MAURITIUS RESEARCH COUNCIL

LOW COST EQUIPMENT FOR TEACHING - SCIENCE & TECHNOLOGY IN PRIMARY SCHOOLS

Final Report

Year 2004

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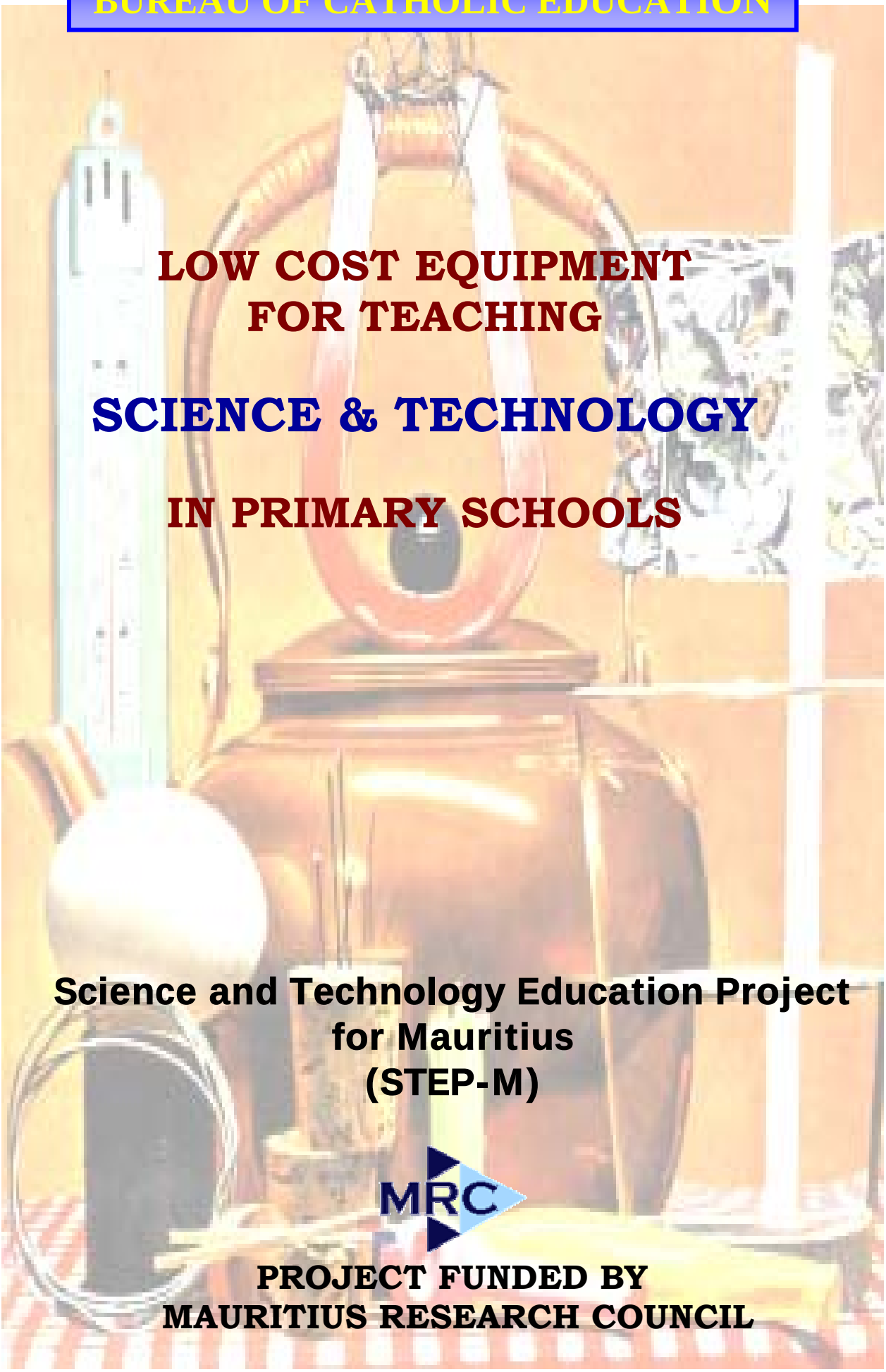
BUREAU OF CATHOLIC EDUCATION

PILOT PROJECT - Revised Edition 2004

LOW COST EQUIPMENT FOR TEACHING

SCIENCE & TECHNOLOGY

IN PRIMARY SCHOOLS



Science and Technology Education Project for Mauritius (STEP-M)

MRC

PROJECT FUNDED BY MAURITIUS RESEARCH COUNCIL

SCIENCE AND TECHNOLOGY EDUCATION PROJECT FOR MAURITIUS

STEP-M

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The project team wishes to thank all those HTs, DHTs, teachers (and their pupils!) from RCA Primary Schools, who have tested the experiences and contributed ideas.

Sources

- Source book for Science and Technology teaching, UNESCO, Paris,1990
- Low-cost equipment for Science Teaching, Book I, II, III, Peter Davis, MIE, 1977
- Early experiences, Richard Macdonald Educational, London and New York, 1972
- Childcraft, 'Science at Work', World Book, 1993
- Childcraft, 'Discovering Science', World Book, 1993
- New Primary Science, Malkiat Singh, Nairobi, 1976
- Water is life, Volume II, Dr. Helen Vretta, UNEP / WAGGGS, 1991
- Mauritius Integrated Science Project, Form I, Form II(Atchia, Davis, Dyall, Nicolas,

  Sin Yan Too), MIE 1977
- The Second Book of Experiments, Leonard de Vries, John Murray, 1963
- Teaching Primary Science, B. L Young, Longman, 1979
- Big Book of Science

WHAT IS SCIENCE?

TO THE TEACHER

- Science is a study of nature. It is our way of **understanding how things work** in the world around us.
- Science is concerned with both the non-living or material things and with the living world.
- Science is **a way of thinking and a way of doing things**.

  Scientists always **look for evidence, scientists always verify through observation and experimentation BEFORE** coming to a conclusion.

The scientific way of thinking is thus **an invaluable lesson for life.**

LOW COST EQUIPMENT FOR SCIENCE TEACHING

A baby who looks at her hand, a baby who brings her toe into her mouth, "tastes" her first toy or listens to the sound of a rattle is already exploring the world around him/her. He/she is already doing Science.

A kitten which runs out in the rain and comes back all wet and cold and which alters its behaviour *"next time it rains I stay indoors"* is already applying correctly the result of good observation.

Children show a natural interest in their own body and self. This is SELF-INTEREST in the best sense of the phrase.

Children will explore the world in which they live, always in relation to how these elements of the environment affect them-their life, feelings and sensations.

They will look

- At rainwater, seawater, rivers and lakes, waves and tide
- At air, wind, cyclones, clouds, smoke and rainbows
- At animals swimming, running, flying, creeping

- At plants, big and small, mushrooms, waterweeds, moulds
- At sunlight, heat, sound and noises of all types, lighting and thunder
- At the thousand of man-making things from houses to public buildings, shops, bicycles, motorvehicles, planes and boats and the product of technology: radios, TV sets, kettles, locks and keys, plastic and glass things, wooden and metallic things.
- At the food they eat, the clothes they wear, the things they utilise in everyday life.

The list is inexhaustible.

We, adults and educators, must facilitate and guide children's exploration of the world. The way to do this is through **SCIENCE AND TECHNOLOGY EDUCATION.**

It is generally agreed that in a modern science course at any level, **equipment must be available for practical work.**

Guided discovery and enquiry are essential to learning science. They are necessary in order to interest children to learn the art of enquiry.

Equipment and apparatus can be expensive and even very expensive.

Low-cost equipment have a lot of advantages over expensive and imported equipment. These advantages are not just financial but as you will see also pedagogical.

ADVANTAGES OF LOW-COST EQUIPMENT

1. **Cheapness**

   Equipment made of paper, string, cardboard, nails, tins, etc, **cost nothing**. Others only a few rupees.

   For example: a Newton's Disk imported from supplier may cost £50 (i.e Rs 2000). However a low-cost Newton's Disk, if produced one per student, may cost less than Rs 5 a piece. If coloured pentels are already available it can be made for free!

2. They illustrate the **same principles** as the expensive equipment.

3. Making and using low-cost equipment **encourage the active method and groupwork and can be great fun**. Each pupil can make his or her own equipment and even bring it home. It's the active method of learning at its best.

4. **Strength**

   Made of paper, wood, metal, string, etc. such equipment can be treated roughly with no damage. Hence pupils feel more at ease.

5. Pupils can bring equipment home or remake them at home often with great keenness and pride. **They will show to their parents, brothers, sisters and friends what they have discovered at school.**

   "Ma ! Ma Vini mo montré toi qui mo finn apran lékol zordi"

   A case of parent education through children.

6. **Effective use of limited funds**

   Many science equipment for many experiments can be produced under their low-cost variety. (Unfortunately there are, as yet, no low-cost computers).

This introduction to the use of low-cost equipment for science teaching at primary level in Mauritius is an occasion to pay tribute to an old Englishman, Mr. Peter Davis, who first initiated us to this art at the MIE way back in 1975, in the context of the introduction of a new discipline called Integrated Science.

Dr Michaël Atchia

The original pilot project was funded by the Mauritius Research Council under contract MRC /RUN – 0202.

WHY SCIENCE IN PRIMARY SCHOOLS?
WHY PRACTICAL SCIENCE IN PRIMARY SCHOOLS?

Aims

- Intrigue and delight young children.
- Develop and expand the competence of young children across the range of human capacity and skills.
- Contribute to the enrichment of the whole child by extending the child's horizons and by amplifying his or her innate capacity and desire to question, explore experiment, discover, cope and learn.
- Foster the child's capacity to contribute responsibly to the lives of those around him/her and to the world at large.

Interactive model of teaching to investigate key ideas in science

THE TEACHER:

- Uses what child brings from home.
- Encourages learners to generate questions as the basis of their investigations.
- Values the central role of the teacher in creating worthwhile learning interactions.
- Values the interaction between learners working in group.
- Concludes the work by discussing the conclusions.

Both teacher and learner are involved together in 5 steps of the interactive model:

- Preparation and guidance
- Exploration and investigation by the teacher
- Learner's questions
- Reflection and Conclusion
- Evaluation

BUREAU OF CATHOLIC EDUCATION

LOW COST EQUIPMENT FOR TEACHING AND LEARNING SCIENCE IN PRIMARY SCHOOLS

ASSEMBLING A CLASS KIT FOR LOW COST SCIENCE EQUIPMENT

(One Kit Per Class)

Container: 6 Solid cardboard boxes of the same size, 'stackable'.

Tools Required:

Scissors, cutter, knife, compass box, stapler
hammer, sticky tape and glue (x 6, one in each box)

Materials required:

Empty tin cans, elastic bands, cotton reels,
string, handkerchiefs, staples, paperclips, nails
plastic sheets, pieces of cardboard, pieces of wire,
pieces of wood, felt pens, pencils, rulers,
plastic spoons, corks, knitting needles,
mirrors, balloons, pins, plasticine,
a pipe, a square piece of glass,
tracing paper, a transparent container,
a piece of pH paper, cardboard, batteries, etc, etc.

Note: Each class kit is made up of 6 separate boxes; the class is divided into 6 working groups and each group is provided with 1 box. Pupils are encouraged to bring material from home and to take finished equipment home.

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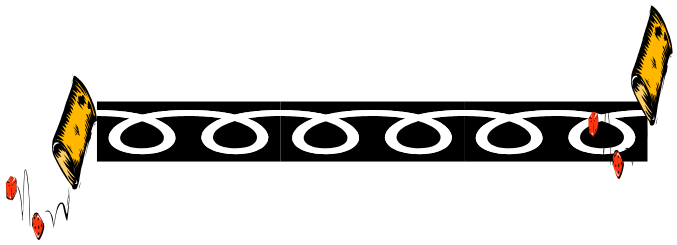
BUREAU OF CATHOLIC EDUCATION

LOW-COST EQUIPMENT FOR SCIENCE TEACHING

STEP - M

Worksheet 1

SOUND AND HEARING



Experiment: **A tin-can telephone**

Objective: To understand that sound is made by vibrations. You can feel vibrations. The vibrations you feel are sound energy. Sound is made from tiny pushes and pulls. When the vibrations stop the sound stops too. To see how sound waves travel through other things.

Materials required:

A hammer
A small nail
2 tin cans(Green peas cans)
3½ metres string
2 paper clips

How to make the tin can telephone:

1. Ask an adult to use the hammer and the nail to punch a small hole in the centre of the bottom of each can.

2. Push the ends of the string through the holes.They must go from the outside to the inside of each can.

3. Tie each end of the string to a paper clip.Pull the string until the paper clip touches the bottom of each can.

How to use the equipment:

Give a friend one of the tin cans.Stand far enough apart to stretch tightly.Talk softly into your endof the telephone while your friend holds the can to one ear.Then have your friend talk while you listen.

Expected result:

When you talk your voice makes the bottom of the can vibrate. The vibrations move along the tight string. When they reach the other end of the string they make the bottom of the second can vibrate. So your friend hears what you say.

When the joined strings are stretched into a Y shape you and your friends can have a three-way conversation.

Learning outcomes:

The vibrations move through the air, out and away from the thing that make them. Eventually they reach our ears and we hear them as sound.

What is vibration?

Vibration is the action of moving to and fro rapidly and repeatedly.

Some examples of vibration:

- Start the engine of a car, remain seated and feel the vibrations.
- When using a driller at home, place your hands quite near.
- What do you feel when you pass by a place where a breaker is being used. For example : road work, building site, etc.
- You can make use of a guitar ; you place some bits of paper on the strings while you are scratching on the strings-the bits of paper will move up and down.
- You stretch an elastic band tightly and ask someone to give a pull on it-you can feel the vibrations.
- You can put some seeds on a drum and see them jumping while you give some beats.

Adapted from :'Childcraft'
Discovering Science – 1993 World Book

Worksheet 2

SOUNDS AND HEARING

Experiment 1:

Produce some sounds using your book, ruler, pencil, eraser, mug etc.




Experiment 2:

Stretch a piece of elastic between your teeth and hand. Pluck it from the middle. Can you hear a sound ?

Now alter the length as you pluck. Can you make different noise with the same piece of elastic ?

Experiment 3: Singing wine glasses

With a little practice anyone can make a glass sing. Just be sure you do not press too hard on the rim.

Here is a simple way to start a wine glass singing:

Use a thin-stemmed glass and partly fill it with water. Then moisten one of your fingers and run it lightly round and round the rim of the glass. Do not press too hard, and make certain your hands are clean before you start. With practice you will find it easy to make the glass sing a note.

Experiment 4: A moaning ruler

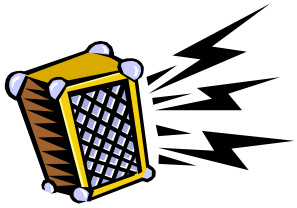
It is great fun to make unusual sounds.

This is how to produce moaning and wailing sounds:
Make a small hole near one end of flat ruler. Tie a piece of string about two feet long to the hole. Hold the string in your hand and whirl the ruler round and round in front of you as if you were a sling. But keep clear of your friends. At first you may hear only a fluttering sound but as the ruler whirls faster and faster it will moan in an eerie way. It may even wail. Someone unable to see how the sound is made could well think it was the wind howling in the trees.

Adapted from 'New Primary Science'
Malkiat Singh

Worksheet 3

SOUND AND HEARING



Objective: Sounds travel through solids. Sounds move in all directions from a source.

Experiment 1: Two children position themselves on adjacent sides of a building.One then speaks the other's name quietly. He will not be heard by his friend. If the first child then raises his voice,eventually the second child will hear him probably because the sound is reflected back to him from some nearby object.

Expected result: Sound needs a substance to carry its waves.

Experiment 2: Tie a piece of metal in the centre of a piece of string.Now hold the two ends of the string to your ears.Get your friend to hit the metal . you will hear the sound quite loud because it travels along and through the string.

Experiment 3: Place your ear against the surface of a table . Get your friend to scratch at the other end of the table .You hear the sound because it is travelling through the wood of the table.

Learning outcomes :

Sound cannot be transmitted if there is nothing to vibrate.

Adapted from :
New Primary Science
By Malkiat Singh

Worksheet 4

SOUND AND HEARING

Experiment: To show that sound is better transmitted through solids than through the air.

Materials needed:

a wrist watch (not digital)
a table

What to do?

1. Hold the watch to your ear and listen to the ticking. Then gradually move it away until you can no longer hear the sound.

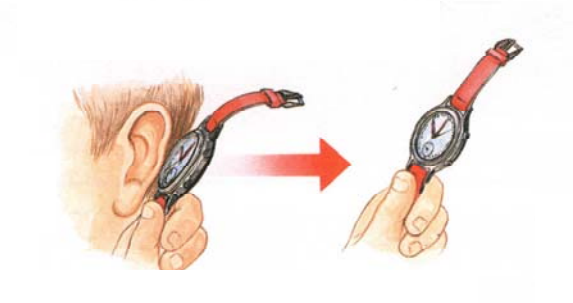
2. Place the watch on the table. Put your ear on the table at the same distance which you measured first.

What happens?

The ticking of the watch is distinctly heard by your ear.

Because:

Sounds are better transmitted through solids than through the air. Sounds travel easily through bricks and glass. That is why sounds can be heard through walls and windows.



Worksheet 5

THE WIND

Objective: What does the wind do?

Look at the things that the wind does:

1. It blows things along – Paper in the gutter
   Washing on the line
   Sailing boats, kites, dried leaves

2. It holds things up: gliders, parachutes, birds

How to make a glider?

Materials needed: a sheet of paper

Fold the sheet as shown in figure 1

How to make a parachute?

Materials needed: A large handkerchief or a plastic sheet
A cotton
4 pieces of string of the same length.

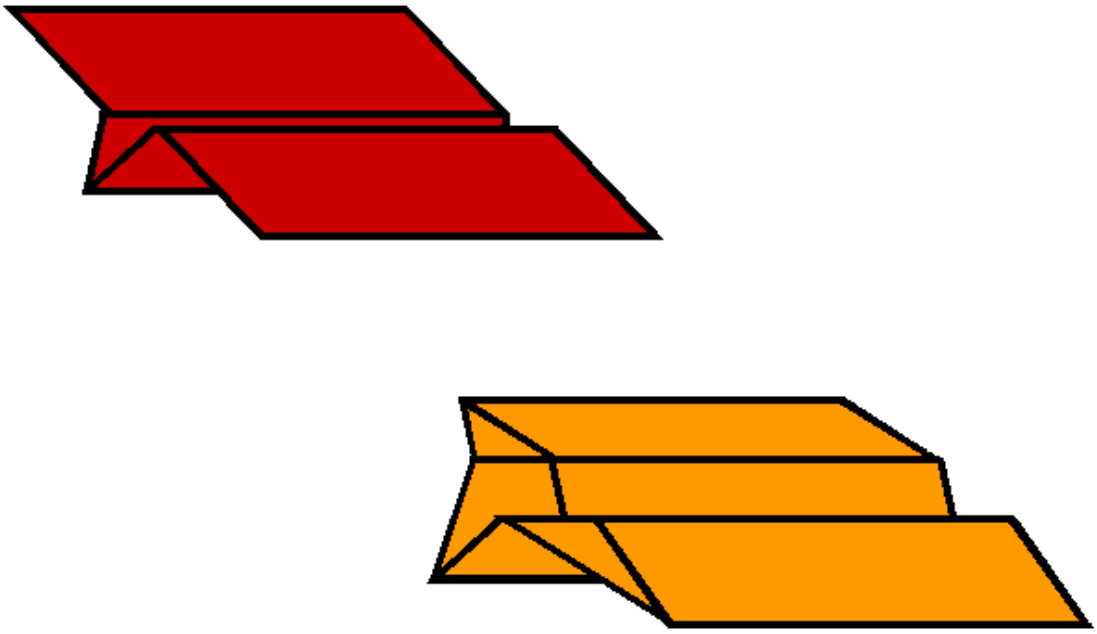
Procedure: Step 1 – Make a hole in the middle of the handkerchief of the plastic Sheet
Step 2 – Tie each piece of string to each corner of the handkerchief
Step 3 – Pass the 4 other ends through the hole of the cotton reel then tie them in the knot.

Learning outcome: The wind also holds things up.

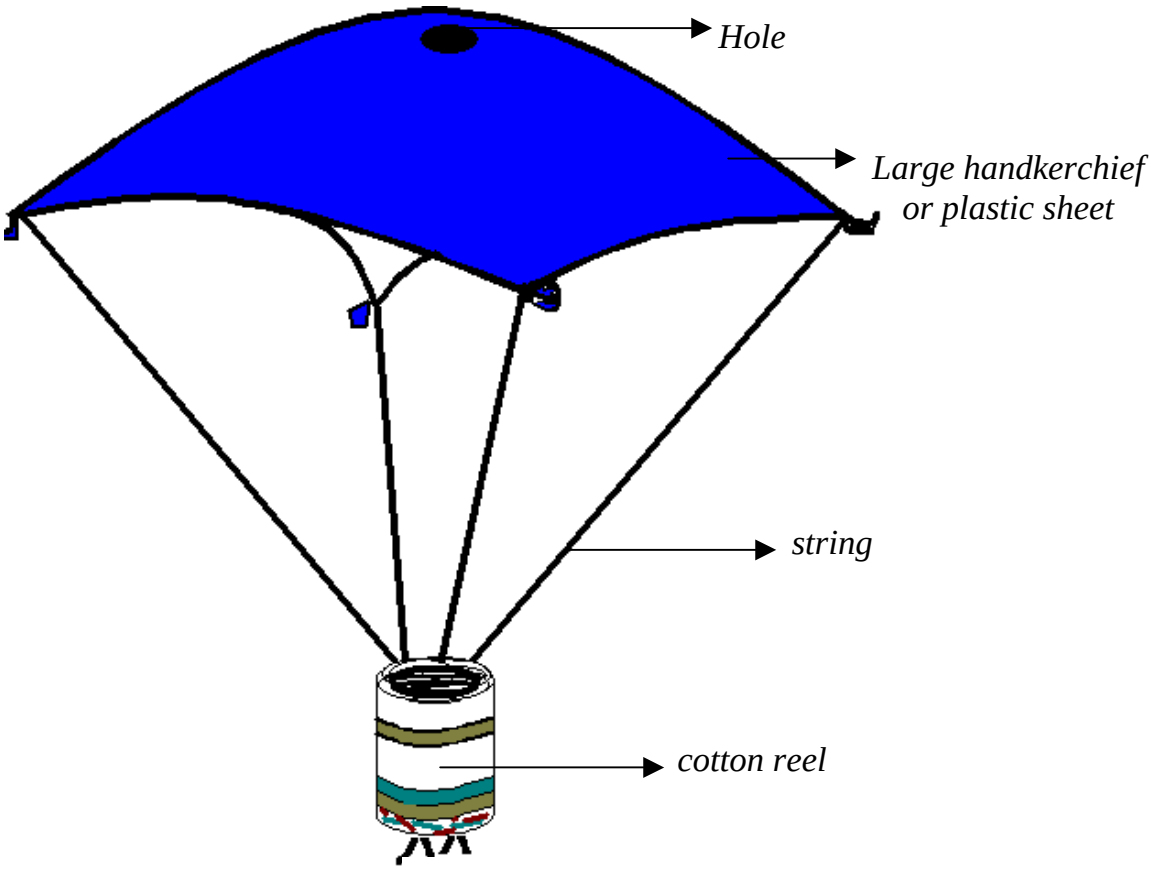
Adapted from 'Early experiences'
Macdonald Educational, London and New York

Figure 1

Gilders



A parachute



Worksheet 6

THE WIND

Objective: Which direction does the wind come from?

Experiment 1: Let children blow on things, such as a piece of paper or a ping pong ball. Can they blow a piece of paper towards themselves?
They will find that things tend to move away from the wind.

Experiment 2: Hold up a wet finger. The side that dries most quickly will feel colder. This is the side the wind is coming from.

Experiment 3: Pluck a handful of grass and let it fall.
Hold up a handkerchief.
Look at smoke from a factory.

Expected Result: Children will learn that wind always blow from a direction

Adapted from 'Early experiences'
Macdonald Educational, London and New York

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LOW-COST EQUIPMENT FOR SCIENCE TEACHING

PRIMARY SCIENCE PROJECT (PSP)

Worksheet 7

THE WIND

Objective: Wind has power to make things move

Material required:
A square piece of paper
A pencil with a rubber on the end
A ruler
Scissors
Sticky tape
A drawing pin

Step 1: Draw 2 lines from corner to corner of the paper

Step 2: Cut inwards from each corner halfway to the centre point.

Step 3: Fold over each point with a dot on it and tape it to the centre.

Step 4: Push the drawing pin through the centre and into the rubber on the pencil.

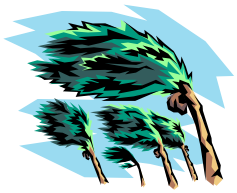
How to use the equipment:
(i) You can blow on the pinwheel and watch it spin
(ii) Hold it in a place like the corridor or outside where there is a strong wind

Expected Result: Wind has power. Wind power makes things move.

Adapted from 'Childcraft' Make and Do, 1993 World Book

Worksheet 8

THE WIND



Objective: To show the wind direction?

Experiment 1: How to make a wind sock

Materials required:

A piece of string
A piece of wire
An old nylon stocking
A piece of plasticine

How to make a windstock?

1. Make a loop with the wire
2. Cut the nylon stocking about 30-40 cms
3. Tie one end (where it is smaller) tightly with an elastic band
4. Fix a lump of plasticine on the edge
5. Tie a piece of string about 50 cms long to the opposite edge where the plasticine is fixed.

Learning outcomes:

By holding the end of the string in the open air, the child will learn from where the wind is blowing.

Adapted from 'Early experiences'
Macdonald Educational, London and New York

Worksheet 9

THE WIND

Objective: Measuring the force of the wind.

How to make your own anemometer.

Materials required:

1 square piece of wood (8- 10 cm side)
1 long nail (7.5 cm)
2 elastic bands
1 old spoon
2 staples (piton)

Procedure:

1. Drive the nail into one corner of the wooden board leaving about 5.5 cm protruding.
2. Wind the two elastic bands several times round the nail leaving a space in the middle-one nearer the board, the other next to the nail's head. (these are to stop the spoon sliding about)
3. Bend the handle of the old spoon as shown in the drawing.
4. Then drive the 2 staples into the edge at the back of the board so that you can hang your anemometer on a couple of nails. You must do this in such a way that the wind can blow directly against the hollow side of the spoon. The stronger the wind, the further the spoon is driven backwards and upwards-hence the position of the spoon gives an indication of the strength of the wind.

Now you can mark it out. The speed of the wind which makes large branches move will force your spoon-indicator to a certain position. Different positions can be noted on the board. So by reference to the Beaufort scale we see that it is Force 6, so that mark can be numbered 6. Similarly, when the wind is blowing at different speeds you can mark and number other positions.

Adapted from: The Third Book of Experiments
Leonard de Vries

Worksheet 10

WATER

Objective: Water can cause an image formed bigger than the original object.

Materials required:

A sheet of prints
A pipe
Water
A square piece of glass

Method 1: Dip the pipe in a glass of water.
Then let 1 drop fall on a letter print or a word print.

Expected result: It will appear enlarged.

Method 2: Put the piece of glass on the sheet of prints. Then let a waterdrop on a letter or word. It will appear even bigger or larger.

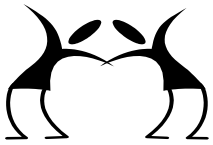
Learning outcome:

Both water and glass enlarge objects and appear to bring them nearer.

Adapted from Early Experiences
Macdonald Educational

Worksheet 11

REFLECTIONS



Objective: Investigating reflection of a spot of light from a mirror

Materials required: A little mirror covered with cellotape at the back for safety purpose.

How to use it?

1. Where does a mirror have to be held to see behind? Overhead? Round a corner?
2. How far can the spot of light go?
3. Can it be shone into the shade? On to the ground?
4. Can it be done into the sunlight?
5. What shape is the spot? Always?

Learning outcome: Using a mirror outdoors is the same as using a torch indoors.

Adapted from Early Experiences
Macdonald Educational

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LOW-COST EQUIPMENT FOR SCIENCE TEACHING

STEP - M

Worksheet 12

REFLECTIONS

Objective: Investigating reflections with 2 mirrors

Materials required: 2 big mirrors of the same size
A toy
Plasticine

Step 1: Stick a piece of plasticine at 2 corners of each mirror so that it can stand by itself.

Step 2: Place the toy between two mirrors facing one another.
Look down the side of one mirror into the other.

Expected results: There is a succession of reading images.
Can you count them?
Otherwise get into the place of the toy and look into either mirror.

Step 3: Place the two mirrors at an angle with the toy between them.
How many images are there?

Step 4: How many images are there if the angle between the two mirrors are varied?

Learning outcome: This principle is embodied in a kaleidoscope.

Adapted from Early Experiences,
Macdonald Educational, London and New York

Worksheet 13

AIR

Objective: To show that air has weight

Materials required:
2 balloons
1 ruler
1 pin

Procedure: Fill two balloons with air. Hang them on a foot-ruler in such a way that they balance each other. Now prick one of them with a pin. It becomes empty. Notice the beam.

Expected result: It tilted towards the balloon, which has air in it.

Learning outcomes: This shows that air has some weight.

Adapted from 'New Primary Science'
Malkiat Singh

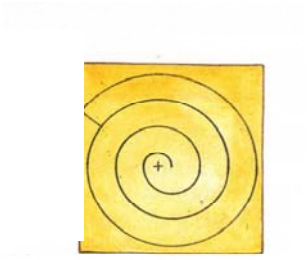
BUREAU OF CATHOLIC EDUCATION

LOW-COST EQUIPMENT FOR SCIENCE TEACHING

STEP - M

Worksheet 14

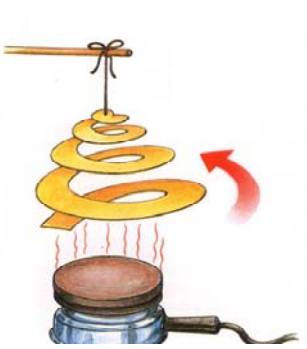
AIR



Experiment: to show hot air rises.

Material needed:

- a square of paper (13 cm square)
- a pencil
- scissors
- a piece of string about 20 cm long
- A source of heat. (Candle light)



What to do?

1. Draw a spiral on the paper as shown in diagram. Cut along the spiral lines
2. Make a little hole in the centre of the spiral. Thread the string through and fasten with a knot.
3. Hang the spiral above the source of heat.

What happens?

The spiral begins to spin round on its own.

Because:

The air is warmed up by the source of heat. The hot air rises. As it meets the spiral, it makes it spin round.

Worksheet 15

ELECTRICITY

Topic: Electricity at rest – Electricity Standing – Static Electricity

Objective: Kindle the curiosity of finding out by oneself

Materials required:

The immediate world at home; stroking animal fur (e.g. your cat). A fur product (e.g. a woollen pullover)

A nylon shirt, a silk shirt, a synthetic-fibre shirt.

Your hair, your mirror, your plastic comb

A plastic ruler or a plastic pen-top, your hair or animal fur, pieces of paper

How to use the equipment:

Stroking the cat in a gloomy room especially during a heavily cloudy day.

Taking off your clothes one night in a gloomy room.

Combing your hair

Rubbing plastic material with hair or fur and holding close to bits of paper

Expected Result: Tiny sparks may be seen

Your shirt crackles noisily; tiny sparks may be seen; sudden electrical shock may be experienced if fairy sensible to.

You may hear your hair crackle

Paper bits are attracted and held (sticking paper or plastic)

Learning outcome:

We cannot feel electricity with our senses. We can only detect its numerous effects

Adapted from New Primary Science
Malkiat Singh

Worksheet 16

ELECTRICITY

Objective: Easy way of learning electricity.

Materials required:

A bulb
A battery
A piece of plastic covered with a metal wire or an opened out paperclip.

Learning about the battery:

A battery has two terminals.

Learning about the bulb.

A bulb has two terminals.

Procedure: To make the bulb light, one terminal on the battery has to be connected to one terminal on the bulb.

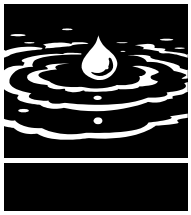
The other terminal on the battery has to be connected to the other terminal on the bulb.

These connections has to be made by the piece of plastic covered wire where the plastic has to be cut back (the metal wire is inside. If a wire like this is not available you can always use the opened-out paper clip has the biggest hand in the class?

Adapted from: Teaching Primary Science
B. L. Young

Worksheet 17

ENVIRONMENT



Objective: To filter dirty water

Materials required: A glazed tile.
Plant pot
Sand
Gravel
Broken crockery or coarse gravel (chippings)
A clean bowl

Procedure: Place the following materials in the plant pot in the given order: broken crockery or coarse gravel (chippings), gravel, sand.

Place the glazed tile on the sand.
Place the clean bowl under the plant pot.
Pour the water on the glazed tile.

Expected result: Clearer water will be collected in the clean bowl.

Adapted from Mauritius Integrated Science Project
Writing and organising team :
Michaël Atchia
Peter Davis
Devi Dyall
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Worksheet 18

ENVIRONMENT

Topic: Soil

Objective(s): The best way to conserve soil is to maintain vegetation on it. It protects the soil from erosion.

Materials needed:
A hose
A plank
A big stone
Soil

(To be done with the help of the caretaker or the teacher)

Procedure:

1. Cut a chunk of soil about 40 cm by 20 cm, 10 cm deep covered with grass.

2. Cut another chunk of the same size not covered with any vegetative.

3. Arrange the first chunk on a plank or other support as shown in the figure. Run water from a hose on the slope for 10 minutes.

4. Now replace the first chunk by the second one and run water. (Same hose, same flow) for 10 minutes.

Conclusion: What do you observe between the chunks?

Expected result: The soil with grass on it will remain same.
The bare soil will be washed away thus reducing the Volume.

Learning outcomes: Vegetation prevents soil erosion.

Adapted from:Mauritius Integrated Science Project
Writing and organising team:
Michaël Atchia
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Worksheet 19

DIRECTION

Objective: Discovering where the north or the south is.

Material needed: A watch.

Experiment: To be done outdoors.
Lay the watch down so that the small hand points exactly towards the sun. Bisect the angle between the small hand and 12. See the drawing and this bisector, the arrow in the drawing, points to the south.

Learning Outcome: It is also possible to find the north , the south , the east, the west even without a compass.

Adapted from : The Second Book of Experiments
Leonard de Vries

Worksheet 20

FORCE

Topic under study: Centrifugal Force

Objective: Getting a dish to spin very fast inside a soft plastic bowl.

Materials required :
1 circular washing-up bowl
1 smaller metal dish with sloping sides
1 washing-up mop
water
milk

How to use the equipment:

1. Pour a cupful of milk into the metal dish with sloping sides which should be a little smaller than the bowl.

2. Pour enough water into the bowl.

3. Press on the sloping side of the dish with the washing-up mop thus giving a circular motion.

Expected result:

With a bit of practice you willfind that you can make the dish spin round at a terrific speed and that when you stop your movement it continues to spin for quite a long time.

Learning outcomes:

This force is called the centrifugal force. A possible application fo centrifugal force is in industries, for the separation of liquids/milk and cream.

Worksheet 21

FORCE

Objective: How forces work.

Material needed: 1 plain chair with an upright back
Yourself

How to proceed:

Sit on a chair just like the boy in the picture, with your back straight and placed right up against the back of the chair.

Your legs should be vertical and your feet flat on the floor. Do you think it is possible to get up from this position? This means that you must not alter your position in any way before you rise. You must not bend your body nor move your feet.

But even though you try with all your energy and will, you cannot do it. However if you bend forward so that the upper part of your body comes above your feet, or if you move your feet far enough back beneath the upper part of your body, then you can stand up, and there is no way to do it.

Worksheet 22

VOLUME

Objective: Measuring volume

Materails required: A large tin of water
Your hand.

Procedure:

Mark the level of water before you put your fist into the water. Then mark the level of water after (Use a felt pen).

Take out your hand and measure the distance which the water rises.

This experiment can be carried out with the class of children. Boys and girls seperately.

Questions: Is your left hand as big as your right hand ?
Does the water rise further when the hand is flat or when it is a fist ?
Who has the biggest hand in the class ?

Adapted from :Teaching Primary Science
B. L. Young

Worksheet 23

HEAT

Objective: To show that some materials conduct heat better than others.

Materials needed: A plastic spoon, a wooden spoon, an aluminium spoon and an inox spoon, some grains of lentils or peas, a plastic mug/vessel, and a candle.

Experiment:

Step 1: Stick a grain of lentils or peas on each spoon's handle using some melted candle wax.

Step 2: Put all the spoons in the empty mug.

Step 3: Fill the mug with hot water.

Step 4: Observe on which spoon's handle the wax will melt first allowing the grain of lentils or peas to fall down.

Learning outcome:

The plastic spoon will be less hot. Plastic is a bad conductor of heat. Thus grab handles of saucepans and other kitchen utensils are covered with plastic.

Worksheet 24

HEAT

Objective: To show that heat travels from a warmer place to a colder place.

Materials needed: A metal knitting needle, beads coated with candle wax, a thick book and a candle flame.

Experiment:

Step 1: Take a long metal knitting needle.

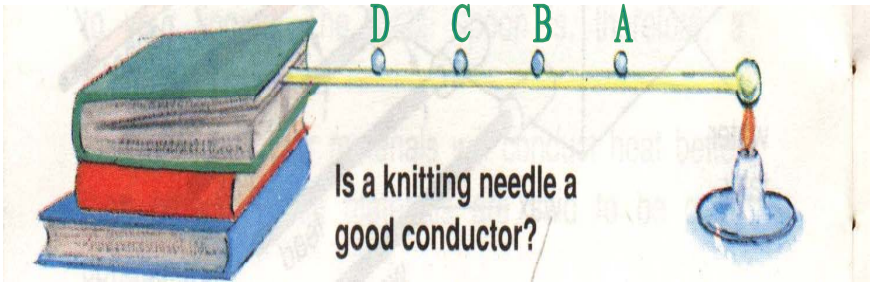
Step 2: Fix the beads, using candle wax, along the needle.

Step 3: Use the thick book to clamp one end of the needle.

Step 4: Heat the other end using a candle flame.

Expected results: The beads will not all fall at the same time. Bead A will fall first, after some time bead B will fall, followed by bead C and so on.

Learning outcome: Heat travels from a warmer place to a colder place.



Worksheet 25

HEAT

STUDY OF HEAT CONDUCTION III

Objective: To show that heat travels from a warmer place to a colder place.

Materials needed: A long nail, a lump of wax a strip of paper and a candle flame.

Experiment:

Step 1: Take a long nail.

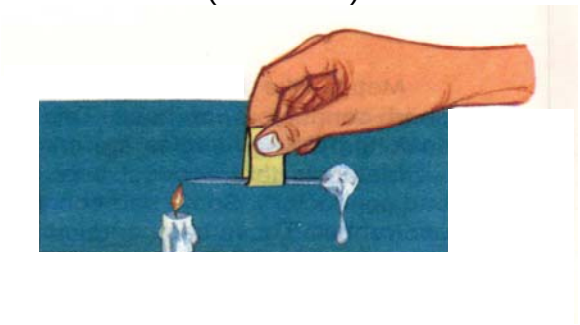
Step 2: Fix a lump of wax to the head of the nail.

Step 3: Hold the middle of the nail with a strip of paper.

Step 4: Heat the sharp end of the nail in the candle flame.

Learning outcome:

Heat travels from the sharp end of the nail to its head and after some time the lump of wax starts melting. Thus showing that heat travels from a warmer place (the sharp end) to a colder one (the head).



Worksheet 26

HEAT

Objective: To show that a liquid expands with heat.

Materials needed: A bottle, water mixed with ink, a drinking straw (une paille), a cork and a candle flame.

Experiment:

Step 1: Fill the bottle with water mixed with ink.

Step 2: Push the transparent tube into the cork, which will fit the bottle tightly. The water will rise a little in the tube.

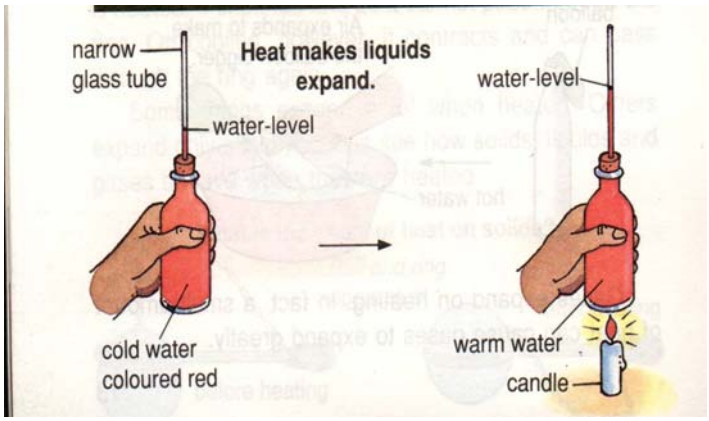
Step 3: Mark the water level on the tube.

Step 4: Hold the bottle over the candle flame. (Do not wait for the water to boil)

Step 5: Observe what happens to the water in the tube.

Step 6: Allow the water to cool down and observe what happens to the level of water in the tube.

Learning outcome: A liquid expands when it is heated.



Worksheet 27

LIVING THINGS - PLANTS

Objective: To prove that plants need light energy to produce chlorophyll.

Experiment:

Step 1: Choose a plant like the geranium, the leaves of which are rather green.

Step 2: Fix a strip of black paper on both sides of the leaf.

Step 3: Expose the plant to sunlight all day long.

Step 4: At the end of the day, remove the strip of paper.

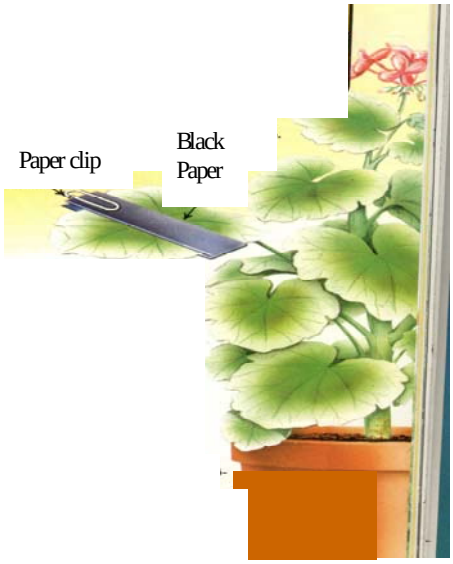
Step 5: Observe the leaf.

Expected result:

The part of the leaf covered by the strip will be of a different colour but not green

Learning outcome:

Light is necessary for plants to manufacture their food and chlorophyll.



Worksheet 28

LIVING THINGS - PLANTS

Experiment: To show how water is taken from the base/root to different parts of the plant.

Materials required: 2 glasses of water (one coloured red and the other blue), a celery branch.

Step 1: Fill 2 glasses about 15 cm high with water.

Step 2: Colour the water of one of them red and the other blue.

Step 3: Put the two glasses side by side.

Step 4: Take the branch of celery and divide it into two parts, starting from the base, halfway up.

Step 5: Put one half in one glass and the other half in the other glass.

Step 6: Leave the branch there for two hours.

Step 7: Observe the colour of the celery stem.

Step 8: Red colour goes up on one side and blue colour goes up on the other side.

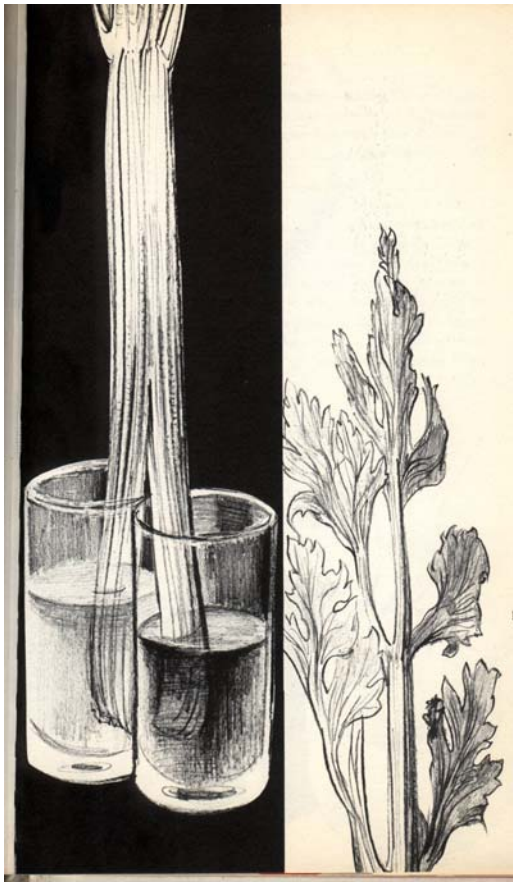
Step 9: Take off the celery stem and allow it to dry.

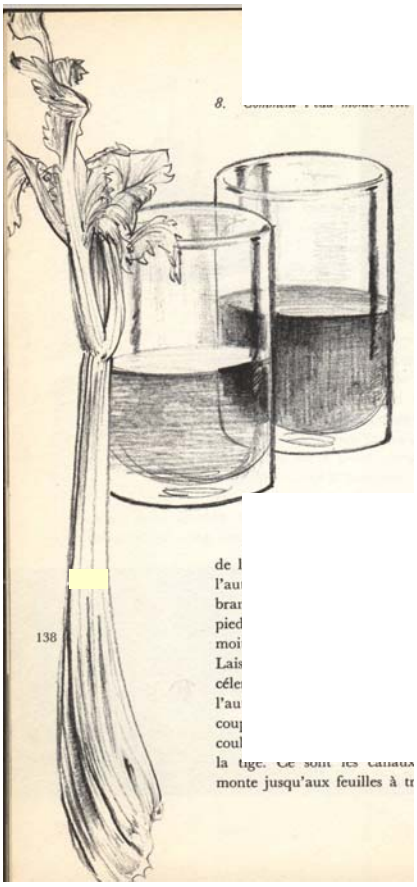
Step 10: Cut the bottom of the plant crosswise.

Step 11: You will notice dots of colour which show the way through which the coloured water has gone up.

Step 12: These are aquiferous conveyors of the stem.

Step 13: The water goes up unto the leaves.





Worksheet 29

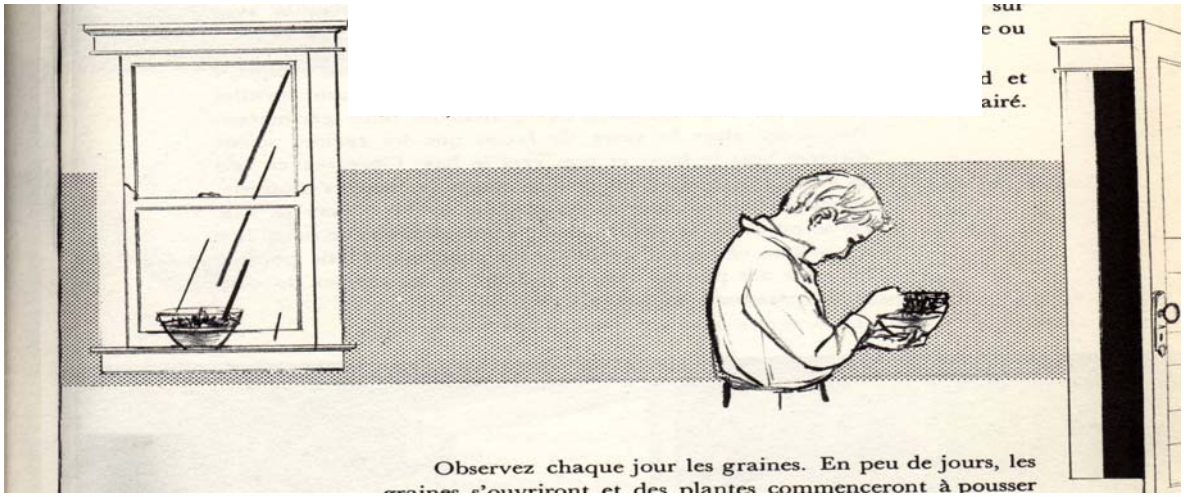
LIVING THINGS - PLANTS

Experiment: To show that seeds germinate not only in light but also in the dark.

Materials needed: 2 bowls, 2 pieces of blotting paper, some soya bean seeds, cellophane paper and water.

Step 1: Place a piece of blotting paper in each bowl.
Step 2: Add some water to each bowl so as to soak completely the blotting paper.
Step 3: Place the soya bean seeds on the blotting paper in each bowl.
Step 4: Cover the bowls with cellophane paper.
Step 5: Place one bowl in a warm and lighted place and the other bowl in a warm but dark place.
Step 6: After some days the seeds in both bowls will germinate and will begin to grow.

Learning outcome: Seeds germinate and grow not only in light but also in the dark.



Worksheet 30

LIGHT

Experiment: To show that light travels in a straight line.

You need: two squares of cardboard
a torch
two strips of cardboard
a few books

What to do ?

1. Pierce a hole in the centre of the two cardboard squares. Make supports for each square by folding the cardboard strips and cutting nutches as you see in the picture.

2. Place the squares in the supports and line up the holes. Put the torch on the books with the light aimed at the first square. Kneel or sit down so that your eyes are level with the hole in the second square.

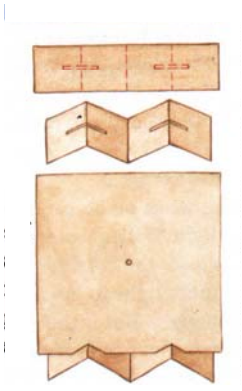
What happens ?

Your eyes see the light through the sun holes.

1. Move one of the squares so that the holes are no longer lined up.

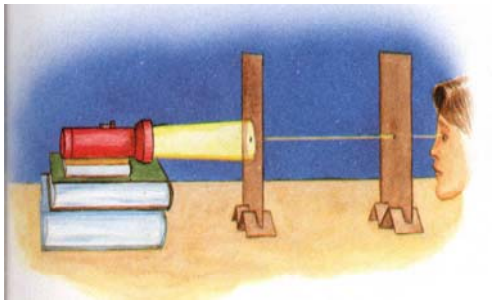
What happens ?

The eye can no longer see the light.



Because:

Light travels in a straight line, so it cannot pass through the hole if it cannot find the end of its path.



Worksheet 31

LIGHT

Experiment: How to prepare a simple garden sundial.

Materials needed:

a cardboard disc, about 20 cm in diameter.
A stick about 10-15 cm long.
Scissors
A pencil
A watch
A patch of ground where the sun shines throughout the day.

What to do?:

1. Make a hole in the centre of the disc. Push the stick through to about one third of its length. Put in the earth, so that the disc is firmly on the ground.

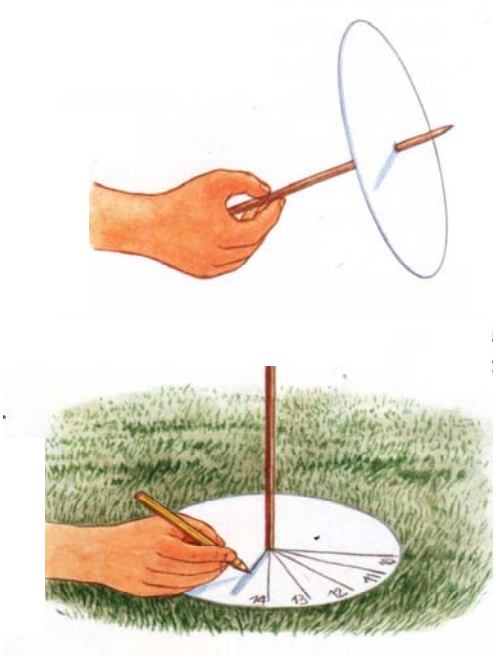
2. As soon as your watch is on the hour, mark where the shadow of the stick falls on the disc with your pencil. Write down the time beside the line.

3. Do the same thing each hour, remembering to write down the time for each shadow.

Learning Outcomes:

The shadow thrown by the stick is in a different position for each hour. The pencil lines spread out from around the stick towards the outer edge of the disc.

The position of the stick's shadow changes as the position of the sun appears to change. You have made a sundial, an instrument once used for the measurement of time.



Worksheet 32

COLOURS AND LIGHT

Light appears to be white, but it is made up of the seven colours of the rainbow, or the colour spectrum.

Experiment: How to obtain the colours of the rainbow.

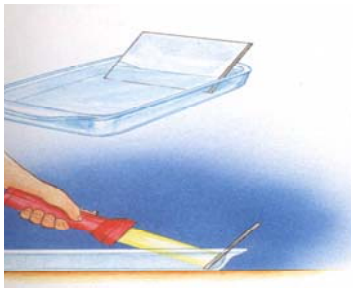
Materials needed: a torch, a shallow rectangular container, a plain mirror, a piece of white card, water

What to do?

1. Fill the container with water.
2. Place the mirror in the water and slowly lean it at an angle against a short side of the container.
3. Shine the torch on the water so that the beam lights up the part of the mirror which is under water.
4. Place the white card in front of the mirror to catch the reflected light.

Learning Outcome:

The white light catches a reflection with the colours of the rainbow. The beam of the light reflected on the mirror as it escapes from the water become refracted.



Worksheet 33

COLOURS AND LIGHT

Objective: To show that sunlight is made up of different colours of the spectrum, that is red, orange, yellow, green, blue, indigo and violet.

Materials needed: A circle of white card of diameter 8 cm; a sharp pencil; felt pens or crayons of the seven colours of the spectrum.

Experiment:

Step 1: Cut out a circle of white card of diameter 8 cm.

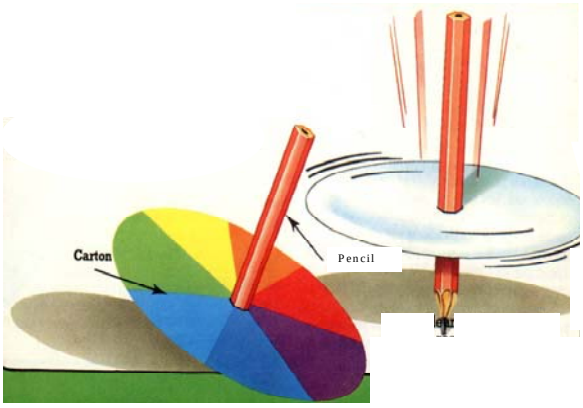
Step 2: Divide the card into seven equal segments.

Step 3: Paint / colour the different segments of the card using the seven colours of the spectrum.

Step 4: Insert a pencil at the centre of the disc and make it turn like a top.

Expected result:

You will see how the seven different colours blend into one colour when they are moving at great speed. (Since the colours are not pure, the result may be that it looks a bit grey.)



Worksheet 34

SOLUTION

Experiment: How to obtain crystals of salt from a salt solution.

Materials needed: Table salt, two glasses, a length of cotton thread, a small plate, a spoon, water

What to do?

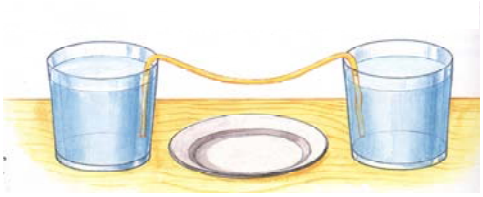
1. Pour cold water into the two glasses
2. Put salt in both glasses mixing it until you can add no more. (Saturation)
3. Link the two glasses with a thread, so that the two ends dip well into the water. Put the plate under the thread which hangs down between the two glasses.

What happens?

After a day or so, salt crystals form on the thread and on the plate.

Because:

The salt water rises along the thread. The water evaporates from the thread (and from the plate where some droplets fall) leaving the salt, which solidifies into crystals.



Alternative experiment:

Pour sea water in a device on a rock exposed to the sun. Salt crystals will be formed.