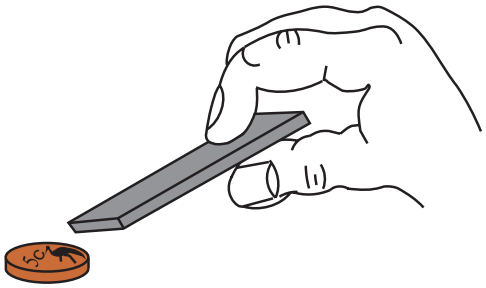
STEP 2

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



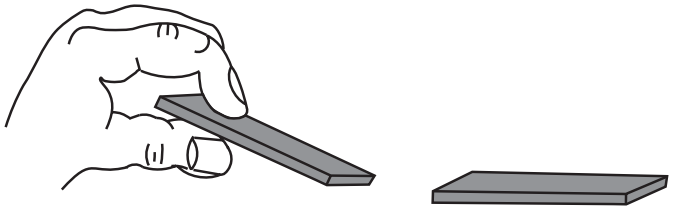
Test your decisions by bringing a magnet close to each of the objects and record your findings in the third column of the table.

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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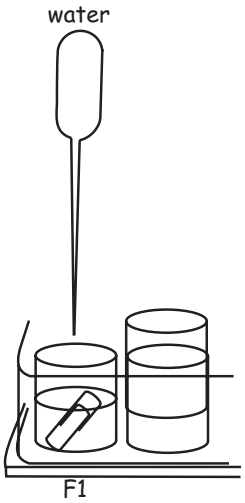
Activity 4.21 THE MAGIC OF MAGNETS

Focus question: In what way can magnets be used?

You will need:

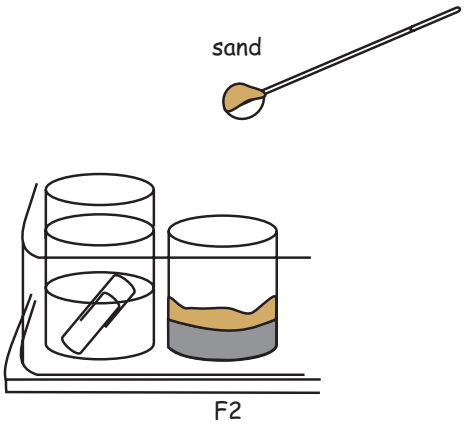
- 1 comboplate
- 1 propette
- a piece of string
- 1 microstand
- sand
- a paper clip
- 1 magnet
- iron filings
- 1 microspatula
- water

STEP 1



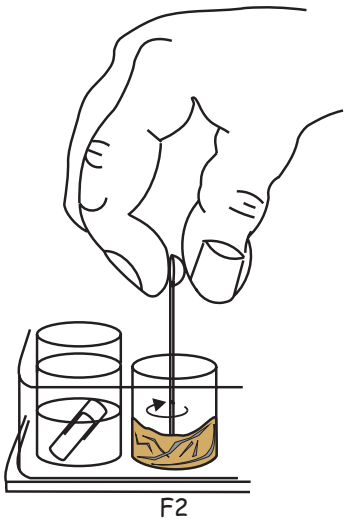
Put a paper clip in well F1 and add water.

STEP 2



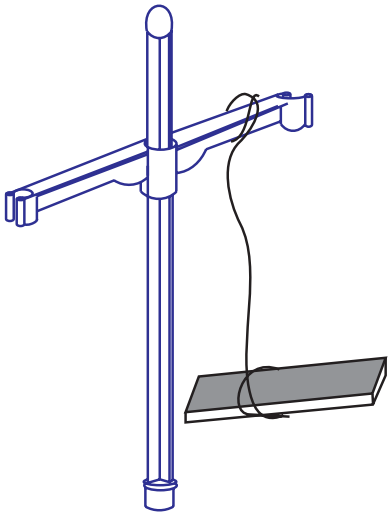
Put a thin layer of iron filings at the bottom of well F2 and fill to one quarter with sand.

STEP 3



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

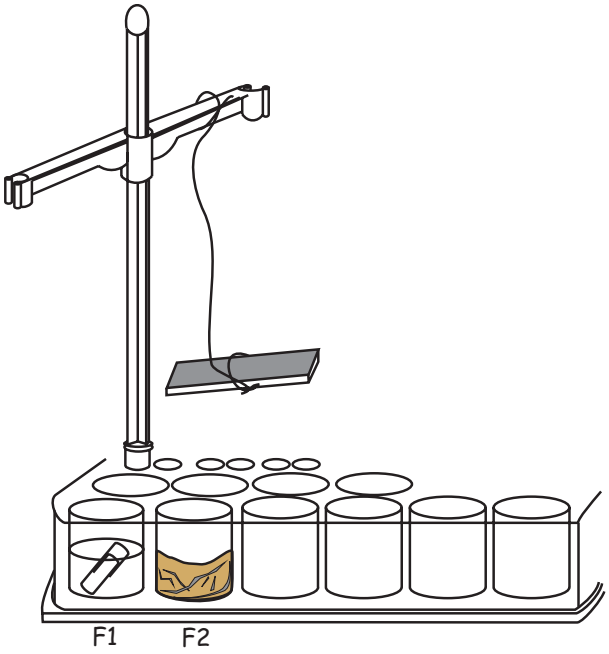
STEP 4



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

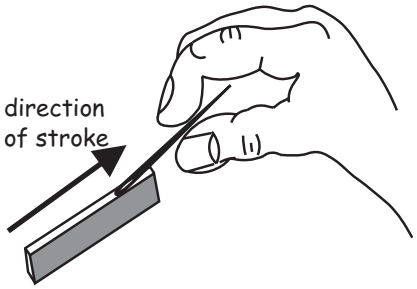


Lay the needle on top of the paper floating on the water.

Q1 What happens?

STEP 3

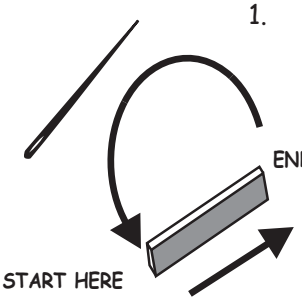
Take the needle off the paper.



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.

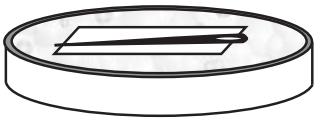
When you reach the other end of the magnet, lift the needle up in a circular motion. Stroke the needle again in the same direction as before, from the end you first started at. Repeat the stroking twenty times.

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.

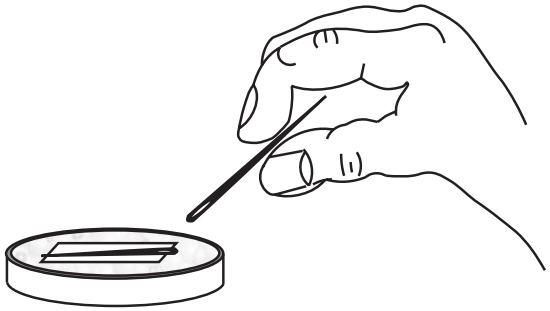
Q4 What can you say about the direction of the magnetised needle and the compass needle?

Q5 What causes the direction of the needles?

Q6 In which direction do the needles point?

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STEP 7



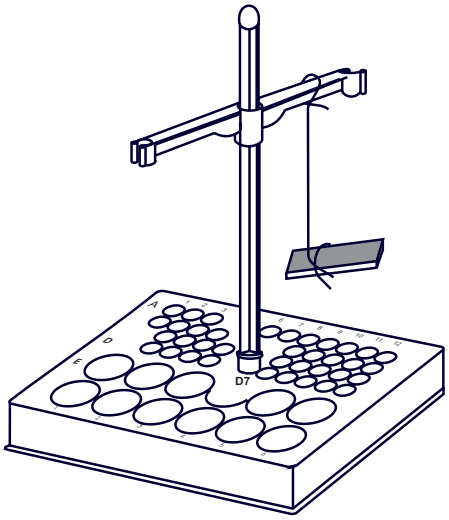
Take another needle and bring one end to the needle in the dish so that it is closest to the end which was stroked with the magnet.

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?

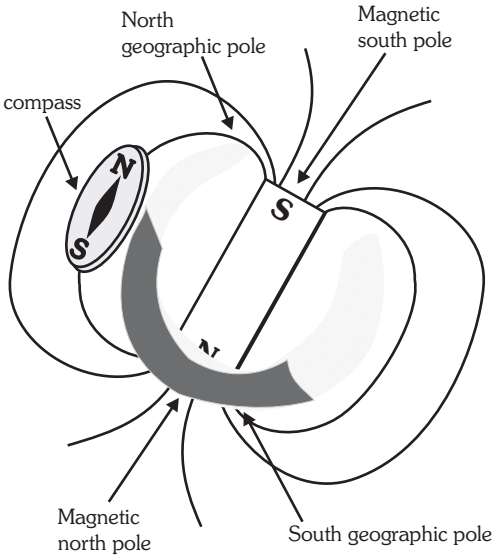
Q10 In which direction does a free swinging magnet point when it comes to rest? Why?

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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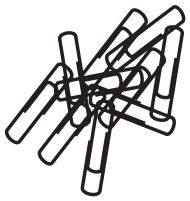
Activity 4.23 JUST HOW STRONG IS YOUR MAGNET?

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

You will need:

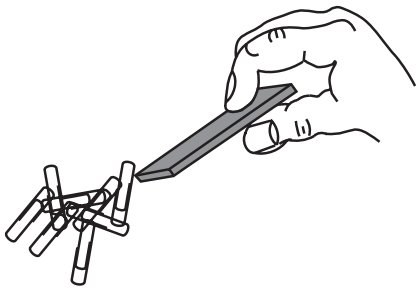
- 1 glass vial
- 1 petri dish
- 10 paper clips
- 1 magnet
- iron filings
- a piece of paper

STEP 1



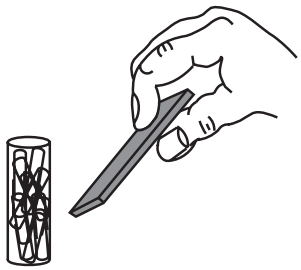
Put paper clips in a little pile.

STEP 2



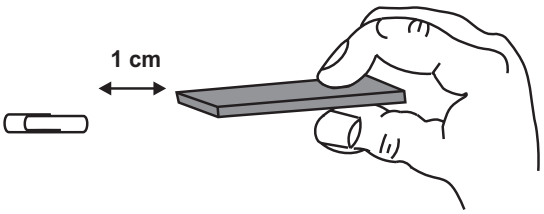
Bring the magnet near the paper clips and pick up as many of the clips as the magnet can possibly carry.

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



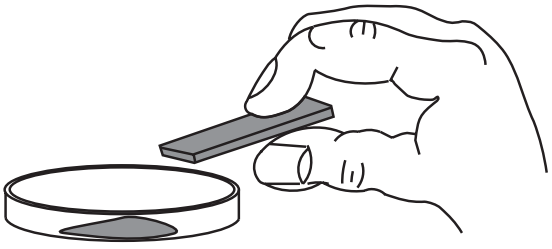
Bring the magnet to a distance of about 1 cm from one paper clip and see what happens.

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.

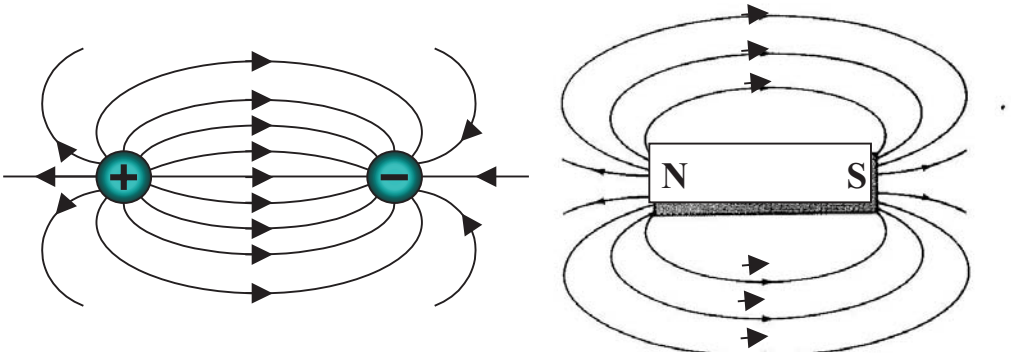


Diagram a Diagram b

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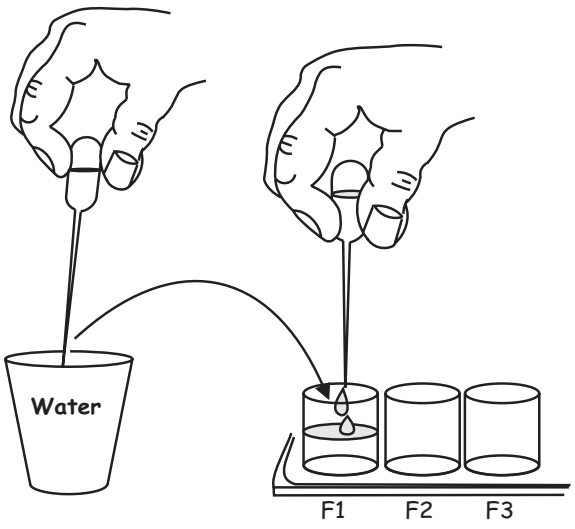
Activity 4.24 HOW MUCH WATER CAN THE LARGE WELL OF MY COMBOPLATE HOLD?

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

You will need:

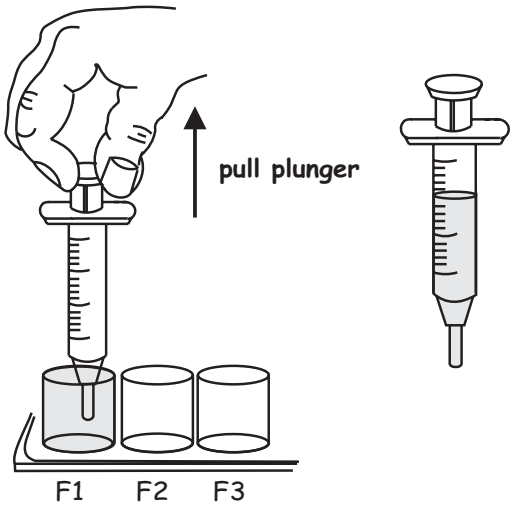
- 1 comboplate
- 1 propette
- 1 gas collecting tube
- 1 syringe
- 1 small sample vial
- water

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:

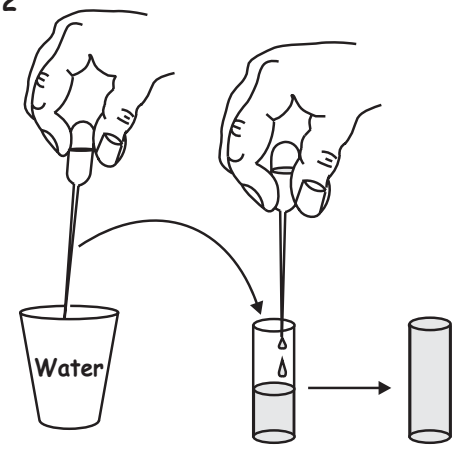
•1 small sample vial •1 propette •1 large sample vial •water

STEP 1

Check the volume of the small vial used in activity 4.24

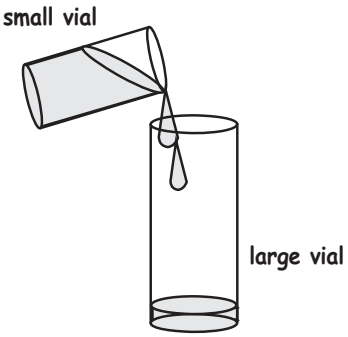
Q1 What is the volume of the small sample vial?

STEP 2



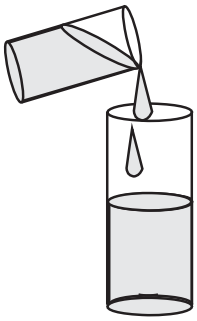
Use a propette to fill the small sample vial with water to the brim.

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?

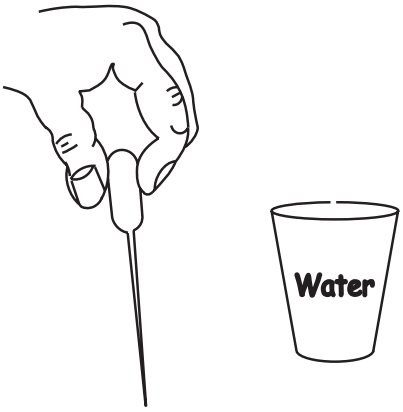
Q4 The volume of the large vial is _____ times the volume of the small vial.

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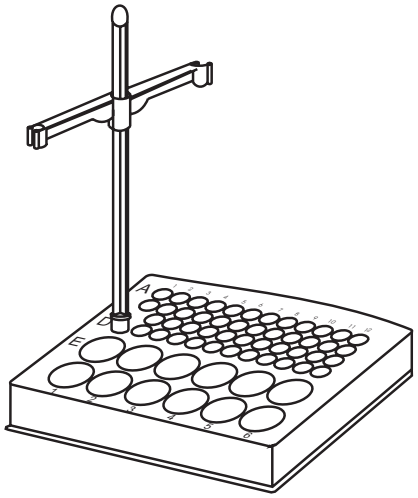
Activity 4.26 WHAT IS THE VOLUME OF THE SPRING IN MY KIT?

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

You will need:

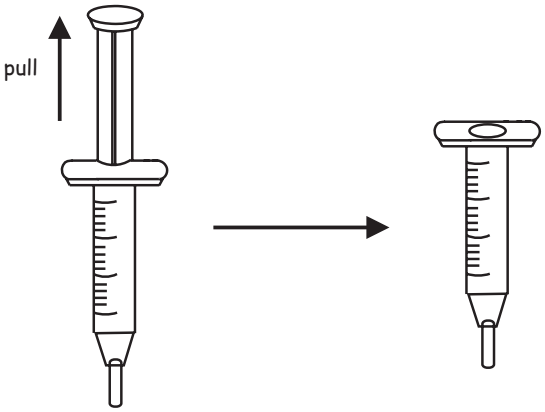
- 1 comboplate
- 1 microstand
- 1 propette
- 1 syringe
- 1 spring
- prestik
- 1 paper clip
- water

STEP 1



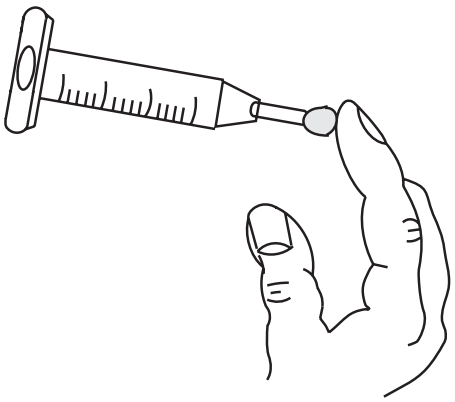
Insert a microstand into a small well of a comboplate.

STEP 2



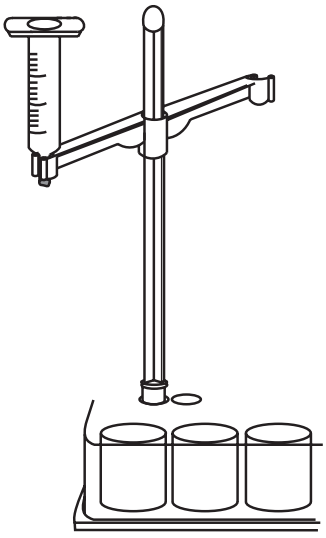
Remove the plunger of the syringe.

STEP 3



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

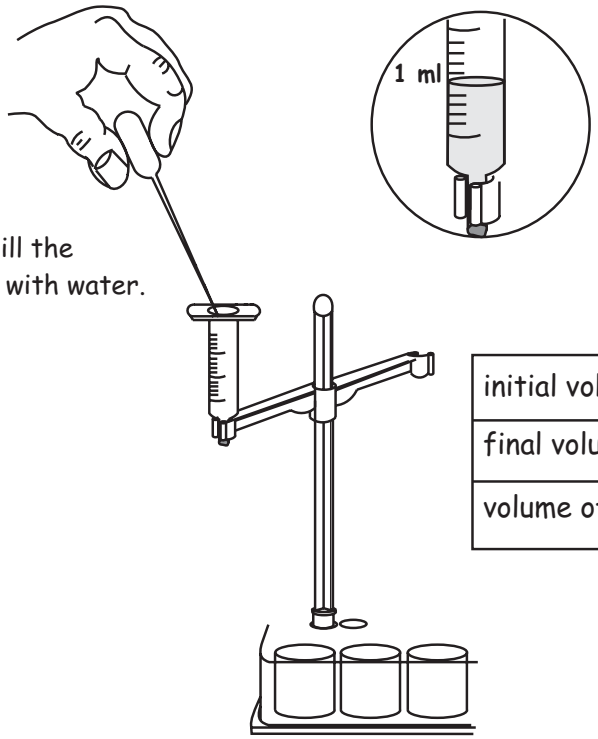
STEP 4



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

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STEP 5

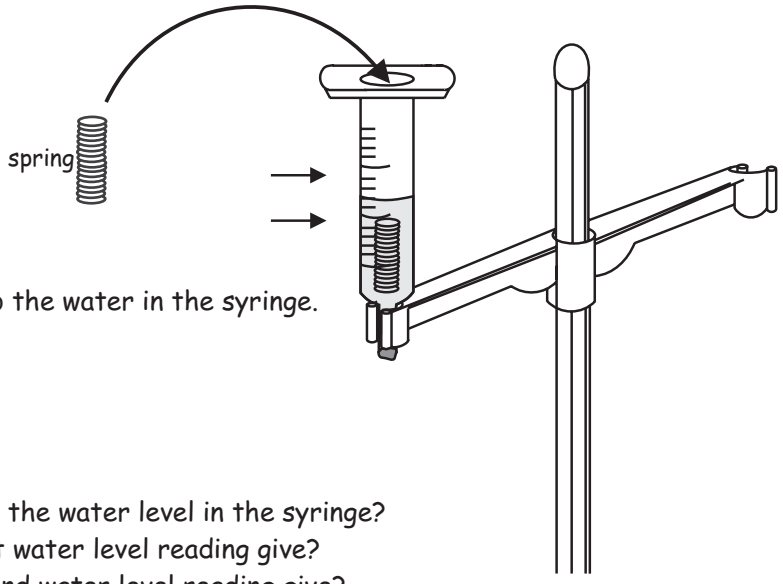


Use a propette to fill the syringe up to 1.0 ml with water.

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

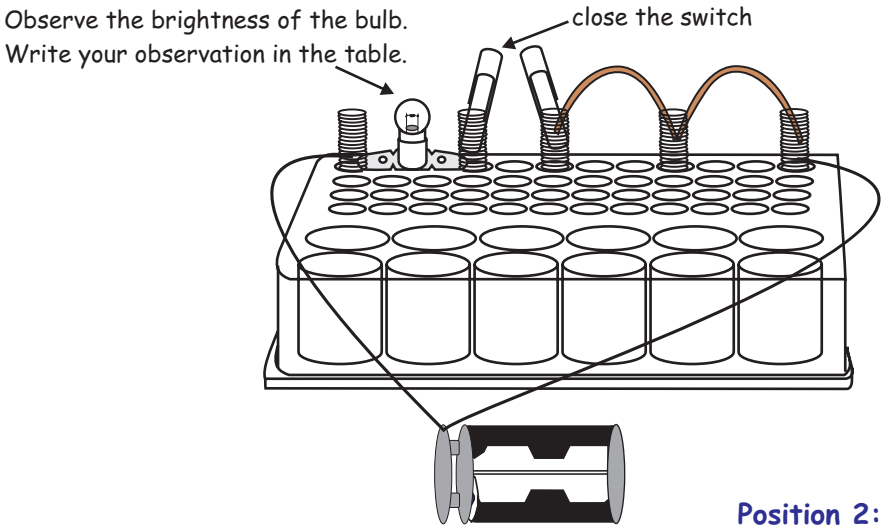
•a comboplate •3 x bulbs •3 x bulb holders •5 x springs •2 x paper clips
•2 x copper strips

What to do

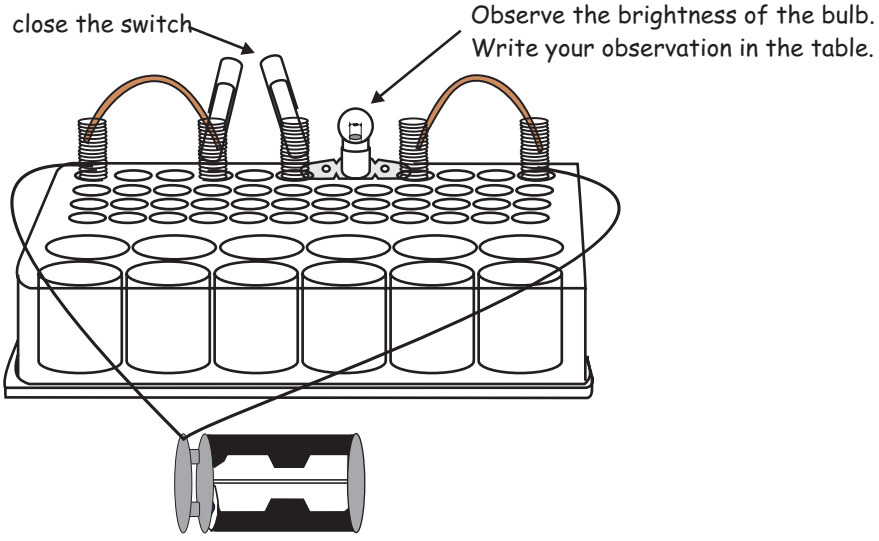
Work in pairs or groups of three. Use the micro-electricity kit to construct the series circuits given in the figures below. Complete the given table. Remember to predict the brightness of the bulb before you close the switch.

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

Position 1: Before the switch

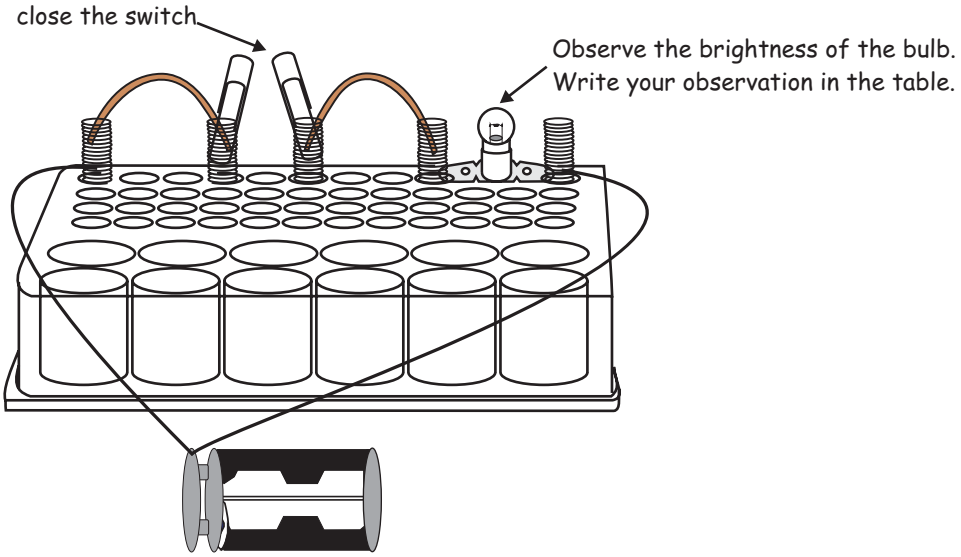


Position 2: After the switch



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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

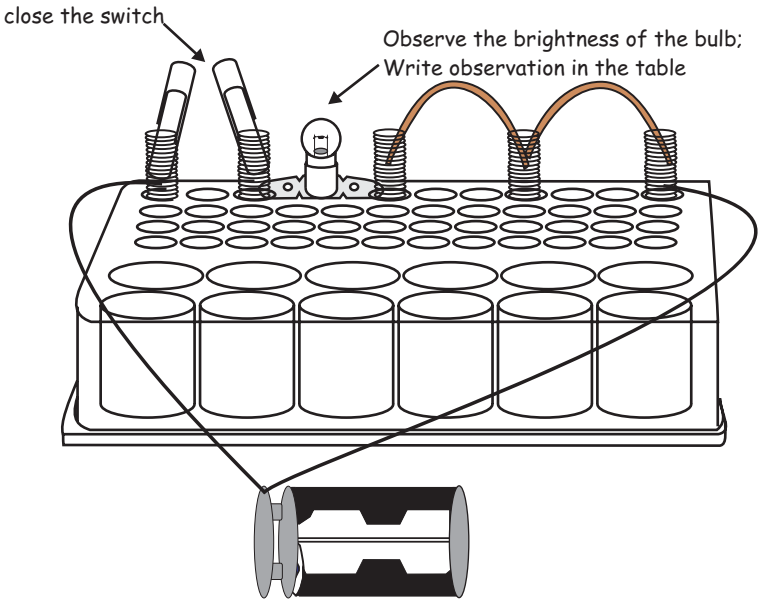
- a comboplate
- 3 x bulbs
- 3 x bulb holders
- 5 x springs
- 2 x paper clips
- 2 x long copper/zinc strips
- a cell holder
- a cell connector
- 2 x 1.5 volt cells

What to do

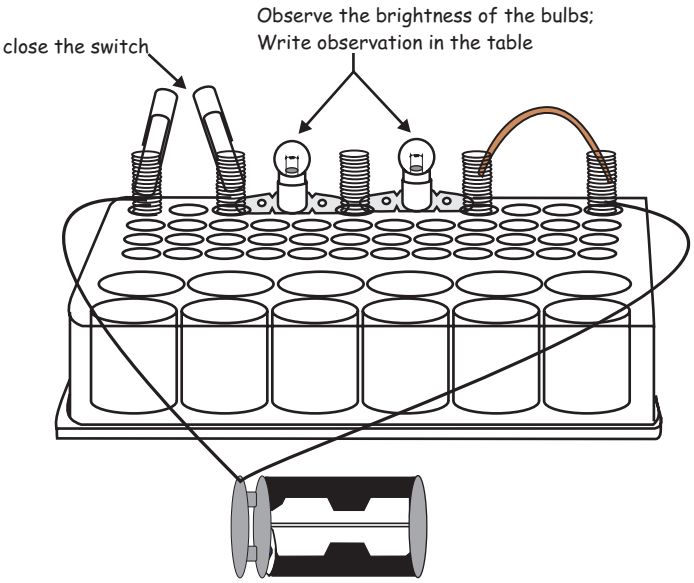
Work in pairs or groups of three. Use the micro-electricity pieces to construct the series circuits given in the figures below. Complete the given table. Remember to predict the brightness of the bulb/s before you close the switch.

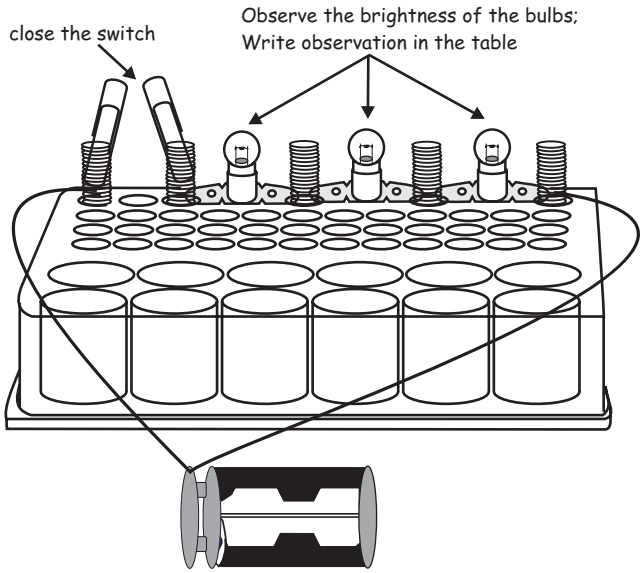
Note: Only pack away your circuits at the end of the Discussion section.

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

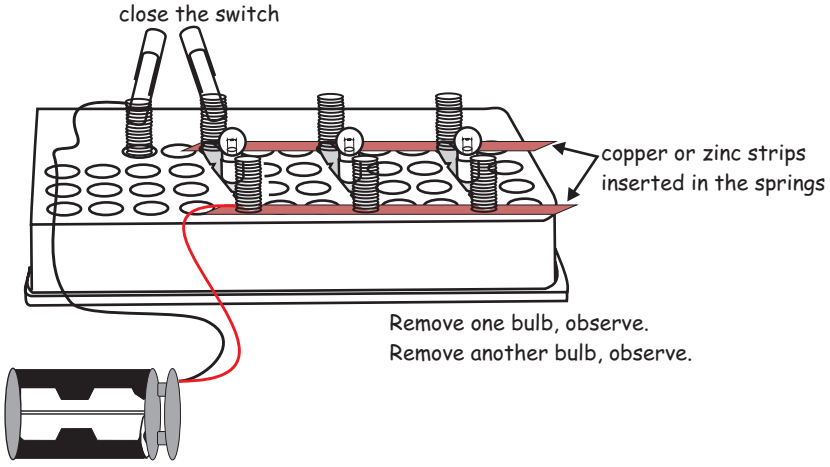
Test your prediction.

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;

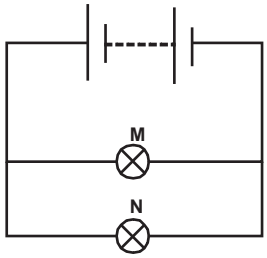
a) Which circuits are parallel and which are series?
b) Give the reasons for your choices.

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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.

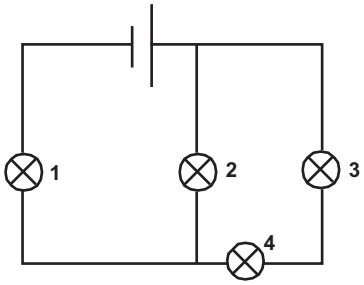
Q4 You are given some circuit diagrams. Chose the correct multiple choice answer for each.

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



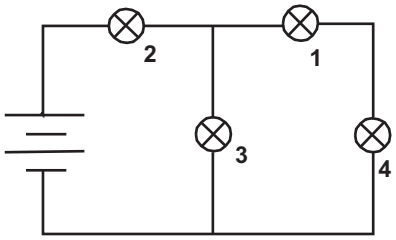
A It glows exactly as before
B It glows brighter
C It glows less bright
D It does not glow

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



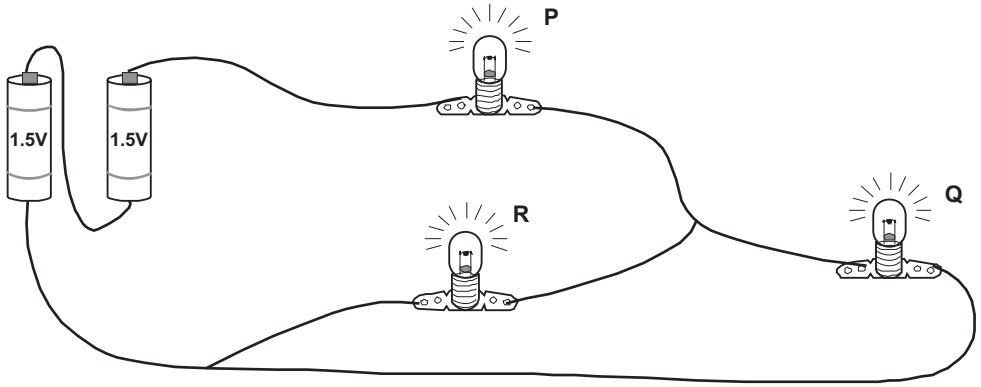
A 1 and 2
B 2 and 3
C 1, 2 and 3
D 3 and 4

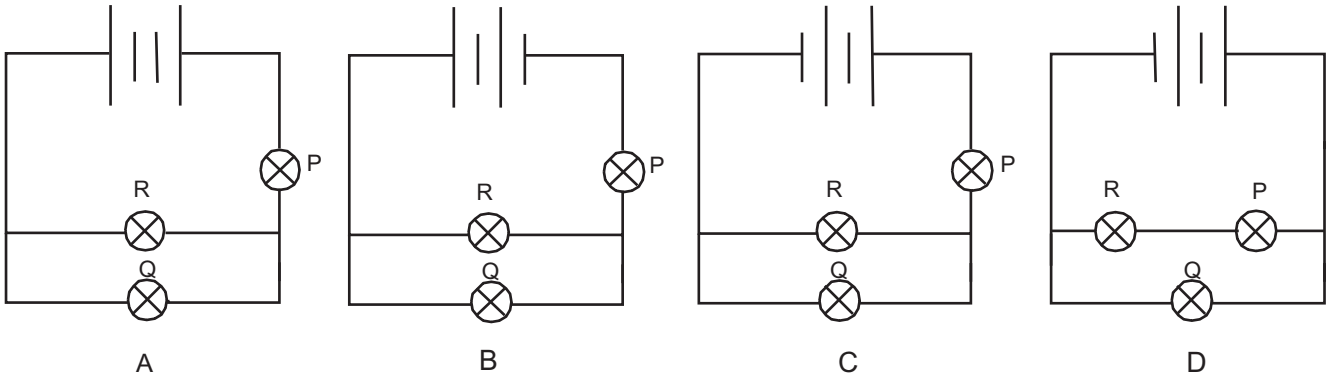
4.3 Which bulb must be removed from the circuit to make ALL the other bulbs go out?



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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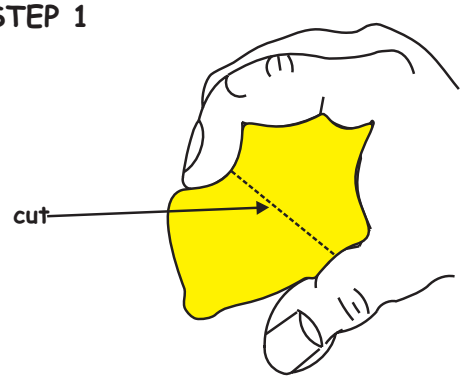
Activity 4.30 THE ELECTRIC LEMON

Focus question: What is the energy transformation in this activity?

You will need:

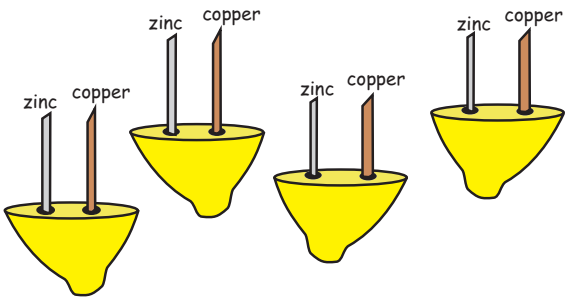
- 1 comboplate
- 4 x copper strips
- lemons (1 or 2)
- 2 x springs
- 1 bulb holder
- 4 copper wires
- 8 paper clips
- 4 x zinc strips
- a LED-light emitting diode
- a pair of scissors

STEP 1



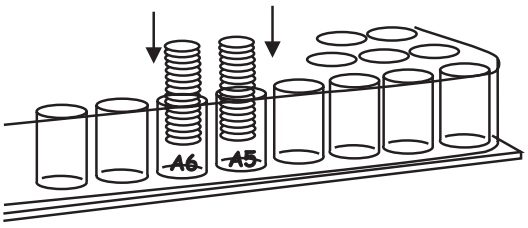
Squeeze the lemon gently and cut it into four equal pieces.

STEP 2



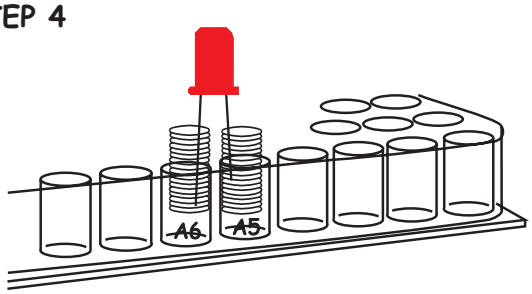
Push a copper strip into one hole and a zinc strip into the other hole of each lemon.

STEP 3



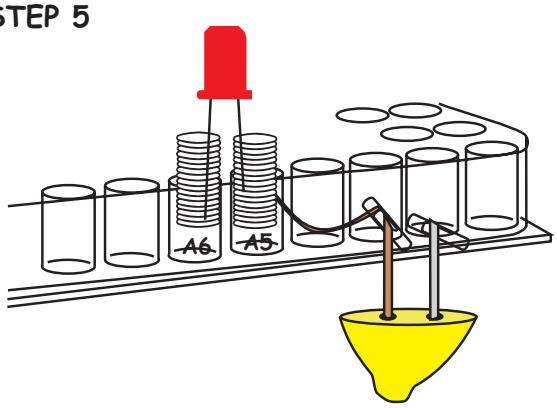
Put one spring into well A5 and the other in well A6 of the comboplate.

STEP 4



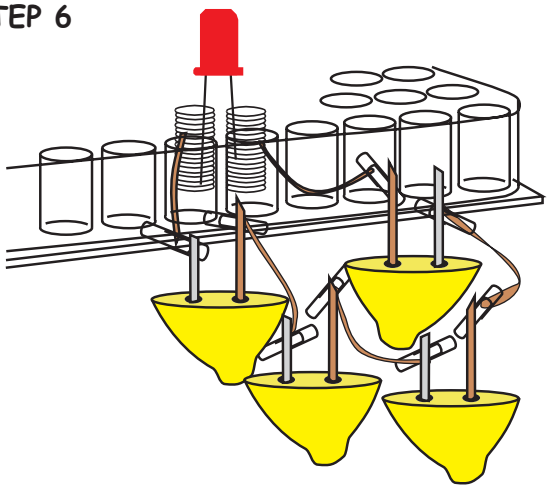
Insert the pins of the LED inside the two springs.

STEP 5



Slide one end of the piece of copper wire into the spring in well A5. Clip the other end of the wire onto the copper strip of the first lemon with a paper clip.

STEP 6



Complete the circuit by joining the other three lemons using paper clips and the strips as shown in the picture.

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Q1 What happens when you connect the fourth piece of lemon to the spring in well A6?

If the LED does not light up, add more lemon pieces until it does.

Q2 What are the cells in this activity?

Q3 What will happen if you disconnect a wire between the second lemon and the first?

Q4 What forms a circuit in this activity?

Q5 What conducts the electricity inside the lemons?

Q6 What do you think can happen to the light if the number of lemons is increased?

Q7 What is the energy transformation in this activity?

Q8 What are the electrodes in this activity?

Q9 What forms an electrolyte in this activity?

Q10 Draw a rough circuit diagram to show how you connected the cells to the LED.

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ACTIVITY 4.31 A MOULD

INTRODUCTION

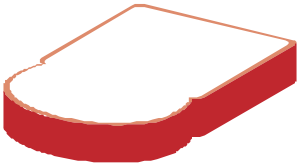
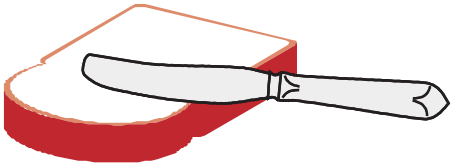
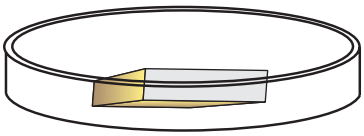
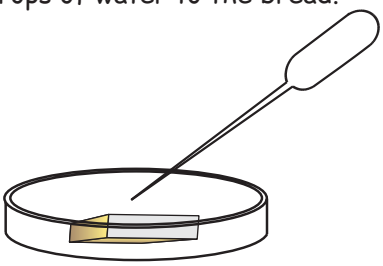
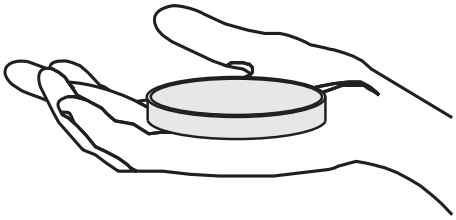
When things rot, they sometimes grow moulds. Certain moulds absorb food from dead and rotting materials. Some moulds are useful and some moulds are harmful.

You can grow a mould.

Part A

To grow a mould you need:

•a petri dish with lid •a piece of bread •propette •tap water

1 Get a slice of bread which is a few days old. 	2 Next, cut it into pieces which will fit into the petri dish. 
3 Put the pieces of bread in the petri dish. 	4 Then use the propette to add a few drops of water to the bread. 
5 Walk about and wave the petri dish in the air. 	6 Last, put the petri dish in a dark, fairly warm place with the lid ON. 

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Part B

To study a mould you need:

•hand lens •petri dish with mould •forceps

What to do:

Look at the bread in the petri dish after about a week. If nothing has changed, leave the bread for another few days. Mould should have developed by this time.

Use the hand lens to see the mould more clearly. Follow the instructions and answer the questions below.

Q1 What colour is the mould?

Q2 Does the mould have clear roots and stems?

Q3 In general, what does the mould look like? In your notebook, draw some of the mould.

Q4 Is the mould on the surface of the bread or in the bread?

Q5 There are swollen structures at the tips of some threads (**hyphae**). Look carefully at these. Draw a hypha with a swollen structure in your notebook.

These swollen structures are called **sporangia**. They produce **spores**. Moulds reproduce by means of spores.

Q6 Does the mould smell?

Extension questions

Q7 What you do you think is happening to the bread while the mould is growing on it?

Q8 Name some other things that you have seen with mould.

Q9 How do think the mould got onto your bread in the petri dish?

Q10 Mrs Gumede is angry. She bought some fishpaste two weeks ago and she used some. Today she wants to use some more and it is full of mould. She is going back to the shop to complain.

a) How did the mould get onto the fishpaste?

b) Pretend you are the shopkeeper. Write down all the questions you want to ask Mrs Gumede to find out more about the mouldy fishpaste.

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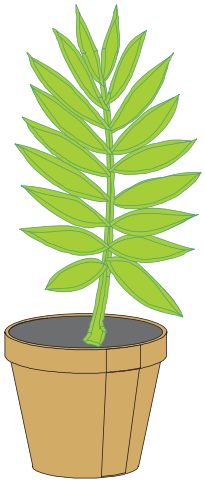
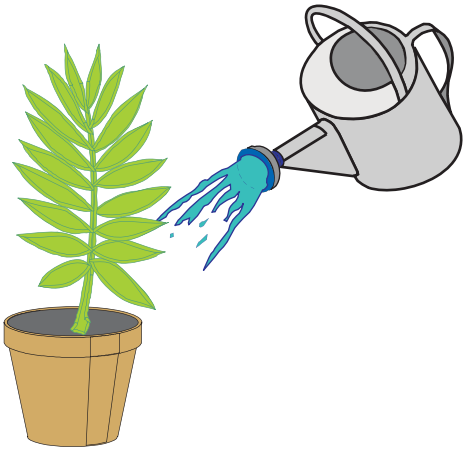
Activity 4.32 A FERN PLANT

INTRODUCTION

Today many people grow ferns in gardens and in pots. You can also grow a fern.

To grow a fern you need:

- a plant pot
- some stones or gravel
- potting soil

1 First put some stones or gravel in the bottom of the plant pot. 	2 Then fill the plant pot with potting soil. 
3 Next, put a small fern in the plant pot. 	4 Remember to water your fern every day. 

Now you can learn more about a fern.

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To study a fern you need:

•hand lens •propette •forceps •petri dish •tap water
•newspaper •fern plant

What to do:

Step 1 Complete the exercise below in your notebook.

PARTS OF THE FERN

The roots

Step 2 Examine the roots of the fern. Are they all about the same size or is there one main root?

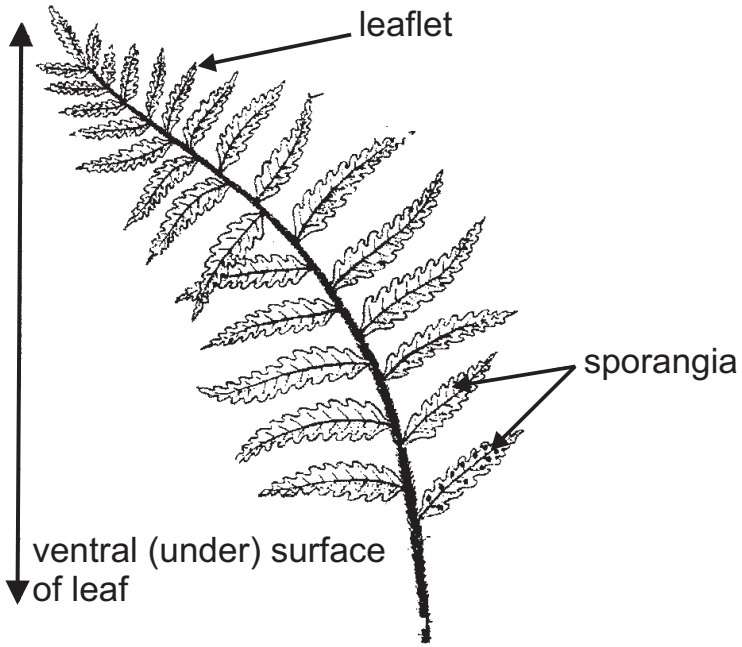
Q1 Is the root system a fibrous root system or a tap root system?

The stem

Q2 Is the stem above the ground or is it below the ground?

The leaves

The leaves (or fronds) of ferns are usually divided into many smaller leaflets. The dia gram below shows a fern leaf.



Step 3 Draw one of the leaves of your fern. Be sure to show the leaflets.

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HOW A FERN REPRODUCES

On the underside of some of the leaves you will find little dots. We call these structures **sporangia**. These contain many **spores**.

Step 4 Draw the underside of a leaf or leaflet to show the pattern of sporangia.

Step 5 Use the forceps to scratch some of the sporangia from the surface of the leaf into the petri dish.

Step 6 Use the hand lens to examine a sporangium and its spores.

Step 7 Make a drawing of the sporangium and its spores.

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Example 1: A DICOTYLEDON

INTRODUCTION

We use flowering plants for many things. Many people grow flowering plants for sale. You can also grow a flowering plant. We will start with a dicotyledon.

To grow a dicotyledon flowering plant you need:

•a plant pot •some stones or gravel •potting soil •a few soaked bean seeds

1 First put some stones or gravel in the bottom of the plant pot. 	2 Then fill the plant pot with potting soil. 
3 Next, put two soaked bean seeds into the soil, about 3 cm deep. 	4 Remember to water your seeds every day. 

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You will soon see little green shoots above the surface of the soil. They will grow into young plants. If the young plants get too big for the pot, you can plant them in the soil outside or in another suitable place.

Now you can learn more about a flowering plant (bean).

To study a bean plant you need:

- propette
- hand lens
- petri dish
- forceps
- water
- newspaper
- bean plant about 15 cm tall

What to do:
Place a whole bean plant on damp newspaper. Complete the exercise below in you note book.

PARTS OF THE BEAN PLANT

The roots

Step 1 Examine the roots of the bean plant.

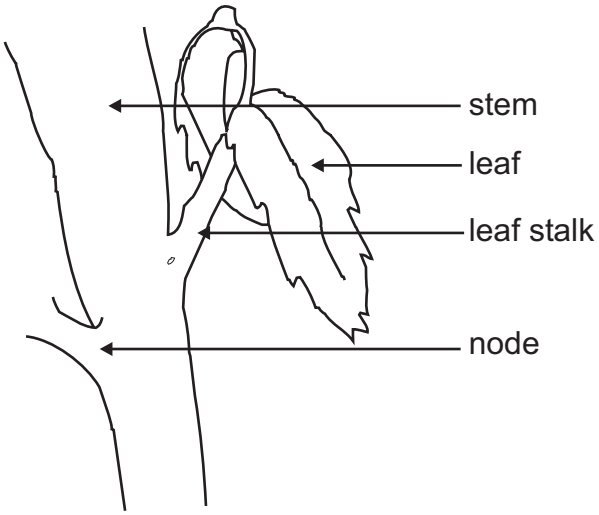
Q1 Are they all about the same size or is there one main root?

Q2 Is the root system a fibrous root system or a tap root system?

Step 2 Use the hand lens to find root hairs.

The stem

The drawing below shows the stem of a plant.

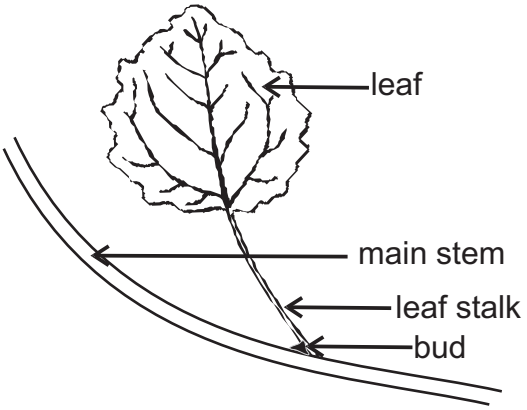


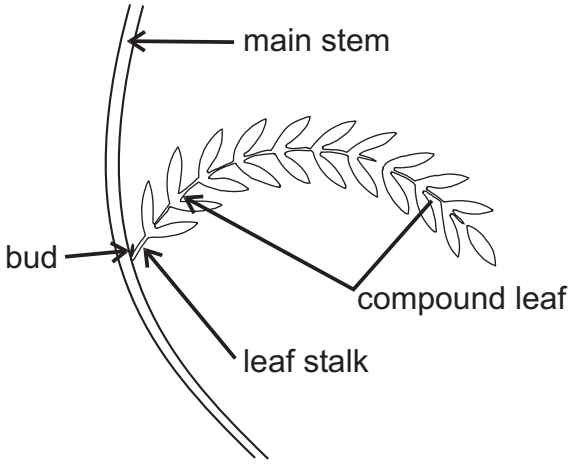
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Q3 Find the labelled structures on your own plant.
Q4 Make a drawing of part of your plant, showing some of the stem and one leaf.

The leaves

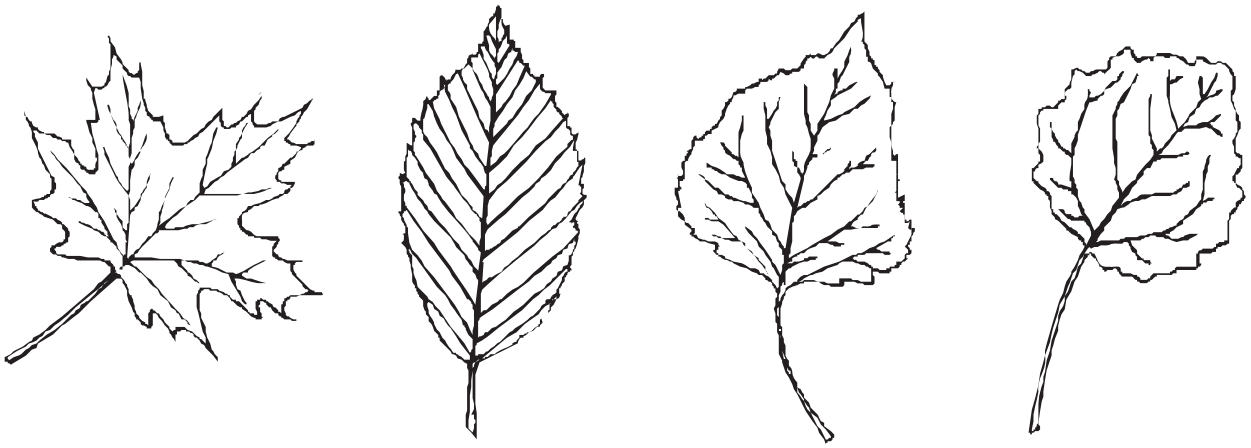
The leaves of flowering plants may be simple or compound. The figures below show a simple leaf and a compound leaf.





Q5 What is the difference between simple leaves and compound leaves?
Q6 Is the leaf of your plant a simple leaf or a compound leaf?

The figures below show different leaves from dicotyledonous plants.



Keep this page in a safe place. You will need it later when you study the leaves of monocotyledons.

In your notebook, draw a leaf of your plant and show:

- ❑ margins
- ❑ veins
- ❑ mid-rib
- ❑ petiole (stalk)
- ❑ apex (tip)

Roots, stems and leaves are called the vegetative parts of plants. Later you will look at the flowers of dicotyledons.

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ACTIVITY 4.34 A MONOCOTYLEDON FLOWER

INTRODUCTION

You have already studied the roots, stems and leaves of monocotyledons. Now you will study a flower of a monocotyledon.

To obtain a suitable flower:
Your teacher will tell you what to do.

To study a monocotyledon flower you need:
•hand lens •petri dish •forceps •propette •flower

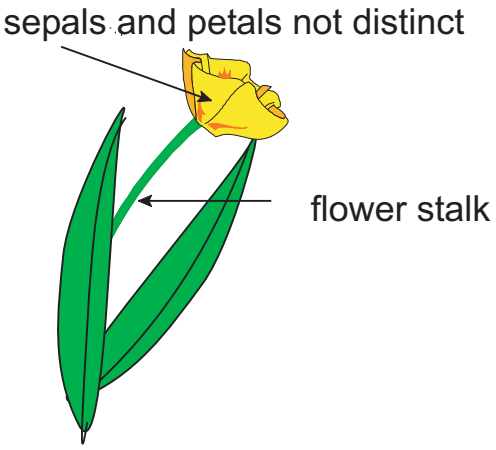
Step 1

Place the flower on the petri dish.

Step 2

Use the hand lens to see more clearly when it is necessary.

PARTS OF THE FLOWER



The figure above shows the parts of a monocotyledon flower which you are likely to see on the outside. Remember flowers from different plants do not look exactly the same.

Step 3

Find the labelled parts on your flower.

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Step 4

Look carefully at your flower and answer the following questions:

Q1 Is it possible to tell the difference between sepals and petals?

We call these parts (petals and sepals together) perianth parts or **tepals**.

Q2 What colour are the perianth parts?

Step 5

Remove two or three perianth parts from the flower. Now the inside parts are visible.

Observation Questions

Q3 How many stamens are there on your flower?

Q4 Are the parts of the flower in multiples of three or of five?

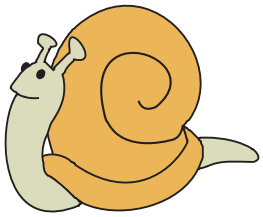
Q5 Are the perianth parts joined to each other or are they free?

Q6 Compare the flowers of monocotyledons and dicotyledons. You can use a table like the one below.

	Monocotyledon	Dicotyledon
flower parts		
in multiples of		

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ACTIVITY 4.35 A SNAIL ZOO



INTRODUCTION

> At sunset, when the night-dews fall,
> Out of the ivy on the wall
> With horns outstretched and pointed tail
> Comes the grey and noiseless snail.
>
> James Reeves (b. 1909)

Have you ever kept a snail? It is easy to make a home for snails in your lunch box. Your teacher will tell you what else to do.

What to do:

Part 1 Setting up an environment for snails

- ♣ Snails are very efficient escape artists so you must devise a way to keep them in the lunchbox without keeping the lid on permanently. Discuss your plan with your teacher.
- ♣ When you collect the snails, take care that you also pick some of the plant material on which they were feeding.

Part 2

Step 1 Set up the lunchbox as shown on the next page, with about 2 snails per container.

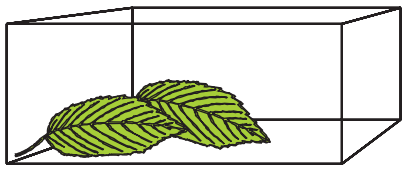
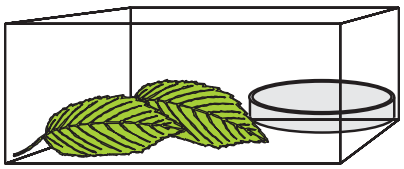
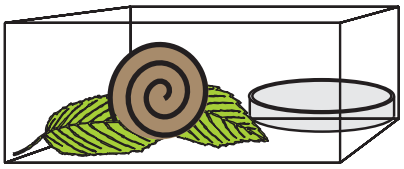
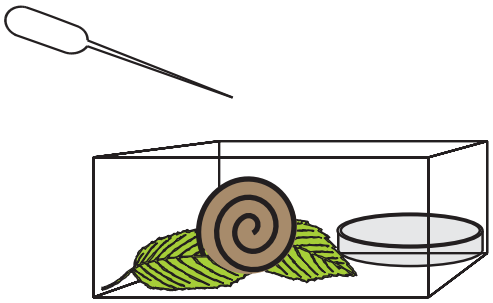
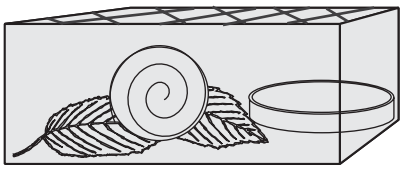
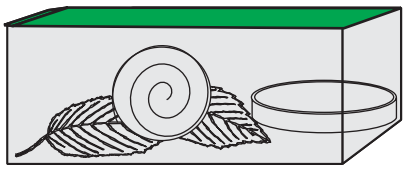
Step 2 Examine the snails every day, remove old plant material and replace it with fresh food with a few drops of moisture.

Step 3 Observe the snails carefully and answer the questions that follow.

To keep a snail you need:

- a plastic lunch box with a lid
- petri dish
- propette
- damp soil
- some lettuce, spinach or cabbage leaves
- a snail
- tap water
- some mesh (wire screen - provided by your teacher)

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1 First put some damp soil and leaves in your lunch box. 	2 Then put the petri dish with a little water in the lunch box with the leaves. 
3 Next put the snail on a leaf in the lunch box. 	4 Use the propette to add a few drops of water to the leaves. 
5 Place the mesh over the lunch box. 	6 Last, cover the lunch box lightly with the lid. 

Now you can learn more about a snail.

Part B

To study a snail you need:

•hand lens •petri dish •tap water •forceps •propette •snail

What to do:

Step 1 Watch the snail carefully and complete the exercise below in your notebook. Hold the snail on a leaf and use the hand lens to see more clearly.

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PARTS OF THE SNAIL

The head

Q1 Snails have feelers called tentacles. How many tentacles are there? Are the tentacles all the same?

Q2 Look for the snail's mouth at the front of its head. What shape is the mouth?

The shell

Q3 On what side of the snail is the shell? Left or right? To find out which is left or right, look at the snails below:



Snail A Snail B

You are looking at the left side of Snail A and at the right side of Snail B. We work out the left and right of snails and other animals in the same way as we work out left and right on ourselves, that is from the direction they face or from the direction in which they normally move.

Q4 Do all snails have the shell on the same side?

Q5 What is the use of the shell, do you think?

Q6 Draw the shell of a snail. Be sure to put in the right number of spirals.

The snail's stomach and intestine and some other organs are inside the shell.

The foot (the rest of the snail)

Q7 Why is this part called the foot, do you think?

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PART B WHAT THE SNAIL DOES

How the snail moves

Step 1 Use the propette to add a few drops of tap water to the petri dish.

Step 2 Put the snail on the petri dish.

Step 3 Hold the petri dish above eye level.

Step 4 Look at the undersurface of the snail's foot and write down what you observe.

Step 5 Put the snail back on a big leaf and watch it move for a while. You may see a white trail of mucus (slimy material) which the snail leaves behind.

Q8 How does this slimy material help the snail to move?

Q9 Can the snail climb upwards and downwards or can it only move on a horizontal (flat) surface?

Q10 Work with other people in your class to design an investigation to find out the average speed of 10 snails. Write out your method, carry out the investigation and report your results. Show all your calculations.

How the snail eats

Step 6 Place the snail on a fresh, green leaf.

Step 7 Use the hand lens to observe the snail as it moves along, eating the leaf. Write down what you see.

Q11 What does the eaten part of the leaf look like? Draw it or describe it.

How the snail breathes

Step 8 Look at the snail's body near the widest end of the shell. You will see a small opening. If you watch it carefully, you will see it open and close. This is the opening to the snail's "lung".

Something to think about

Q12 Read the poem on page one. Why do you think snails come out "at sunset when the night dews fall"?

Q13 There is also a cartoon drawing of a snail on page one. Look at the drawing and look at the real snail. In what ways is the cartoon drawing **incorrect**?

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ACTIVITY 4.36 SIX JOINTED LEGS - INSECTS

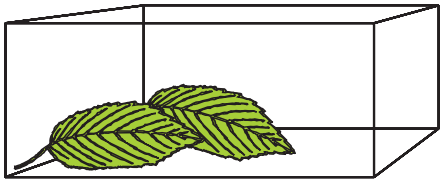
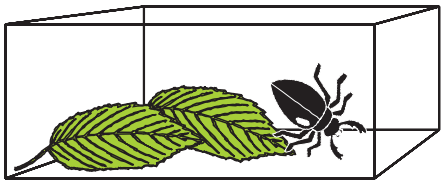
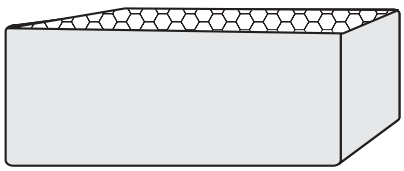
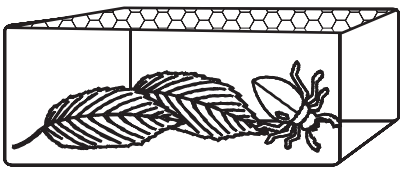
INTRODUCTION

The word Arthropoda means "jointed legs". Insects, crabs, spiders, millipedes and centipedes are all Arthropoda. There are more different types of Arthropoda on Earth than there are of any other animal. It is easy to keep and study Arthropoda. First, we will study an insect.

To keep an insect you need:

•a plastic lunch box with a lid •petri dish •propette •some mesh
•food* •an insect* •tap water

* Your teacher will tell you what to do.

1 First put some food for the insect in the lunch box. 	2 Then put one or two insects in the lunch box with the food. 
3 Put a piece of mesh over the lunch box. 	4 Keep the lunch box in a cool place. 

To study an insect you need:

•hand lens •petri dish or vial •tap water •forceps •propette •insect

Step 1

Put the insect onto the petri dish or vial with the lid loosely on.



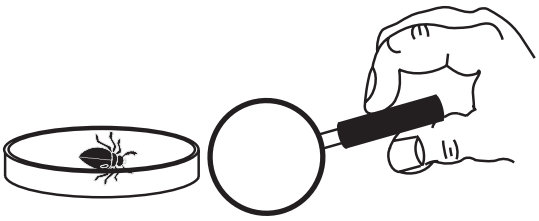
Step 2

Complete the following exercise in your notebook.

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Step 3

Use the hand lens to see more clearly when it is necessary.



HABITAT

Q1 Where does the insect live; on land or in water?

Q2 What special structures does the insect have which are suitable for its habitat?

GENERAL STRUCTURE

Q3 Is the body smooth or segmented (divided)?

Q4 If it is segmented, are the segments equally clear on both surfaces?

Q5 If it is segmented, is the segmentation equally clear on all the body parts?

BODY DIVISIONS

Q6 Into how many regions is the body divided?

Q7 In your notebook, draw an outline sketch of the insect showing body divisions ONLY.

DETAIL OF SOME PARTS OF THE INSECT

I The head

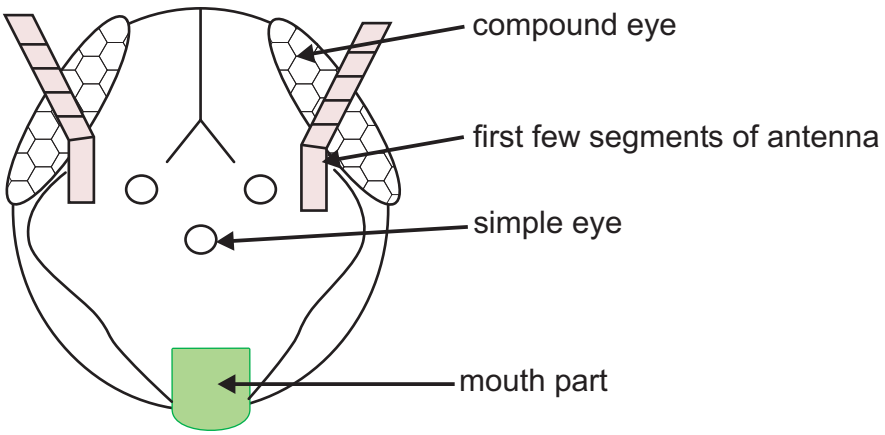
Q8 How many feelers or antennae are there?

Q9 Insects have compound eyes which look like a network. How many compound eyes do you see?

Insects also have simple eyes which are more difficult to see.

Look for the insect's mouthparts at the front of its head.

The figure below shows a diagrammatic view of an insect's head seen from the front.



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Step 4

Study the figure. Use it as a model and draw your insect's head in detail showing compound eyes, simple eyes, antennae, mouthparts.

II The Thorax

Q10 Look at the ventral (under) surface of the insect. Into how many parts is the thorax divided?

Q11 The legs are attached to the thorax. How many legs does the insect have?

Q12 Are all the legs the same? Answer this question fully.

Q13 Watch the insect for a while. Does it use the legs only for walking or does it use the legs for other things? Answer this question as fully as possible.

Q14 How many wings does the insect have?

Q15 Are the wings all the same? Answer this question as fully as possible.

Q16 In your notebook, draw one leg and one wing of your insect.

III The Abdomen

Q17 Look at the abdomen from the side. You may see little holes on some of the segments. These are the spiracles or breathing holes of the insect. Which segments have spiracles?

Q18 Why do you think we would not see spiracles on all insects?

WHAT THE INSECT DOES

I How the insect moves

Step 5

Watch the insect carefully. Find out which legs are on the ground at the same time when it walks. In other words, does the insect move its first two legs, then the next, then the next; or does it move all the legs on one side and so on?

II How the insect eats

Step 6

Continue to watch the insect carefully.

Q19 What does the insect eat?

Q20 How does food get into the insect's body? Does it use its legs, does it "lap" like a dog and so on?

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III How the insect breathes

Step 7

Continue to watch the insect carefully.

Q21 Does the abdomen move?

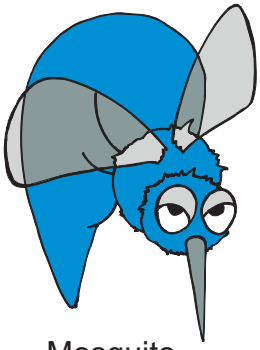
Q22 Do the spiracles move?

Something to think about

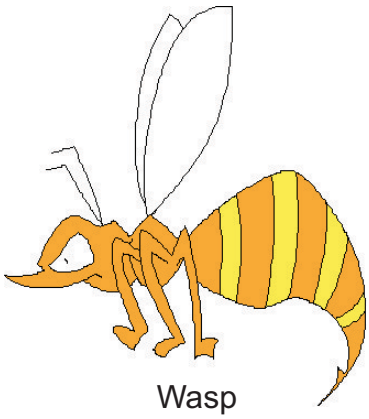
Q23 There are many more insects on Earth than any other animal. From what you have learned about insects, why do you think insects are so plentiful? Answer the question by talking about:

- what insects look like and their size
- where they live
- how they move
- what they eat
- how they find out about their surroundings

Q24 An artist drew the following cartoon pictures of insects. Write a letter to the artist explaining how each picture should be changed so that it is more accurate.



Mosquito



Wasp



Ladybird



Dragonfly



Ant

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Activity 4.37 MORE JOINTED LEGS - SPIDERS

INTRODUCTION

You have already learned that spiders and scorpions, like insects and crustaceans are Arthropoda. Many spiders and scorpions are poisonous so we will study them outside instead of keeping them in the laboratory.

To find spiders

* Your teacher will tell you what to do.

Observe the spiders and their behaviour. DO NOT ANNOY THEM. DO NOT TOUCH THEM.

What to do:

Step 1 Observe the spider without worrying it.

Step 2 Complete the exercise below in your notebook.

Step 3 Use the hand lens to see more clearly when it is necessary.

HABITAT

Q1 Where do we find spiders in nature?

Q2 In what ways is the body of the spider suitable for its habitat?

GENERAL STRUCTURE

Q3 What shape is the body?

Q4 Is the body flattened in any way?

Q5 Is the body clearly segmented all over or not?

Q6 How many legs does the spider have?

WHAT THE SPIDER DOES

How the spider moves

Q7 Which of the following words best describes the way the spider moves? [**You may select as many words as you like**] run, jump, hop, scuttle, shuffle, dash, leap, flap, hurtle, walk.

How the spider eats

Step 4 Watch the spider carefully and answer the questions below.

Q8 What does the spider eat - meat or vegetation?

Q9 Where does the food come from?

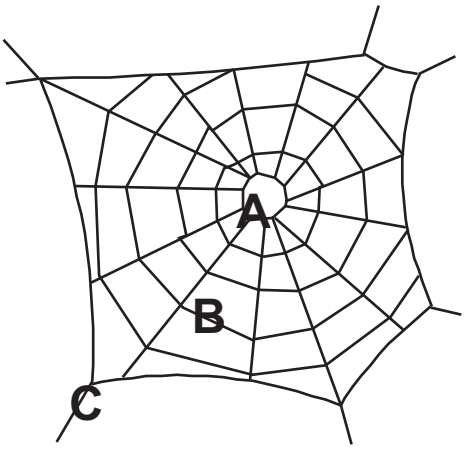
Q10 How does food get into the spider's body? Does it use its legs, does it use its mouthparts, does it chew its food?

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Webs

Not all spiders spin webs. Those spiders which do spin webs use a special kind of silk for their webs. If you are watching a web-spinning spider, you can see what it does in its web.

Step 5 Draw a picture of your spider's web. Mark A, B and C in the positions shown underneath.



Each day, record where on the web you saw the spider; for example A (in the centre), B (in the body of the web) C (on the margin of the web).

Q11 Where does the spider spend most of its time?

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Activity 4.38 EVEN MORE JOINTED LEGS - CRUSTACEANS

Introduction

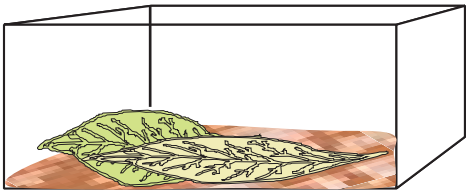
You may have already learned that crabs and other crustaceans are also Arthropoda. Most crustacea live in water, but some live on land. We will now study a land crustacean eg a woodlouse.

To keep a woodlouse you need:

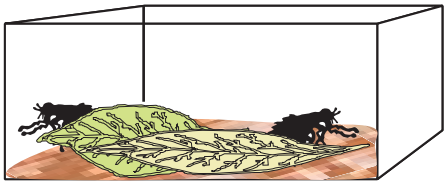
- a plastic lunch box with a lid
- propette
- petri dish
- leaf litter*
- one or more woodlice
- tap water
- some mesh
- soil
- stones

* Your teacher will tell you what to do.

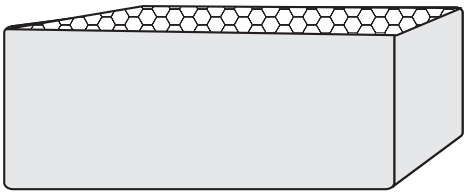
1. First put some soil, stones and leaf litter for the woodlouse in the lunch box.



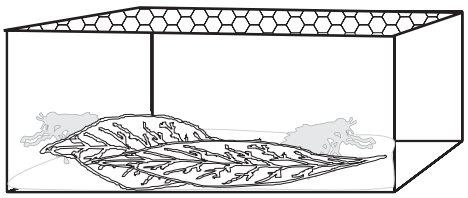
2. Then put one or two woodlice in the lunch box with the other material.



3. Put a piece of mesh over the lunch box.



4. Keep the lunch box in a cool place.



To study a woodlouse you need:

- hand lens
- petri dish or vial
- propette
- woodlouse
- tap water
- forceps
- fallen leaves from a tree

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HABITAT

Q1 Where do you think you would find a woodlouse in nature?

Q2 In what ways is the body of the woodlouse suitable for its habitat?

GENERAL STRUCTURE

Q3 What shape is the body?

Q4 Is the body flattened sideways or upper to lower surfaces?

Q5 Is the body smooth or segmented (divided)?

DETAIL OF SOME PARTS OF THE WOODLOUSE

The Head and Thorax

Q6 How many feelers or antennae are there?

Q7 How many eyes do you see?

Q8 The legs are attached to the thorax. How many legs does it have?

Q9 Are all the legs the same?

The Abdomen

Q10 Are the segments of the abdomen roughly the same or very different from each other?

WHAT THE WOODLOUSE DOES

How the woodlouse moves

Q11 Which of the following words best describes the way the woodlouse moves? (**You may choose as many words as you like**) run, jump, hop, scuttle, shuffle, dash, swim, flap, fly, walk.

How the woodlouse eats

Watch the woodlouse carefully.

Q12 What does the woodlouse eat?

How does food get into the woodlouse's body? Does it use its legs, does it "lap" like a dog and so on?

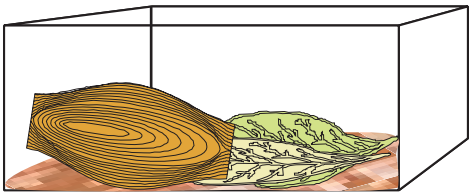
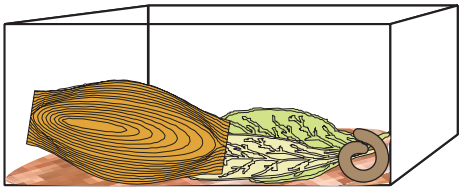
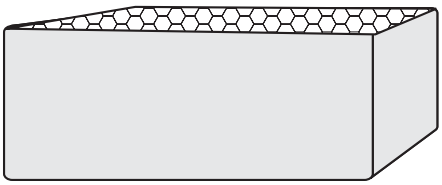
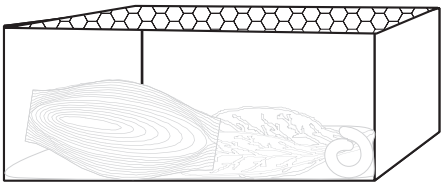
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ACTIVITY 4.39 MANY MORE JOINTED LEGS - MILLIPEDES

INTRODUCTION

You may already have learned that millipedes and centipedes, like insects, spiders and crustaceans are Arthropoda. Most centipedes are poisonous so we will study a millipede. Your teacher will tell you how to obtain a millipede.

A To keep a millipede

1 First place some soil, twigs, bark and leaf mould in the lunch box. 	2 Next, put a millipede in the lunchbox with the other things. 
3 Cover the lunch box with mesh. 	4 Keep the lunch box in a cool, dark place. 

Observe the millipede and its behaviour.

What to do:

- Observe the millipede without worrying it.
- Complete the exercise in your notebook.
- Use the hand lens to see more clearly when it is necessary.

HABITAT

Q1 Where do you think you would find a millipede in nature?

Q2 In what ways is the body of the millipede suitable for its habitat?

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GENERAL STRUCTURE

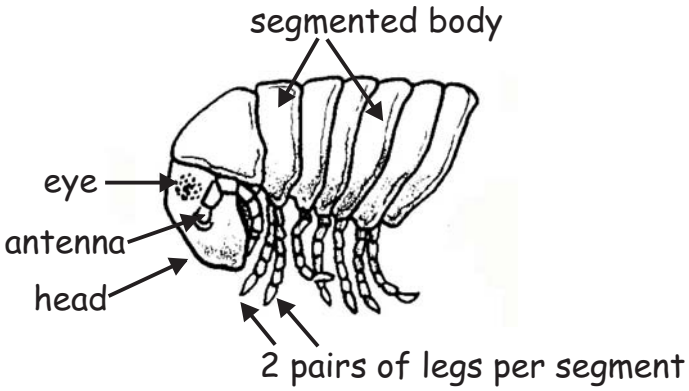
Q3 What shape is the body?

Q4 Is the body clearly segmented all over or not?

Q5 Is the body clearly divided into parts like the body of an insect?

Q6 How many legs does the millipede have on each segment?

DETAIL OF SOME PARTS OF THE MILLIPEDE



The figure above shows the side-view of the front part of the millipede. Look at your millipede and find the head, eye, antenna, segments and two pairs of legs per segment.

WHAT THE MILLIPEDE DOES

How the millipede moves

Q7 Does the millipede use all the legs at once?

How the millipede eats

Q8 What does the millipede eat?

Getting out of trouble

Q9 Touch the millipede's body softly. What does it do?

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