JOY OF LEARNING

(Handbook of Science & Environmental Education Activities)

STANDARDS 9 - 11

Developed by

Centre for Environment Education

and

Vikram A. Sarabhai Community Science Centre

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FOREWORD

Opportunities for learning exist everywhere. The Joy of Learning handbooks are an attempt at showing some ways in which these opportunities can be made use of. These books do not constitute a complete curriculum, nor do they cover all the different aspects that need to be dealt with at different levels in our education system. But each activity gives students an experience of a small part of the study of science and environment. And these small pieces of experience build into a larger mosaic of understanding. The activities have been selected from very different parts of the mosaic to give a feeling for the tremendous variety of educational activities that can be carried out at the school level. We hope that these will provide a framework and approach that teachers can use to develop a number of activities based on their local environment and available opportunities.

The teacher is the key to the whole education system. It is only through the initiative and innovativeness of the teacher that any successful programme can be carried out. The format of the activities calls for a redefinition of what a school activity is, and what the role of the teacher is. The teacher's role in these activities is not that of transferring information but rather one of being a facilitator, a leader and a resource person in a learning process that is participatory. No teacher can be expected to know all the answers, nor should it be required. On many occasions, the teacher will need to join the students in asking question and getting the students to discuss how they will And the answers. It is also important to stress that all the 'answers' are not yet known.

The activities have been developed to encourage students to observe and explore their surroundings, to understand fundamental principles of science, and relationships in nature, and to learn better how humans are an integral part of the intricate web of life. We believe that learning can be more fun, both for the students and the teacher, when based on real experiences.

The New Educational Policy 1986 identified several thrust areas. In the field of science these include energy, environment, conservation, wildlife management, social forestry, agriculture, industry, population, health, nutrition, food and shelter. The new syllabus designed by the NCERT in 2004 for environmental education for all stages of school education emphasized the development Of healthy attitudes and encouraging positive actions through activities, projects and field experiences. We feel that the way to achieve these is to introduce these opportunities to students through a wide range of activities, and not by explicitly adding textbook contents covered by thrust areas. The relevance of each activity to the particular thrust area has been indicated on each page.

While some of these activities are primarily to be covered in the Science Class, many of them can be carried out in other subjects taught at school. This has been indicated with the respective activity.

Many schools in India may not have the resources and reference material to back such programmes. Attempts have therefore been made to keep the need for such material to the minimum Although, material re9uirementshave been suggested with each activity, most of them can be done with alternative materials. The duration of each activity and the suitable time and season for it are also indicated.

We hope that these activities will lead to ‘Joy of Learning’ a process in which both students and teachers enjoy exploring their environment together.

Kartikeya V. Sarabhai
Director, CEE

JOY OF LEARNING – THE JOURNEY

In 1986 National Council of Educational Research and Training (NCERI) as part of its massive teacher training programme, increasing. The NCERTs initiative in this direction was an opportunity to explore ways to introduce the activity approach in schools.

The tight deadline within which some relevant material could be developed, necessitated an intensive effort - bringing together, in a workshop, some of the groups working in the field of science, health and environmental education, and having some experience in activity-based teaching and learning. The outcome was Joy of Learning I (JOL), published in 1986.

JOL I continues to be reprinted, and used across India and in other countries of the South Asian region, in its original or translated versions. Today JOL I is available in 16 languages. Many excellent activities which the workshop had generated and which did not go into JOL I, were subsequently included in the second volume, Joy of Learning II, which is for standards 5-8 and published in the 1996.

Almost two decades later, the genesis of this volume, Joy of Learning III, is similar to that of JOL I. In November 2003, the Gujarat Secondary and Higher Secondary Education Board (GSHSEB) planned for a three-day event, called Balotsav to be carried out across Gujarat for secondary and higher secondary students. The event was designed to create an environment in which students would be exposed to a variety of activities and opportunities to “learn”. This learning would be with respect to subjects and topics which are part of the academic curriculum, as well as to real-life skills and understandings.

To generate ideas and activities for the event, GSHSEB and CEE organized an intensive workshop which included participants with expertise in a variety of subjects and areas, as well as the learning-by-doing approaches. These activities were used across Gujarat during Balotsav. They were subsequently compiled into this handbook JOL III.

JOL III is for standards 9-11. The activities are designed to help students to provoke the mind. To encourage students to question, investigate, collect and organize information about environmental issues and scientific phenomena and relationships; to understand societal values and recognize rights and responsibilities.

As with the two preceding volumes, this volume of JOL is also based on the acceptance that an activity approach is an effective tool in learning, and that teaching and learning should be a joyful experience.

ACKNOWLEDGEMENTS

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Ideas for many of the activities in this Handbook were contributed by experts from Gujarat Secondary and Higher Secondary Board (GSHSEB)Centre for Environment Education (CEE), Vikram A. Sarabhai Community Science Centre (VASCSC), Centre for Health Education Training and Nutrition Awareness (CHETNA), Gujarat Ecological Educational Foundation (GEER Foundation) and other Institutions during an intensive two-day workshop.

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Some of the activities in this handbook were originally published in earlier CEE publications:

Building Blocks: From Environmental Awareness to Action; A Teacher's Manual 2003 (Activities 32, 37)

Dealing with Disasters: Awareness, Preparedness. Response; An Educators' Manual, 2004 (Activities 22, 23, 25, 26, 27)

Energy Matters: A School Energy Education Guide, 2000 (Activity 19)

Energy: Manual for College Teachers, EnviroScope Series, CEE & World Resource Institute. 2000 (Activity 16)

Guide to Green Citizenship: A Practical Workbook on Environmental Education for + 2 Vocational Students (Activity 11)

Paristithi Vigyan - Jeev Shrushti Na Tana Bana. 2002 (Activity 39)

Towards a Green Future: A Trainer's Manual on Education for Sustainable Development, 1999 (Activities 30. 31. 41. 42. 47)

Activity 35 has been adapted from The Australian Teacher's Guide to World Resources, Editors, John Flen and Mary Paden, World Resources Institute and Griffith University, 1997

ACTIVITY INDEX

1 NAPIER'S BONE

Focus

Mathematical operations

Subject

Mathematics

Duration

1 Hour and 30 minutes

Group Size

5

Materials

Thick paper of 12 x 10 cm writing material, scissors, cutter adn protractor for each group.

Objective

To make a simple calculating device for multiplying a number by a single digit number.

Activity

John Napier was a Scottish mathematician who invented logarithms (1614) and 'Napier's Bones', an early mechanical calculating device for multiplication and division. Tell the students that they will now make their own calculator using his design.

Distribute a thick sheet of paper about 12x10 cm to each student. Ask them to draw a 10x10 matrix and make boxes as shown. As indicated in Fig 1, fill up the matrix with multiples of 1 to 9. The units digit may be written in the lower triangle and the tens in the upper triangle. After filling in the blanks, let them carefully cut out each column.

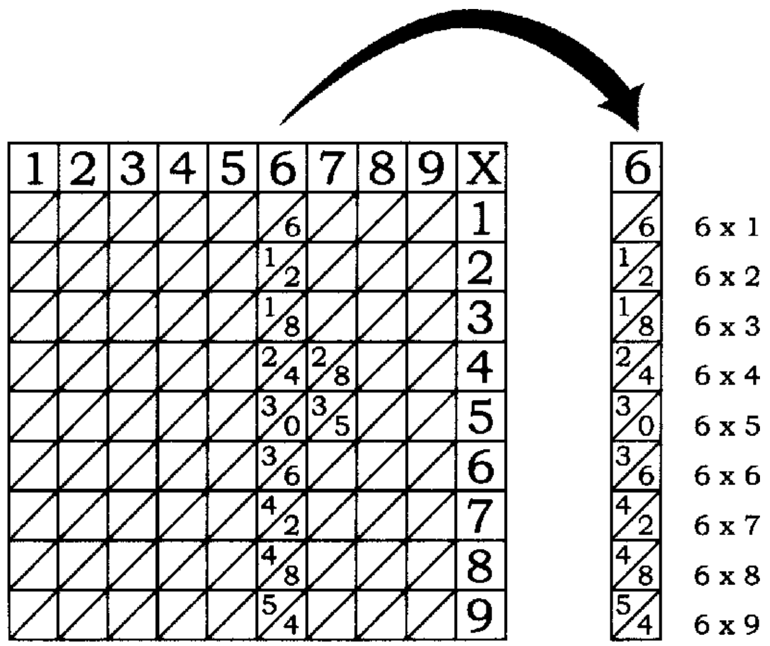


Fig 1

Now demonstrate how to do a simple multiplication using this calculator.

Example

Multiply 348 by 7

To obtain the solution, ask the students to keep the Strip X with 1- 9 digits on the left. Now ask the students to arrange the Strips 3, 4 and 8 to the right of this as shown.

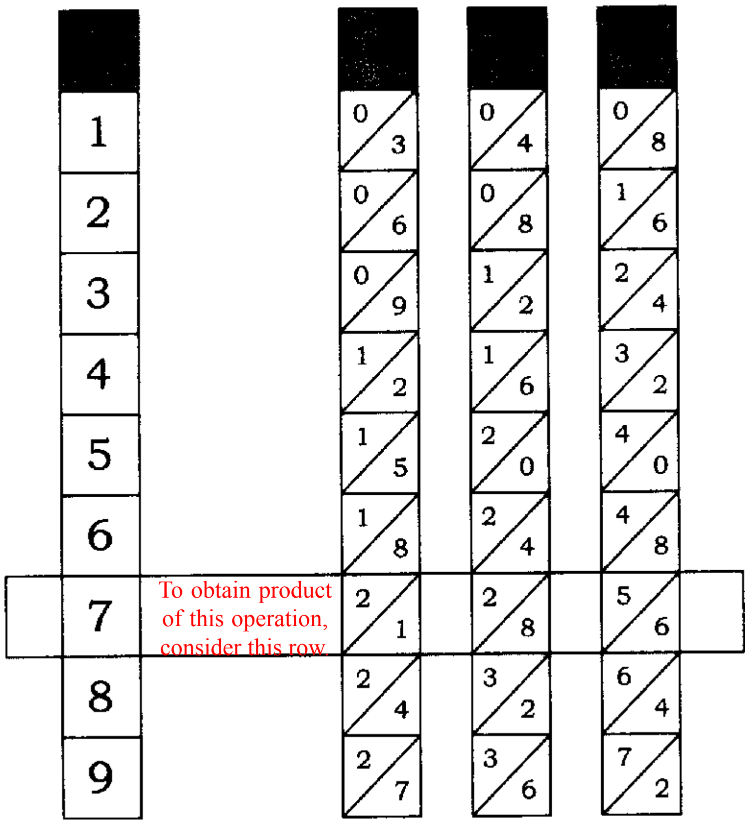


Fig 2

Consider Row 7 in relation to the operation required to be done in the steps given below;

Step 1

The number 6 in the lower triangle in Strip 8 will be the number at the unit's place.

Step 2

Now add 5 from upper triangle of Strip 8 to 8 from lower triangle of Strip 4. The answer is 13. Take 3 in the ten's place, and carry forward 1.

Step 3

Now add 1 carried forward from Step 2 to 2 from the upper triangle of Strip 4 and 1 from the lower triangle of Strip 3. So, the number at hundred's place is 4.

Step 4

The thousand's place will have 2 from the upper triangle of Strip 2.

Extension / Variation

This activity can be extended to include numbers such as 121 * 4, where you will need two strips containing 1 in the first row.

2 PROVING PYTHAGORAS

Focus
Mathematical operations
Subject
Mathematics
Duration
1 Hour and 30 minutes
Group Size
5
Materials
Thick paper of 12 x 10 cm writing material, scissors, cutter and protractor for each group.

Objectives
To understand the geometrical proof of the Pythagoras Theorem.

Activity
Distribute the thick paper, one sheet to each student or group as decided. Ask them to draw a line of 5 cm length, (leaving 5-cm from the bottom and 12 cm from the left side) and name it BC.

Now, ask them to draw a right angled triangle ABC, with BC as a base and right angle at LB. See that the measures are as given below.

Angle ABC = 90^0, AB = 12cm, AC = 13cm

Then ask the students to draw squares on the side AB, BC and AC with respective side lengths, and label them, as shown in Fig 1.

Now, ask the students to draw a line 1 parallel to side AC, (not a diagonal), joining the sides PA and 9B as shown in the Fig 2

Then draw a line m perpendicular to the line l.

Now cut the square PASB along the lines l and m to get four pieces.

Let them also cut out the square BCTU.

Experimental Proof

Ask the students to arrange the four pieces cut from square PAQB and the square BCTU to fill the square ACRS drawn along the line AC. This can be related with the statement of the Pythagoras Theorem that the sum of the squares of two sides of a right angled triangle is equal to the square of the hypotenuse.

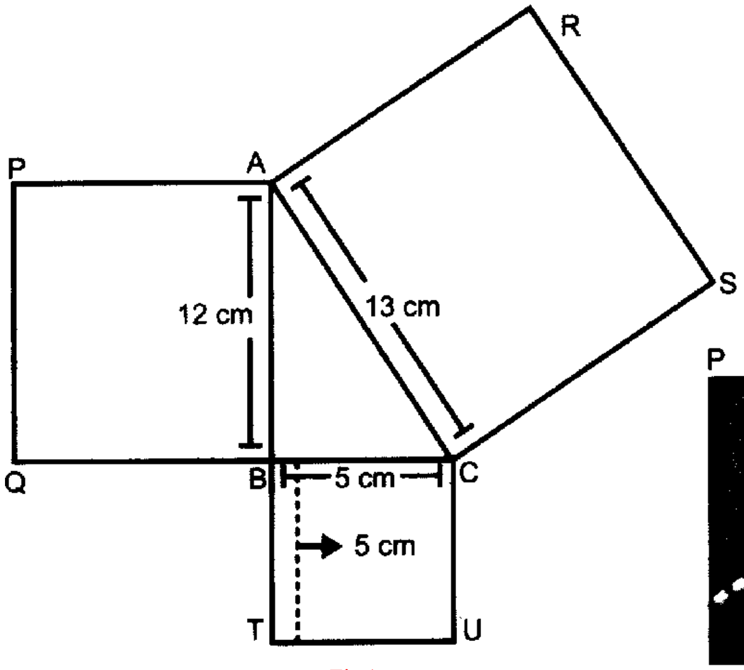


Fig 1

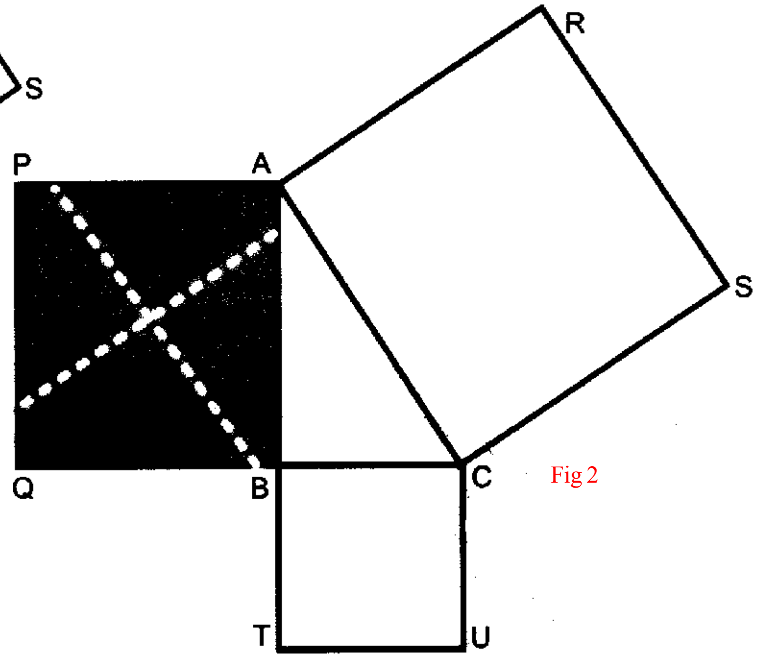


Fig 2

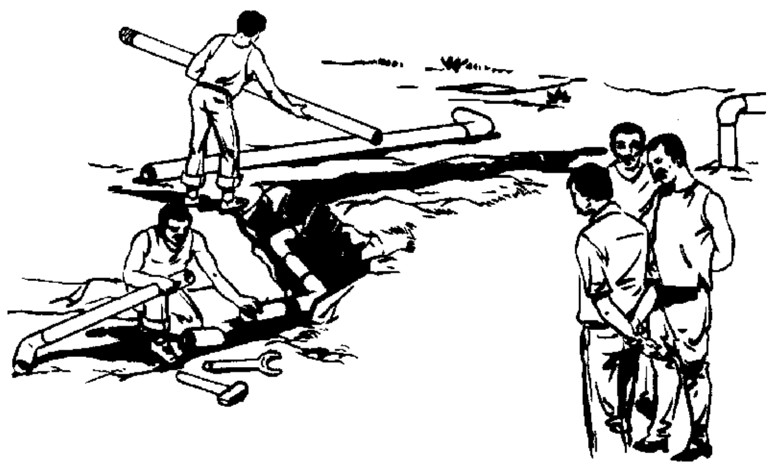
Clue for arranging the pieces

Each of the four pieces cut from square PAQB if you notice, has one angle of 90^0. All one has to do is fit these angles into the four corners of the square ACRS.

Discussion

The Pythagoras theorem has many practical uses. It is used in navigation, cartography and in finding angles of elevation and depression. It is used in geometry for calculation of areas and volumes.

It is also an integral concept of trigonometric functions—the sine, cosine and tangent are nothing but ratios of the sides of lengths of sides of a right angle triangle. It is also the idea behind the fundamental identity of trigonometry – $\sin^2 x + \cos^2 x = 1$.



3 SEEING SQUARES

Focus

Algebra

Subject

Mathematics

Place

Classroom

Duration

30-minutes

Group Size

Individual or in groups

Materials

Thick sheet of paper (13 x 13 cm) one per student or group, writing material, scissors, ruler and eraser.

Objective

To obtain the geometrical proof of the identity $(a + b)^2 = a^2 + 2ab + b^2$

Activity

Distribute the sheets of paper among the students one per individual or group, as decided. Ask students to draw a square of 12 cm in the centre of the sheet. Label it ABCD

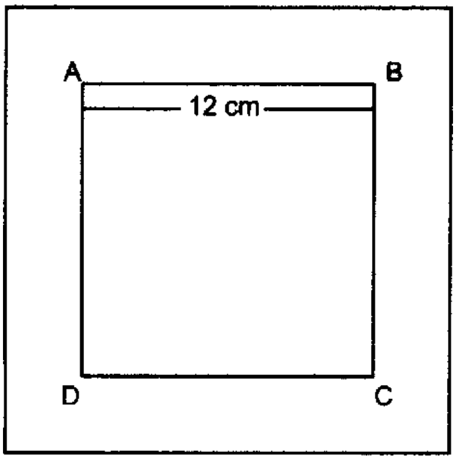


Fig 1

Now, within this square ABCD, draw another square of 7 x 7cm along side AB and AD with A as one of the vertices, and name it APOR. Now draw another square of dimensions 5 x 5 cm along the sides CB and CD with C as one of the vertices as shown. Name it CQOS.

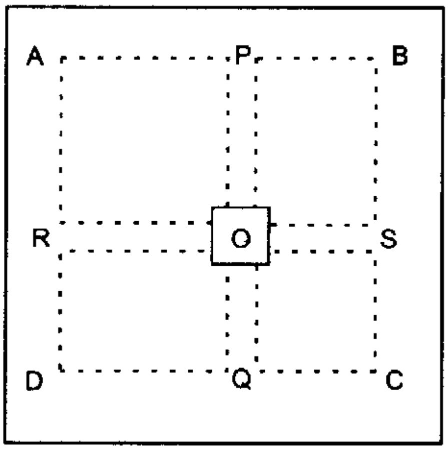


Fig 2

Now ask the students to cut the square along the boundary ABCD and the lines PQ and R5, so that they have the squares with boundaries as shown below.
Now discuss with students the explanation of $(a + b)^2$

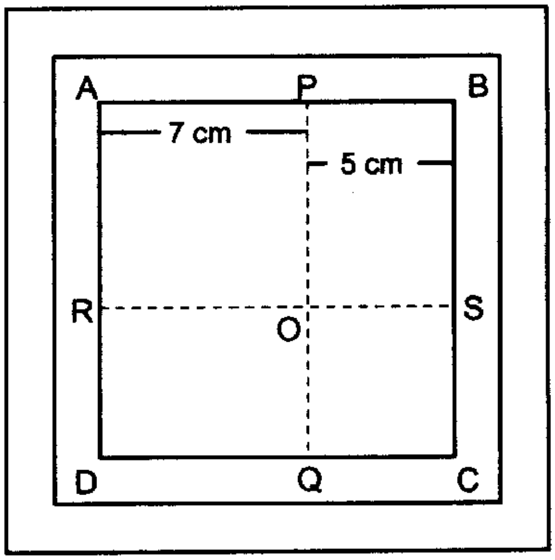


Fig 3

This mathematical identity can be explained as under
Area of the square ABCD = $(12)^2 = (7 + 5)^2$
Area of square APOR + Area of rectangle PBSO + Area of square OSCQ + Area of rectangle OQDR
$(7)^2 + (7 \text{ x } 5) + (5)^2 + (7 \text{ x } 5)$
So this can be written as $(a + b)^2 = a^2 + b^2 + 2ab$

Extension / Variation

The square model can also be used to prove the identity
$(a - b)^2 = a^2 + b^2 - 2ab$

4 CONSTRUCTING SHAPES

Focus
3D Geometry
Subject
Mathematics
Place
Classroom
Duration
30-minutes
Group Size
Pairs
Materials
One sheet of thick chart paper (30cm x 30cm) per student, writing material, eraser, cutter, scissors, gum and ruler.

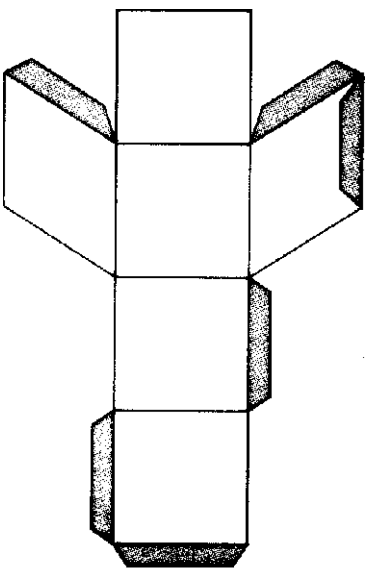


Fig 2

Objective
To make a 3-D object from a plain sheet of paper.

Activity
Distribute one sheet to each pair.

Draw the figure given here (Fig 1) on the board, and ask the students to draw it on paper with the measurements indicated.

Ask the students to cut out the shape along the dotted line as shown in Fig 1, using a cutter or scissors.

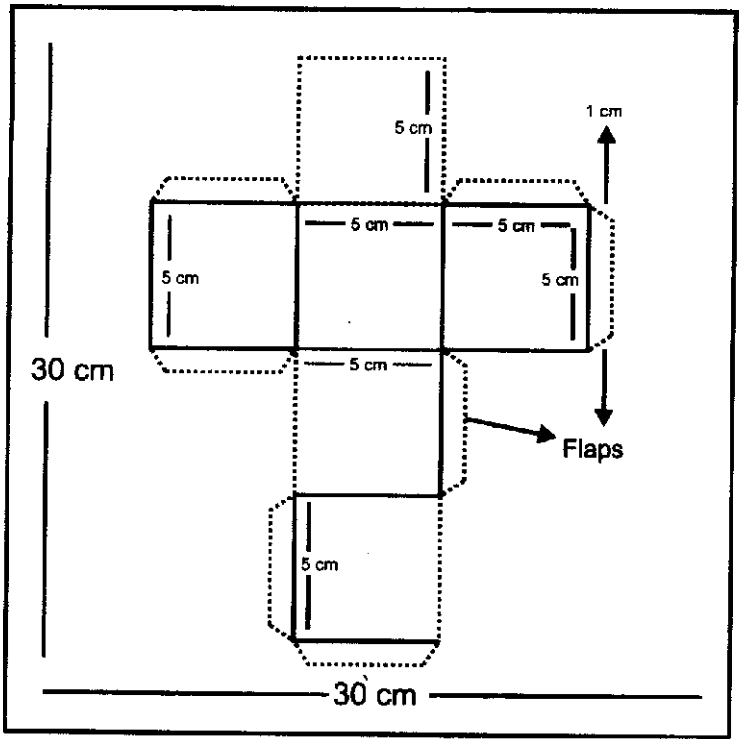


Fig 1

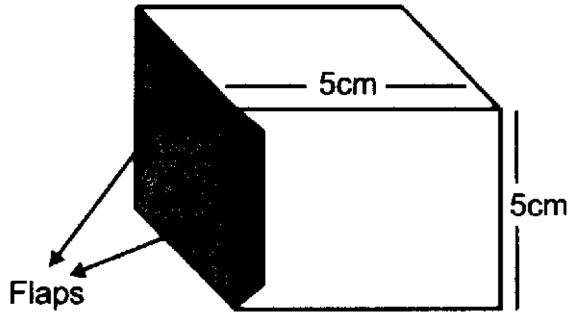


Fig 3

Next ask students to fold and lightly press the paper along the solid lines indicated in Fig 1. Then ask the students to apply adhesive on the inner side of the flaps and stick the edges one after the other. After sticking all the flaps, they will get a paper cube (Fig 3).

Discussion

Tell the students that the figure drawn on the paper to obtain a 3-D shape is known as a 'net'. This net when folded appropriately, gives a solid or 3D shape. Hence for the cube, Fig 1 is the required 'net'. Ask the students to observe the number of flaps in the cube required to join the edges, and then discuss what would happen if the number of flaps is reduced or increased, and whether there is any other arrangement for the flaps than the one given here.

Extension / Variation

Ask the students to make a net for another shape like say a pencil box or a toothpaste carton.

Are they able to make a model using this?

5 STABLE SHAPES

Focus
Geometrical shapes and Structures

Subject
Physics

Place
Classroom

Duration
30-minutes

Group Size
2 - 3

Materials
Thick paper cut to A-4 size (21 x 30cm) gum, books (4 or 5).

Objective

To understand the shapes of structures and their stability.

Activity

Ask the students to roll the sheet along its length to form a cylinder. Glue the last turn over the body of the cylinder, such that it does not open out.

Ask the students to place the cylinder upright on a flat surface. Place a book geometry box on top of it. Ask the students to observe if the cylinder is able to take the weight of the book / box. Now ask students to place more books gently. Observe how many books the paper cylinder can hold.

Observe what happens when cylinders of different diameters are made from the same sized paper and tested for various loads. Does the number of times the paper is rolled over matter in taking the load?

What happens when the base of the cylinder is uneven or when the last turn of the paper cylinder is not glued evenly?

Ask students to fold chart paper into various other shapes like, cuboids, triangular prism, etc. Carry out the load tests to test the stability of each of these structures.

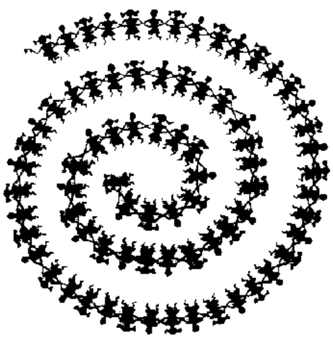
Encourage students to discuss the stability of each of these geometrical forms and their importance in the construction of pillars of buildings.

Discussion

While doing the experiment with the cylinder it may be observed that depending on the load, thickness and diameter of the cylinder the cylindrical structure either crumbles, wobbles or topples.

6 WHAT? VENN?

Focus
Set Theory
Subject
Mathematics
Place
Outdoors
Duration
30-minutes
Group Size
Entire Class
Materials
Black board, chalks, writing material.



Objective
To understand the formation of sets and some set operations.

Activity
Mark out four circular areas on the ground with at least 10-12 metres distance between them. Label them X Y, Z and W. (See Fig. 1)

Ask the students to look at the blackboard and position themselves in the areas X, Y, Z, or W depending on which of the sets they belong to. The sets will be based on the first names of the students. The sets as described below should be written down on the board.

alpha =[x / x is between A & D including A and D, where x is the first letter of the first name]

[Students whose names begin with alphabets between A and D including both of them belong to the set a and may move into the area marked as X]

Beta = (x / x is between H & L including H and L, where x is the first letter of the first name)
(Students whose names begin with alphabets between H and L including both of them belong to the set P and may move into the area marked as Y)
Gamma =[x / x is between N & T including N and T, where x is the first letter of the first name)
(Students whose names begin with alphabets between N and T including both of them belong to the set y and may move into the area marked as Z]
Delta = [x / x is not in any of above sets, where x is the first letter of the first name]
(Students whose names begin with alphabets other than those mentioned in the sets alpha, beta, gamma belong to the set 6 and may move into the area marked as W)

Once they have positioned themselves in their respective areas, go around to ensure that they are in the right circles. Then write the following on the board and ask them to rearrange themselves according to the new sets

"alpha u delta in circle Y" and "beta u gamma in circle Z".

Ask them to draw a Venn diagram related to this activity and also ask them what the Universal set for this activity is.

Now you can change the set conditions, for example, month of birth, area of residence, etc., and repeat similar exercises.

Discussion

Discuss the two set representation methods (List method and Characteristic listing method) and ask the students what type of set representation was used to write the above sets.

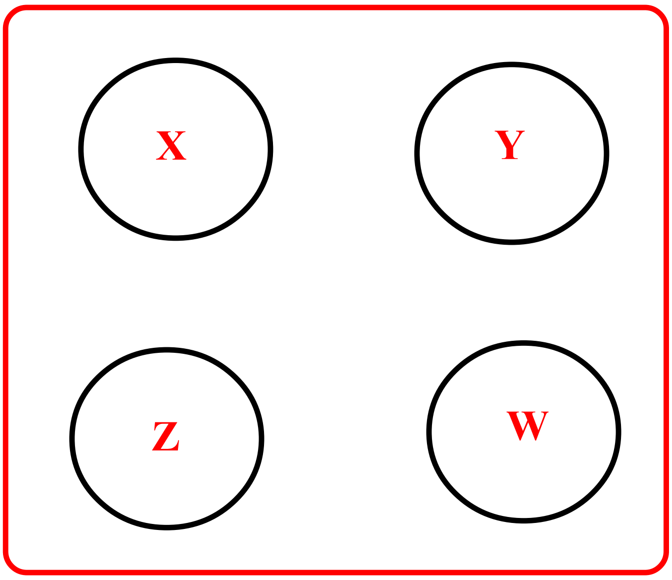


Fig 1

7 LET'S WATCH TV

Focus
Statistics / Quantitative / Research

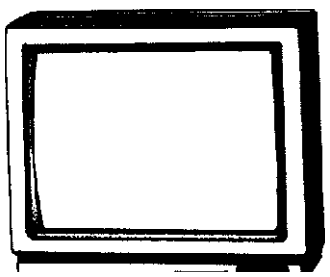
Subject
Social Studies / Mathematics

Place
Indoors and Outdoors

Duration
30-minutes

Group Size
5

Materials
Writing material for each student



Objective

To carry out a survey to find out TV viewing preferences of the public.

Activity

Tell the students that they will be doing a survey to find out more about TV viewing preferences. Discuss the questionnaire given here and ask them if they feel any modifications are necessary. The class should modify as they feel necessary. Then photocopy or handwrite multiple copies of the questionnaire. Tell each group that they must choose a different area neighbourhood. Each group must survey at least 30 people.

Survey Questionnaire

Area :

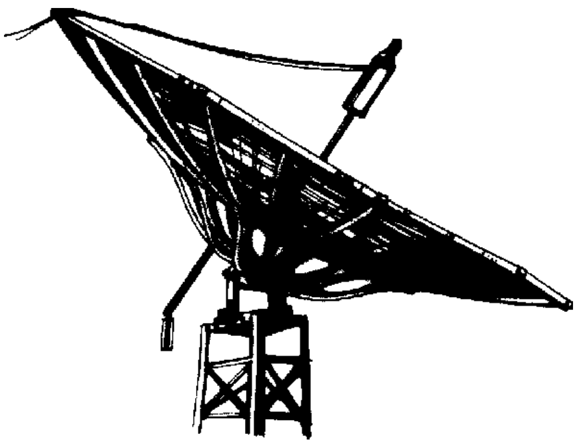
Name :
Sex :
Age :
Occupation :
Student (school / college)
Employed (where)
Self Employed (as what)
Home Maker
Senior citizen

Do you have a cable connection?: Yes / No
When do you watch TV?: Morning /Afternoon /Evening /Night
Average number of hours you watch TV on weekends and week days (note both separately):
Favourite programme category:
(Cartoon Movies Serials / Comedy / News / Sports /Educational Science / Musical /Horror-Thriller / Detective Sports Interviews / Cookery shows / Travel / Feature films Wildlife or specify if others):
Number of programmes you and your family watch together:
Languages of the channels that you watch:
Name five channels that you watch regularly: (in order of preference)

After surveying, ask each group to compile the data gathered, into two tables, one each for weekdays and weekends, given here.

	Category	School Children		College Students		Employed Non-Senior		Non Employed		Senior Citizens	
		G	B	G	B	W	M	W	M	W	M
1.	Cartoons										
2.	Movies										
3.	Soaps / Mega Serials										
4.	Comedy										
5.	News										
6.	Sports										
7.	Educational / Science										
8.	Musical										
9.	Horror / Thriller										
10.	Detective										
Total Viewing Time											

G = Girls B= Boys W = Women M = Men



Discussion

Ask each group to use the survey data and data compiled in the table to answer these discussion questions.

Number of viewing hours per week by

School children

College students

Employed Non-senior citizens

Non-employed

Senior citizens

The per cent of people that watch *Doordarshan* channels. And per cent of the sample that has cable connection.

The per cent of people that have a cable connection.

The per cent of people that watch movies in theatres and multiplexes.

Category of programme -

that has maximum viewer ship / airing time

that has minimum viewer ship / airing time

Reasons?

The category of programme that is watched by all.

Ask each group to make a presentation of their finding. Are there significant differences between the findings of different groups? What could be the reasons?

Ask students what kind of programmes they think school children should watch and why.

Let each group make a plan regarding the use of TV for creating social awareness. (programmes on HIVAIDS, hepatitis, or polio vaccination, rainwater harvesting), by choosing appropriate time slots, programme categories and channels (depending on the survey results). Their aim should be to reach the maximum number of appropriate target audience (students, adults, home makers, mothers, etc.). They have to substantiate their decisions by citing data or examples from their survey.

8 KITCHEN CHEMISTRY

Focus

Gases

Subject

Chemistry

Place

Classroom

Duration

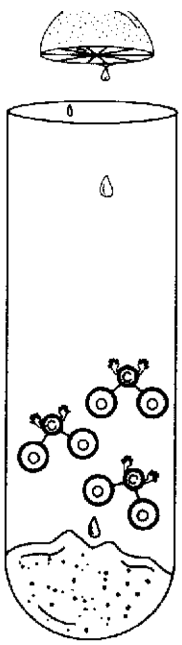
20-30 minutes

Group Size

4-6

Materials

Baking Soda, several liquids (like lemon juice, vinegar, water, milk, curd) filter paper / litmus paper, 3-4 test tubes per group, writing material.



Objective

To learn about the production of Carbon dioxide (CO_2) gas and some of its properties.

Activity

Ask the students to take some baking soda in a test tube and pour one of the liquids on it (lemon juice, vinegar, water, milk or curd) Then wet a strip of blue litmus paper and place on the mouth of the test tube and note colour change, and tell, them to record the observations. Let them clean the test tube, and repeat the same with another liquid.

Discuss the whole procedure and the changes that took place. Baking soda is Sodium bicarbonate (Na_2CO_3). When it reacts with acid (vinegar) Carbon dioxide gas is produced. Carbon dioxide gas being weakly acidic in nature, turns the blue litmus red. Carbon dioxide reacts with water to form a weak acid known as Carbonic acid (H_2CO_3).

Another property of Carbon dioxide can also be shown by placing a burning match stick in the mouth of the test tube, The flame will be extinguished, Carbon dioxide will not burn or support combustion, Air with a carbon dioxide content of more than 10 per cent will extinguish an open flame.

Discussion

Application of properties of this gas in our day-to-day lives can be discussed. Some of the common uses include fire extinguishing systems; use as raw material for production of various chemicals and treatment of alkaline water; carbonation of soft drinks.

Initiate a discussion on how CO_2 is formed naturally by combustion and biological processes including decomposition of organic material, fermentation and digestion; that it is also produced due to human activities like burning fossil fuels; what problems does excess carbon dioxide in the atmosphere lead to and how is it linked to Greenhouse effect.

9 CHANGING COLOURS

Focus
Indicators
Subject
Chemistry
Place
Classroom
Duration
30-minutes
Group Size
6-8
Materials
Turmeric powder, watchglass, clean rag, soap solution, soda water, Calcium carbonate, solution, lemon juice and tomato juice (all these items for each group).

Objective

To enable students to learn about indicators using an easily available indicator - turmeric.

Activity

Divide the students into groups. Give one watch glass and small amounts of the listed materials to each group.

Now tell them to take a small amount of turmeric powder on the watch glass and add 2-3 drops of soap solution to it and note the change in colour.

After this, ask them to clean again the watch glass, dry it and take some fresh turmeric powder.

Ask them to add the other materials mentioned, one by one, and record the observations in the table. They should clean the watch glass and take fresh turmeric powder before adding any new substance.

Indicator: Turmeric powder
Colour : Yellow

[redacted]		
Yellow	Soap solution	
Yellow	Soda water	
Yellow	Calcium Carbonate solution	
Yellow	Lemon juice	
Yellow	Tomato juice	

Discussion

Substances that are basic in nature change the colour of turmeric to red, whereas substances that are acidic help regain its colour.

10 SEPARATING COLOURS

Focus
Chromatography
Subject
Chemistry
Place
Classroom
Duration
20-30 minutes
Group Size
4-6
Materials
Filter papers, black ink, dropper, a pair of scissors and water.

Objective
To observe the separation of different substances in a drop of black ink.

Activity
Ask the students to make groups of 4-6. Give each group a filter paper and ask them to cut the Alter paper in a circular shape (a minimum of 8 cm radius). Now ask the students to put a drop of ink in the centre of the paper. Ask them to wait for a while till it gets soaked in and then put a drop of water exactly on the same spot, and wait. Add one more drop if required, and let the paper dry on its own. Circular coloured bands spreading away from the Centre will be seen. The bands expand with time. You may ask students now;

What do they conclude from this experiment?

Do they observe more than one colour in the paper?

Why did the colour bands appear?

Most non-permanent inks are made of coloured pigments and water. In the above experiment, as the Alter paper absorbs the ink mixed with water, the mixture travels through the paper. The drop of water acts as a solvent that dissolves the pigments. As the water travels up the paper, it carries the pigments along with it. Different coloured pigments are carried along at different rates. Hence we get the coloured bands.

The colours which make up black ink have different solubillties. The most soluble ink spreads through the filter paper while the less soluble ink will travel more slowly. Different colours in the black ink will separate quickly.

Extension
You could demonstrate another technique called column chromatography by placing a drop of ink on a chalk piece.

Discussion

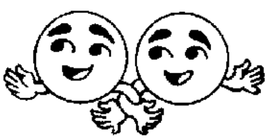
The experiment described above is a separating technique called paper chromatography. Chromatography is a process used to separate different substances from a mixture of liquids or gases. It is an important technique used in chemical analysis and is used to separate substances in small concentrations, such as pollutants in air. It is used in forensic science too.

You could explain more uses of this technique.

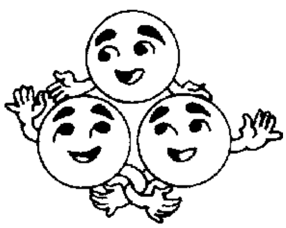
11 HOW MUCH OZONE?

Focus
Atmosphere
Subject
Chemistry
Place
Indoors
Duration
30-minutes
Group Size
Individual
Materials
Cardboard covers of old notebooks, scissors, a 30-cm ruler, gum, string, table, writing material.

Oxygen atom



Oxygen molecule



Ozone molecule

Objective

To understand how little ozone there is in the atmosphere and visualize the tiny amount in the context of the atmosphere.

Activity

Ozone is made up of three oxygen atoms, and is a naturally occurring gas found in the earth's atmosphere. Ozone molecules make up a sparse layer in the upper atmosphere (stratosphere) which is about 15-50 km above earth's surface. This is called the ozone layer. This layers acts as a protective layer shielding the earth from harmful UV radiations.

About 90 per cent of the ozone molecules are present in stratosphere, but are spread they and unevenly, The total number of ozone molecules in this layer is very small compared to other molecules.

Tell the students that this activity would give them an idea of the proportion of ozone in the stratosphere. Ask the students to measure the length (1), breadth (b) and height h) of the underside of a table in centimetres. 1 x b x h gives the volume of the underside space of the table in cubic centimetres (cm^3)

For example, if the dimensions of the table are
l = 70 cm
b = 60 cm
h = 77 cm

Then, the volume of the table is 70 cm x 60 cm x 77 cm = 323400 cm^3
Now ask the students to do a simple ratio calculation equating the volume of the table to the atmosphere. If out of 10, 00,000 parts, 10 parts are ozone, which is the case, how much out of the 3,23,400 cm^3 would be ozone?

(3,23,400 x 10) / 10, 00,000 = 3.23

Thus about 3 cm^3 represents the volume under the table occupied by ozone.

Now, to understand the proportion of ozone molecules as compared to all other gases in the stratosphere, ask them to cut out squares of 1cm x 1cm from a cardboard cover. Let them stack these to make 1 cm high cubes and stick them together with the glue. This is a cube of 1 cm^3. These cubes represent units of ozone.

Tell them to suspend the proportionate number of cubes, three in this case, on pieces of string from the underside of the table. These represent the amount of ozone that would be present if the underside of the table were to represent the stratosphere. Remember that the remaining space is not empty but filled with other gases, oxygen, nitrogen, etc.

Discussion

There are only one to ten units of ozone for every million units of gas or particles in the stratosphere and ozone in measured in parts per million (ppm).

This little ozone in the stratosphere has a vital role to play. Ozone absorbs the bulk of solar UV radiation which is harmful to living creatures. Thus the ozone layer acts like a protective umbrella.

This natural protective shield - the ozone layer- is being destroyed by human activities, thereby decreasing the ozone levels in the upper atmosphere. This process by which ozone is reduced is called ozone depletion. Ozone depletion is caused by ozone depleting substances (ODS) like chlorofluorocarbons (CFCs), and halons.

Where are these substances used? Find out more about them.

12 REFLECTING ON ANGLES

Focus
Reflection
Subject
Physics
Place
Indoors
Duration
20-30 minutes
Group Size
Entire Class
Materials
Two plane mirrors of the same size, protractor, chalk sticks, pencils and scale.

Objective

To observe the images formed by two plane mirrors.

Activity

You could demonstrate this activity to the whole class. Make the following types of arrangement using two plane mirrors of the same size on your table.

First draw a 90^0 angle on the table with the help of a chalk piece, protractor and scale.

Place the two mirrors upright on this angle as shown in the figure.

Call a student to the table and ask her to look at her image at the place where the two mirrors meet. Tell all students to note down the number of images.

Now ask the student to raise one arm or close one eye and note down the image type (real or virtual)
Then change the angle to say, 30^0. This time, place a pencil in the middle and ask the students to note down the number of images. Repeat for 45^0 and 60^0 angles.

Discussion

The following would be observed:

90°	3
60°	5
45°	7
30°	11

Lead students to observe that the relation between the angle between the mirrors and the number of images formed can be given as (360 / n) - 1, where n = angle between mirrors.
What will the number of images when the angle between the mirrors is 180^0
What is the difference between the image formed by one plane mirror and that formed by two plane mirrors?

13 OSCILIATING COLOURS

Focus
Fluid Mechanics
Subject
Physics
Place
Indoors
Duration
30-minutes
Group Size
Entire Class
Materials
1 small transparent plastic bottle (mineral waterbottle) which can be closed, 1 big transparent plastic jar (diameter at least 10 cm and height at least 14 cm) per group. 1 big bowl (of same capacity as the small plastic bottle); 1 paper pin or sewing needle, salt (2 kgs approx) potta sium permagnate or any other coloured chemical which can be dissolved in water, freshwater.

Objective

To understand the way two different fluids mix with one another.

Activity

Ask the students to fill half of the bowl with water. Then ask them to add salt little by little to this water and dissolve it well until the solution becomes 'saturated'.

Now, ask them to add a little potassium permanganate or any other substance to impart colour to the saturated salt solution.

Then ask them to fill the bigger plastic jar three-fourths with fresh water.

Take the smaller plastic bottle and punch two pinholes spaced about half Centimetre apart at the bottom, and fill this bottle with the salt-water solution prepared earlier. Do not fill completely. Close its mouth with its lid. Very gently immerse this bottle in the bigger jar such that the bottom of the bottle goes in first. Observe what happens.

Observation

The following will be seen:

There will be an alternating exchange of solutions i.e., the salt solution will flow down through the pinholes of the bottle, and the fresh water from the jar will flow up.

The 'oscillations' (exchange of solutions! may occur every 3-4 seconds. Both the solutions will eventually mix, but in a very interesting way.

Discussions

Saturated salt solution is heavier than freshwater. When a lighter fluid supports a heavier fluid, instability develops. This instability is known as Rayleigh Instability. The exchange of fluids takes place eventually in intervals.

INTERFERING WITH LIGHT

Focus
Interference (Physics / Optics)

Subject
Physics

Place
Outdoors / Indoors

Duration
30-minutes

Group Size
8-10

Materials
A glass slide, two razor blades, a candle, an electric bulb and coloured transparent sheets (red, green, blue)

Objective

To demonstrate the phenomenon of interference.

Activity

Hold the glass slide over a candle flame so that a thin uniform layer of soot is deposited.

Take two razor blades. Stick them together. Using this, carefully make a cut mark along the width of the glass plate through the layer of soot. Two thin slits very close to each other should be visible on the layer of the soot.

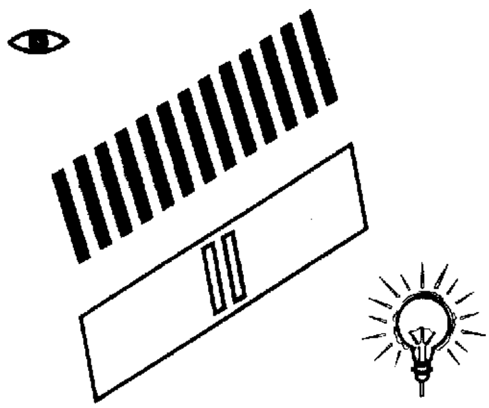
Ask a student to hold the glass slide close to the eyes (2-3 cm away approximately), and look through the silts at an illuminated electric bulb.

What do they observe?

After this, ask the students to hold out their index finger and middle finger, so that there is a very thin gap (slit) between the two fingers. Then ask them to look at an illuminated bulb or tube through this slit.

What do they observe?
Ask them to cover the candle bulb with differently coloured transparent sheets, one at a time, and ask them to observe the pattern of light through the silt formed by the two fingers.

The pattern of bright and dark bands seen is due to the phenomenon known as interference.



Extension

In the same way as mentioned above, try to look at white light (mercury bulb or tube light) through two thin silts. See whether seven colour bands can be observed.

Discussion

Discuss the phenomenon of interference and ask students the name of the scientist who first conducted this experiment to understand interference.

A film of oil floating on water or the thin film of a soap bubble that reflect a spectrum of beautiful colours when illuminated with light, are some of the best examples of interference. Here the waves reflected from the inner and outer surfaces of the him recombine, interfere with each other resulting in a dazzling display of colour that seems to gyrate along the surface of the bubble.

Ask students why a compact disc (CD) surface produces a spectacular rainbow-like effect of colour when ordinary light is reflected from the surface. The closely spaced spiral tracks on a CD contain a series of pits and lands that mimic the ultra-fine lines present on a diffraction grating (A large number of parallel, closely spaced silts constitutes a diffraction grating.) to produce such an effect.

Interference is responsible for the often-brilliant iridescent colouring displayed by humming birds, a variety of beetles and several species of butterflies whose wings cast a metallic lustre.

15 LIFT AND DRAG

Objective

To understand how Bernoulli's Principle is applied in the design of an airplane's wings and how it helps the plane to fly.

Activity

Distribute one sheet of chart paper to each pair.

Instruct them to make a dotted line as shown in Fig 1 and fold and crease at the dotted line.

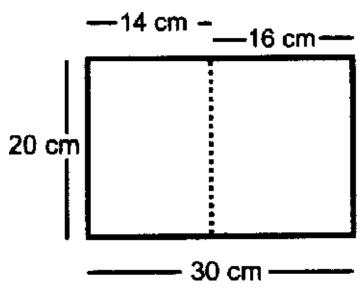


Fig 1

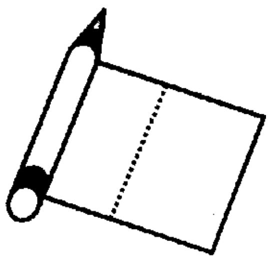


Fig 2

Let them then open the paper and put a pencil on the edge of the longer side and roll it down up to the dotted line. (as in Fig 2). Then let them take out the pencil and release the paper.

Now ask them to stick the shorter (20 cm) edges of the paper together, using glue or tape, so that they get the shape shown in Fig 3. They will get the shape of an aerofoil, which looks like a part of an airplane's wing. The upper surface of this aerofoil is curved and the lower surface is flat, and the front end is curved and thick.

Ask the students to cut their 80 cm thread in half, and then using a needle, thread it through the aerofoil at two places about 2/3rd from the leading edge. (As in Fig 3)

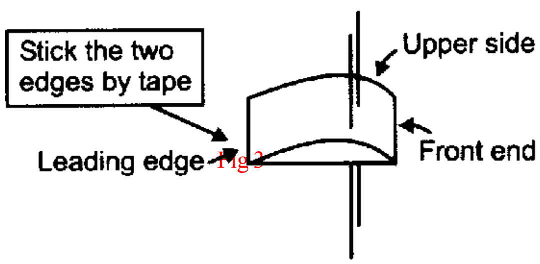


Fig 3

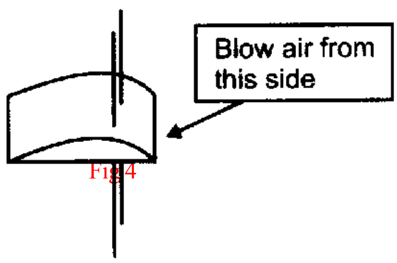
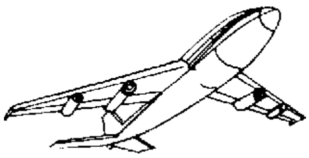


Fig 4



Ask one student to hold the thread so that the aerofoil is Suspended vertically with the curved part up. Another student should blow above the curved edge. (Fig 4)
Ask the students to observe what happens.

Extension / Variation

Ask students to make two aerofoil from sheets of paper of dimension 8 cm x 5 cm each.
Now ask them to take two broom sticks of equal length from a broom and join them to make a T shape using tape or thread (Fig 5).
They could also use plastic straws instead of broomsticks.

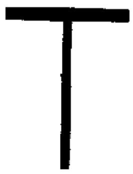


Fig 5

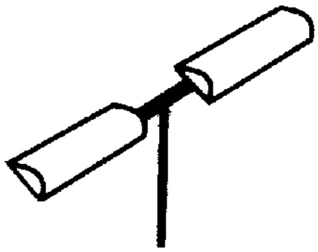


Fig 6

Ask them to apply adhesive glue on the horizontal straw stick and insert an aerofoil from each end of the horizontal straw. They should face opposite sides and the curved surface of the aerofoil should be on the upper side. (Fig 6)

Then, ask the students to hold the vertical straw between their palms, churn between the palms and let go of the toy.

Ask them to observe its motion.

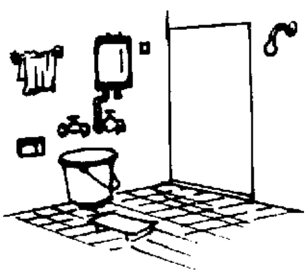
Discussion

Bernoulli's principle explains the pressure differences on each surface of an aerofoil, which gives lift to the wing of an aircraft and how it is put to use in such a design.

Discuss Bernoulli's principle [a rise (fall) in pressure in a flowing fluid must always be accompanied by a decrease (increase) in the speed, and conversely, if an increase decrease) in, the speed of the fluid results in a decrease (increase) in the pressure.]

16 STEPS TO A HOT BATH

Focus
Generation of Energy
Subject
Science
Place
Indoors
Duration
30-minutes
Group Size
5
Materials
Writing material



Objective
To help students understand the various steps in energy generation and also analyze and rate various energy resources on the basis of their environmental impacts.

Activity
Let students list all the sources of energy required to heat a bucketful of water for a hot bath. (Please note that electricity is a form of energy and not an energy resource).
Ask the students to think of the various steps involved in converting different sources of energy into a source of usable energy. Some resources like firewood may not need any conversion for direct use. But many other resources like coal, natural gas and nuclear material have to be mined in the first place and transported for refining enriching to allow further use. This and energy generation require large infrastructure. This will help them realize that all energy resources must be processed and converted by machines and other kinds of equipment into usable energy for end use. This would involve many steps /stages.

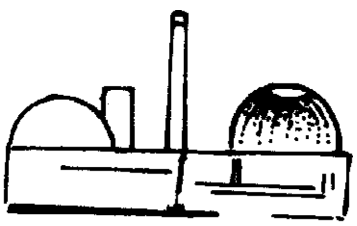
Help students list the ecological and other consequences of various stages of energy production which are seldom taken note of. Some of these are:
- Energy itself is consumed in each stage of energy production (e.g. mining coal requires equipments that run on diesel, petrol and electricity).
- Also, these activities pollute natural resources like air, water, soil and the constituents of the natural environment. Waste is generated in large quantities in this process. The pollutants and wastes affect human health too.
- Energy generating set-ups may be sources of potential hazard. For instance, a nuclear plant is a threat to the area around; a dam impounding huge amounts of water could breach and inundate low lying areas.

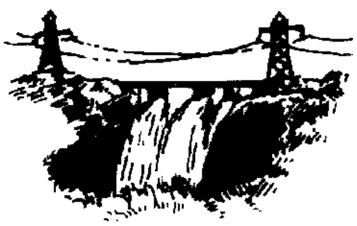
Now, draw the Energy Source-Steps-Consequences matrix on the black board. The columns represent energy sources, while the rows discuss associated factors. Assign one energy resource to each group.

Let them discuss within the group which of the steps and consequences identified and listed in the matrix are applicable to the energy resource given to them. After 10 minutes, one from the group could come to the board and put a cross mark against each applicable stage and consequence. Tally the number of crosses. The number of crosses for an energy source is indicative of its degree of deviation from an ideal source.

Energy Source - Steps - Consequence Matrix

	Source steps / consequences	Coal	Oil	Natural gas	Hydro-electric	Wind	Firewood	Geo-thermal	Solar / Nuclear
	Mining / Harvesting								
	Transporting								
Steps	Enriching / refining								
	Generation								
	Transmission								
	Large Infrastructure requirement								
	Waste generation / dispossal								
	Pollution								
	Disruption of ecosystems								
Consequences	Human health								
	Potential hazards / risks								

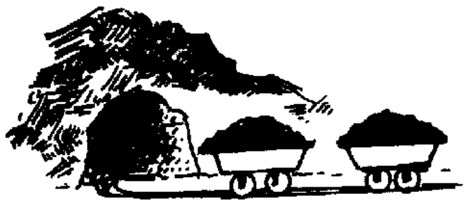




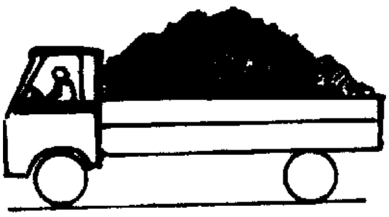
Discussion

Discuss why in spite of having energy sources that are dependable, renewable, safe and environmentally sound, today's primary sources are natural gas, oil and coal which are non-renewable sources. What are the barriers to using renewable sources like wood, biogas, and water with potential energy, geothermal sources, solar energy and wind energy?

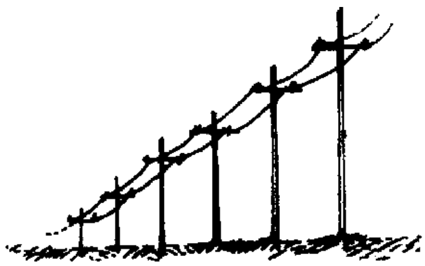
What are the key elements for sustainability of any energy resource?



MINING



MINING



MINING

WASTE AND POLLUTION

17 WHAT AM I PAYING?

Focus
Energy
Subject
Science / Social Science
Place
Indoors
Duration
A day for making observations and 30 minutes for doing the activity
Group Size
Individual
Materials
Writing material

Objective

To understand the concept of work unit cost and the fact that for each family member's energy-wasting habits, some other family member has to work more to meet the costs.

Activity

Tell students that there are several ways to look at how much things cost us. The cost of an item is not solely the amount marked on the price tag, in terms of rupees and paise. In fact, it also possible to think of expressing the cost of an item as the amount of time that one must work to earn enough money to pay for the goods and services needed or desired.

Tell the students that 'work unit cost' is the number of hours an individual must work to pay for a particular goods or service. It is calculated by dividing the cost of an item by the hourly rate of pay that the individual earns.

Example

A person earns Rs. 10,000 a month for 8 hours of work everyday. If the person purchases a bicycle for Rs. 2,500, the work unit cost of the bicycle would be calculated as follows:

Wage per hour = (Monthly wage No. of days per month) hours of work per day
= (10,000 / 30) / 8
= (333.33 / 8)
= Rs. 41.7 hr.
Work unit cost = Cost of the item divided by wage per hour
= 2500 / 41.7
= 59.95 hours
= 59 hours and 57 minutes.
Hence the person has to work nearly 60 hours to pay for the bicycle.

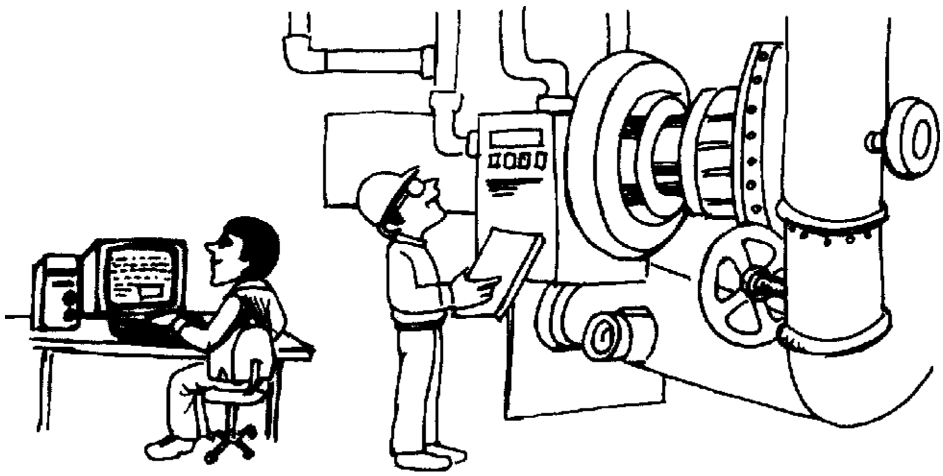
Tell the students that they need to look at the cost of every item as not just the amount marked on the price tag, but also as the amount of time their parents must work to pay for the goods or services needed or desired.

Now, ask the students to observe carefully and list all the energy-wasting habits of the members of the family. Ask them to look at the electricity bill for their home and calculate the 'work unit cost' and number of hours their parents would have worked to pay that.

Discussion

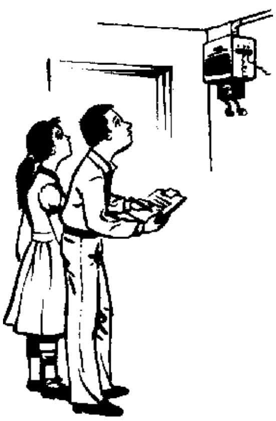
Initiate a discussion with the students on how many hours of work are being spent on wasteful energy habits, so that they may become more conscious of energy conservation.

Let them share this information with all in the family; and tell them how many hours of work their parents have to do towards meeting the same.



18 THE WISE SHOPPER

Focus
Energy Efficiency
Subject
Science
Place
Indoors
Duration
A day for observations, and 30 minutes for doing the activity
Group Size
Individual or in groups
Materials
Writing material, copies of the "Wise Shopper" table.



Objective

To understand the importance of energy efficiency in making purchase decisions.

Activity

Ask the students to list down that product features they would look into if they had to buy an electrical appliance. What other features besides the price would affect their purchase decisions with regard to such items?

List all these features on the black board. If energy efficiency has not come up in the list, ask how many think it is important.

Tell the students that it is wattage ratings of an appliance that actually help to compare the energy efficiency of different model. Wattage ratings determine the energy efficiency which is necessary in order to conserve energy.

Tell them that the total cost of an appliance is the initial cost plus the operating cost. It can be calculated using the wattage consumption of any appliance.

Take up the following example to calculate the total cost of a refrigerator on the board.

The task is to And out which is a better buy between the two refrigerators described: a model “A” that costs Rs. 10,000/- and consumes 300 W for every hour used, or a model “B” that costs Rs. 15,000/- and consumes 200 W for every hour used. A refrigerator will last approximately for 15 years. Assume the cost of electricity to be Rs. 3.50 per kWh (one unit) and that the refrigerator is operated for 24 hours a day.

STEP 1 Calculate the energy consumed in a year by multiplying the wattage of the appliance with the number of hours used per day and by the number of days in a year.

Model “A” would consume 300 x 24 x 365 = 26, 28,000 W or 2,628 kWh or 2,628 Units.

Model “B” would consume 200 x 24 x 365 = 17, 52,000 W or 1,752 kWh or 1,752 Units.

STEP 2 Calculate the annual operating cost by multiplying the wattage consumed in a year with the cost per unit.

The annual operating cost of Model "A"

2,628 x 3.50 = Rs. 9, 198 /-.

The annual operating cost of Model "B"

1,752 x 3.50 = Rs. 6, 132 /-

STEP 3 Compare the total cost (the initial cost plus the operating cost over the appliance's life time) of the two appliances.

The total cost for Model "A"

10.000 + (9, 198 x 15) = Rs. 1, 47,970 /-.

The total cost for Model "B" is

5,000 + (6,132 x 15) = Rs. 1, 06,980 /-.

The difference: Rs. 1,47,970 - Rs. 1,06,980

= Rs. 40,990 /-

This calculation tells us that since a refrigerator will probably last 15 years, the model 'B" whose initial cost was more by Rs. 5,000/- would in fact work out cheaper by Rs 40,990/- in the total cost. Thus, Model "B" is the better buy.

Discussion

Through discussions elicit how energy efficiency needs to be taken into consideration not only at home, but also in schools, workplaces, areas of worship, etc.

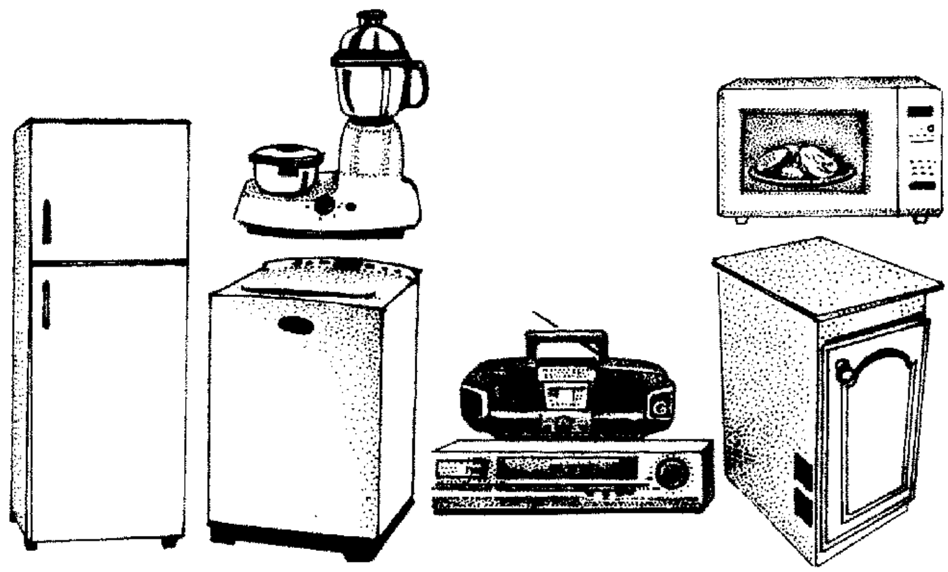
Tell students to collect wattage details of various appliances that they have at home and list in the table Wise Shopper', and do the necessary calculations. [Wattage details are usually in the instruction manual of all appliances, and also often on the appliance, near the power chord of the appliance or at the bottom). This will give an idea on how much power is being consumed by these appliances. You can use the details logged in this table when you have to buy another appliance, and also share the information with Mends and neighbours to help them make better choices.

Wise Shopper

Appliance	Brand	Model	Initial Cost	Operating Cost for 10 years (or its expected life)	Total Cost

Home Appliances

Appliance	Type	Wattage Rating	Running Time For Consumption of One Unit of Power
Bulb	Incandescent CFL	60W 15W	16 hours 40 minutes 67 hours
Air Conditioner	1 - 1.5 tonnes	1500 W	40 minutes
Refrigerator	Ordinary 165 litres Frost Free 165 litres	225 W 350 W	4 hours 45 minutes 2 hours 52 minutes
Water Heater	Instant Geyser Storage Type Immersion Rod	3000 W 2000 W 1000 W	20 minutes 30 minutes 1 hour
Washing Machine	Semi-automatic Automatic	210 W 230 W	4 hours 45 minutes 4 hours 20 minutes



19 A BOX OF SUNSHINE

Focus

Non Conventional Energy

Subject

Science

Place

Indoors and Outdoors

Duration

30-minutes to 1 - hour plus cooking time

Group Size

5 - 6

Materials

For each group: two cardboard cartons (The first box should be approx. 38 cm x 38 cm, and of height 25 cm. The second box should be approx. 31 cm x 31 cm and about 3 cm shorter than the first box), corrugated sheet, one sheet of cardboard to make the reflector (43 cm x 43 cm) silver foil (one roll), dull black paper, flower clips, thick transparent plastic sheet, scotch tape.

Objective

To enable students construct a lightweight portable solar cooker and use it, and list the advantages and disadvantages of cooking food in a solar cooker.

Activity

Help the students to build a solar cooker according to the instructions given. This model of solar cooker is based on having one box inside the other. The larger box of dimensions 38 cm x 38 cm x 25 cm will serve as the outer box, and the box of dimensions 31cm x 31cm x 22 cm will serve as the inner box.

Instructions for making the solar cooker;

1. Paste silver foil on all the inside surfaces of the larger box.
2. Also paste foil on the inside and outside of the flaps (lid) of the outer box.
3. Paste black paper on the bottom of the inner box. On all the other inner surfaces of this box, paste silver foil.
4. Cut off the flaps of the inner box.
5. Make four 'legs' for the inner box by folding four pieces of corrugated sheet and pasting near the four corners at the bottom of the box. The height of the legs should be about 3 cm.
6. Place the smaller box inside the larger one. If the height of the inner box is more than that of the outer box, trim as necessary to bring them to the same height.
7. Fold the flaps of the outer box such that they cover the gap between the outer and inner boxes and can be folded down 2 cm into the inner box.
8. Hold tight and tape down securely, so that there is no gap. If there is extra length, trim it.
9. Now, cut a piece of corrugated sheet (approx. 42 cm x 42 cm) large enough to make a tight fitting lid for the outer box (38 cm x 38 cm).
10. Cut out a window of the size of the inner box (31 cm x 31 cm) from this piece of the sheet. Tightly tape a piece of thick transparent plastic over this window.

11. Paste silver foil on the inside of the lid (except where there is plastic).

12. Now fold and tape the edges of the corrugated sheet to make a tight fitting lid.

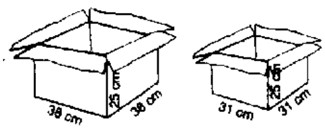
13. Take a piece of cardboard of 43 cm x 43 cm size to make a reflector. Paste silver foil on the inside.

14. Make hinges of cardboard and attach with flower clips to the lid and the reflector.

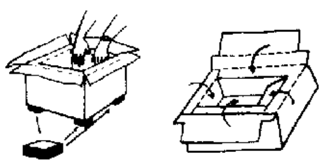
15. Take a piece of cardboard of 15 cm x 12 cm and make serrations as shown in the illustration.

16. Tape securely, at the angle shown, to the outside of the box.

17. Make a firm prop using a folded piece of cardboard or a stick. The prop should be long enough to hold up the reflector at 90^0. The solar cooker is ready to use.

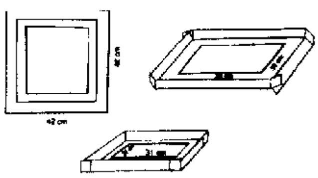


18. Set up the solar cooker where there would be no obstruction of sunlight through out the day. You may have to turn the cooker to allow continuous stream of sunlight while cooking.



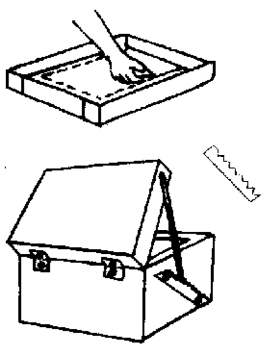
19. Cook kichchdi (take rice and *moong* dal in 2:1 ratio, wash them clean, add Ave measures of water) or rice (wash the rice clean and add two measures water for every measure of rice) in the cooker. Do not cover the dish.

Discussion



Discuss how a solar cooker can prepare food efficiently and at the same time promote good health and wise energy use.

Ask the students to list advantages and disadvantages of using a solar cooker.



Ask each of the students to describe their experience with the solar cooker to their parents, and discuss with their parents the possibility of using a solar cooker at home.

20 MAPS AND SCALES

Focus

Mapping and Scale

Subject

Geography

Place

Indoors

Duration

30-minutes

Group Size

5

Materials

Map of an area, writing material, a full length photograph of a person close to a building.

Objective

Students will learn about scale and its use importance.
Students will learn how to use scale to determine the size of objects.
Use a map scale to find distance on a map.

Activity

Tell the students that 'Scale' on a map is the ratio of distance between two points on the map and the corresponding distance on the ground. A map scale usually is given as a fraction or a ratio. For example, if 1 cm on the map represents 1 km (1,00,000 cm) on the ground, then the map's scale is 1 : 1.00,000.

Ask the students to find a full-length photograph of themselves, standing close to the building, so that the complete building shows in the photograph.

Explain that in the photograph, their size and the size of the building have been proportionately reduced to fit them on the photograph.

Ask them to find out by bow their image size on the photograph is reduced as compared to their actual size. This ratio is the scale of the photograph.

Ask the students to mention the scale on the photographic image. Let them calculate the height of the building by using this scale.

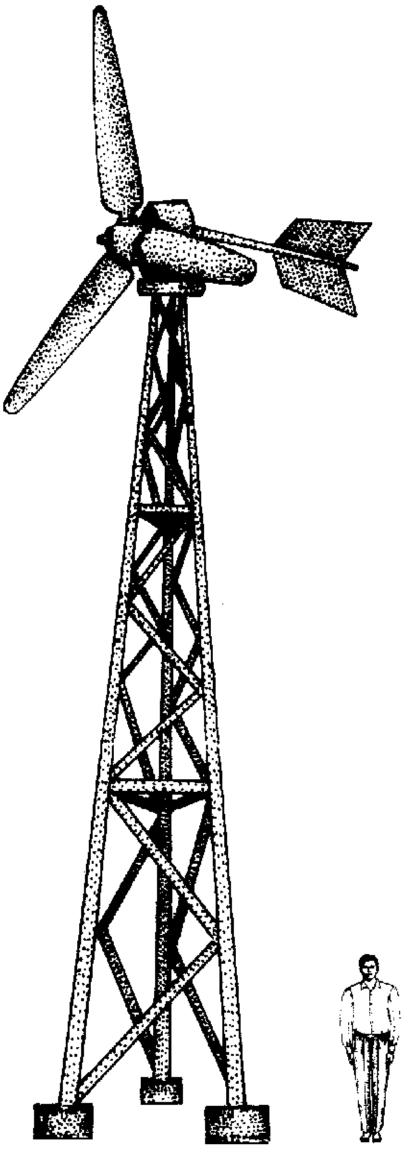
Point out the scale in the legend on maps. Suppose a distance of 1-cm on the scale equals 'X' km on the ground. You may want to show the students that by dividing the number of centimetres on the map by the scale gives the distance between two points in kilometres, e.g., if the distance on the map is 4 cm, and the scale is 1:1000, then, 1 cm on the map equals 1000 km, and actual distance is (4 / 1000) = 4000 km.

Explain to the students that one reason why people use maps is to find the distance between two places. Demonstrate how they can use the scale to measure the distance between two places on the map and calculate the actual distance between these two points on the ground.

Extension / Variation

Select some items found in the background of the photograph like mountain, valley, monuments, buildings, tree, etc.

Let the students use the concept of scale to determine the size of these features. Are they correct in their estimates? Tell them the importance of all objects remaining in the same plane and equidistant from the camera to get the actual size. This is why their calculations will be inaccurate. Objects in the background and their images are not on the same plane. A rectification has to be carried out.



21 JUST PASSING THROUGH

Focus
Soils
Subject
Science
Place
Indoors
Duration
30-40 minutes
Group Size
4-5
Materials
Two transparent 2-litre bottles (e.g. soft drink bottles) a 500-ml. beaker, a mug or a tumbler (you can also cut and use lower half of any plastic bottle), 4 different types of soils (sandy loam, sand, gravel, clayey soil, garden soil, or any other type from around the school or home), fine mesh of 1-mm or lesser size - such as a nylon net or a piece of muslin cloth, sturdy tape, scissors, water, pH paper, stopwatch or wristwatch with a seconds hand.

Objective

To develop an understanding of the relationship between soils, types of soil and permeability, water retention, etc.

Activity

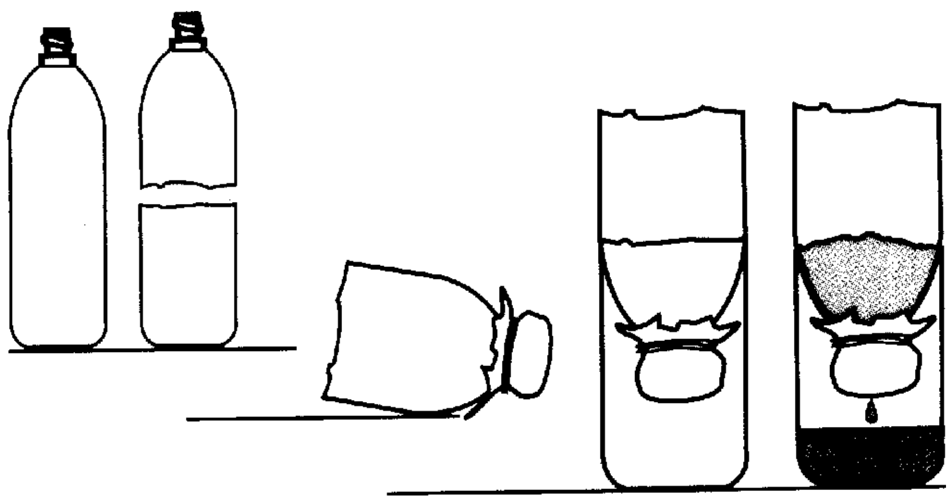
Remove the label and lid of a 2 litre plastic bottle and cut the top off to make an opening of radius 3 cm, Now cut the bottle into two halves. The top half (when inverted) is to be used as a funnel and the lower half is the container into which the water will flow. Cover the smaller opening of the funnel with a piece of nylon net or muslin and fasten with tape. Place the funnel, mesh side down, on the lower half of the cut bottle. Alternately, you could use a 500 mi. beaker as the container.

Choose a soil sample (sandy loam works best for demonstration) and fill up to two-thirds of the funnel with it.

Measure 300 ml of water into a beaker and record both the pH and amount of water. Ask the students to note the clarity of the water. Ask them what would happen if this water was poured the water onto the soil.

1. How much water will flow into the bottom container?
2. How much time will the water take to pass through soil?
3. Will the pH of the water change, and if so, why?
4. What will the water look like when it comes out?

Now pour the water onto the soil, Ask one student to keep a note of the time and record how long it took the water to pass through the soil.



Let each student observe as you pour the water, and note down in her / his notebook.

1. Is all the water staying on top or moving down?
2. Where is it going?
3. Are there air bubbles at the top of the water?
4. Does the water coming out of the soil look the same as the water going in?
5. What is happening to the soil structure, especially at the soil surface?

Measure the amount of water that moved through the soil into the container or beaker. Ask students:

1. What happened to the water that is missing?
2. How has the clarity of water changed after it has passed through the soil?

Ask the students to test the pH of the water that has flowed through the soil. Compare the results with the pH of the water that was poured into the soil. Ask students:

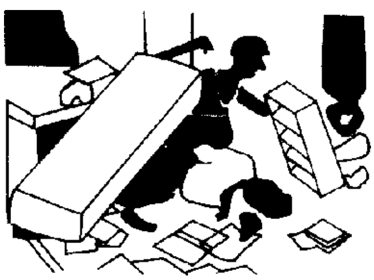
1. Did the pH change?
2. If so, what might have caused this change?

Different groups may do the same experiment taking different soils and discuss the results of their experiment in the class. Their presentation should include observations regarding the points given above, as well as their conclusions about the factors that affected the soil and the water.

Let them focus their observations soil characteristics (physical; particle size, texture, permeability, porosity, colour, chemical; pH) as well.

WHAT'S A DISASTER?

Focus
Disaster Management
Subject
Science / Geography
Place
Classroom
Duration
35-minutes
Group Size
Entire Class
Materials
Paper, pen, scissors, chart paper.



Objective

To help students understand different aspects associated with a disaster and to make them aware of the several types of disasters.

Activity

Students should know that disasters can occur both due to natural and human-made causes.
Make a list of disasters likely to take place in your area.
Develop around 10 cards each related to a disaster. Each of the cards would have information pertaining to some aspect of the disaster. (Some suggested information for some disasters that could go on the cards is given in the box.) The information provided could be either a single word or a sentence.

Ask the students to make a circle. Thoroughly mix the cards associated with all disasters and place them in the centre. Now ask the: students to come forward and pick up one card each. After everybody finishes picking up a card each one has to read the message on his / her card. They now have to move around and identify other team members from the class to form a group with information pertaining to their particular disaster. For example, students with the cards: 'Richter scale', 'earth shakes', 'building cracks', 'intensity', 'epicenter', 'stay under a table or cot', 'keep a safe distance from electricity poles', etc., would form the earthquake group.
There would be some common factors that cut across most disasters e.g., loss of property, loss of human and animal life, etc. Students drawing these cards can join any of the disaster groups. Once the students have all identified their groups, they must develop a chart with the relevant information about the disaster they represent. The chart could have information on the cause of the disaster, the impacts, the response time for rescue and relief, how the impact could have been reduced, what are the learnings, planning for the future, etc. The chart may then be presented to the entire class.

Extension / Variation

Pin a card with the name of the disaster on the back of a student without revealing it to the student. Let the tagged student go around so that the entire class gets to see the name of the disaster. Let the tagged student ask questions that can be answered either as yes or no. To every question asked, the class responds by saying yes / no.

The tagged student has to eliminate the various possibilities and then narrow down on to the correct answer. The number of questions allowed, or the duration which the student with the card takes to ask a question, can be varied according to the situation and the level of difficulty of the question.

Disasters: Key Points

Earthquake: Richter scale, earth shakes, movement of tectonic plates, big cracks on earth's surface, building cracks, intensity, epicentre, buildings collapse, people dead, stay under a table or cot, keep a safe distance from electricity poles, seismograph, P waves, S waves, column and pillar constructions, load-bearing structure, etc.

Tsunami: Harbour wave, Richter scale, epicenter, coastal areas, earthquakes and volcanoes in oceans, rushing waves appearing as a series of towering walls of water that can level buildings, waves travel at the speed of more than 800 km hour, fishing communities, beach resorts, islands, also called 'killer waves'.

Flood Cyclone: Wind speed, low pressure development, hurricane, swept away, submerged houses, spread of epidemics, dead cattle floating, marooned people, food packets, aerial survey, coastal areas affected, houses blown away, bunding, etc.

Drought: Low rainfall, parched agricultural lands, dying cattle, average rainfall, drought relief, water harvesting, water conservation, silos, drought-resistant crops, cattle shelters, bunding, migration of people and cattle, cloud seeding, etc.

Landslide: Torrential rains, falling boulders, loose soil, increase vegetation on slopes, road blockade, quarrying, deforestation, etc.

Industrial disaster: Gas leak, inhalation of toxic gases, chemical tanker overturned, chemicals flowing on the road, Bhopal gas tragedy, awareness about what happens around / in industries, accident preparedness, first aid availability, knowledge of antidotes, etc.

23 WHO IS RESPONSIBLE?

Focus
Disaster Management
Subject
Science/ Geography
Place
Indoors
Duration
35 - minutes
Group Size
4 - 5
Materials
Copies of newspaper clippings, paper, pen.

Objective
To help students understand that human factors amplify the impacts of natural calamities.

Activity
It is important for students to understand that while earthquakes, cyclones, etc., will occur and nothing can stop them, human actions make these into worse tragedies than they need to be.

Put up the statement 'Who is responsible for 1500 deaths in the disaster?' Distribute photocopies of the news clipping provided at the end of the activity or identify and cut out any other similar news clipping.

Make four or Ave groups of students. Tell the groups to act as groups of lawyers who are paid to put the blame on one particular 'villain'. Give each group the 'villain' they will be trying to accuse. This list could include: nature; builders; politicians; municipality; citizens; etc., (depending on the news report).

Give the groups about 15 minutes to prepare their arguments. Call one person from each group to present the arguments, as it happens in a court.

After the exercise, discuss the question as a single group and try to reach a consensus. Stress that there are two aspects of investigations and discussions at times of tragedy—one is to bring to justice those who are responsible, and the other, to learn for the future.

Ask them, from the discussion above, to draw up and list out what they have learnt for the future. Discuss how these might be put to action.

Extension / Variation

Ask the students to become planners for a day. Ask them to plan to reduce the impact of a specific disaster on their city village in the future.

Sample reports of Disasters

1,500 feared killed in Gujarat quake

By Manas Dasgupta

AHMEDABAD, JAN. 26. At least 1,000 people were feared killed, including about 300 in Ahmedabad city, and several thousands injured in an earthquake which struck Gujarat this morning. Several hundreds were also rendered homeless. The Army was called in to assist civic authorities in the rescue and relief operations in Ahmedabad and some other parts. (A PTI report said the toll was over 1,500.) An official spokesman said the toll was expected to go up further as thousands were still trapped under the debris of fallen buildings in several towns.

(According to PTI, the entire northern belt experienced tremors while “vibrations” from the severe quake were felt even as far south as Chennai. Mild tremors were also felt in Kolkata, Shillong, Agartalaand Nepal.)

The quake, said to be the second strongest in the last 50 years in anypart of India, measured 6.9 on the Richter scale, with its epicentre about 20 km northeast of Bhuj, district headquarters of Kutch, lasted several seconds.

Communications hit

The Kutch and Saurashtra regions were said to be the worst affected and with the communication network badly hit, only sketchy reports reached the State headquarters. According to initial reports, at least 160 persons were killed in Bhuj, about 155 in Rajkot, 100 in Morbi, 87 in Jamnagar, 55 in Surendranagar, 25 in Porbandar, 30 in Wankaner, about 40 in Palanpur, 28 in Patan and about 10 each in Broach and Navsari. No information was available from rural regions.

Bridge develops cracks

At least 150 buildings, including about a dozen high-rise structures, collapsed in different parts of Ahmedabad. By evening, at least 247 bodies had been recovered and rescue work was in full swing. The Nehru bridge, one of the six major bridges over the Sabarmati linking the old city with new Ahmedabad, developed a major crack in the middle, forcing the authorities to suspend traffic. There was hardly a building left in the city and many other parts of the State which had not developed cracks. Action by authorities averted a collapse of the western power grid after several power plants in the State collapsed.

The Hindu

Tsunami kills thousands across nation

By Our Bureau and agencies

CHENNAI, DEC. 26. Huge seismic sea waves, triggered by a massive undersea earthquake off Sumatra in Indonesia, left over 9,300 people dead and tens of thousands homeless in India, Sri Lanka and South-East Asia on Sunday. The earthquake, which had its epicentre 257 km south- southwest of Banda Aceh, Sumatra, measured 8.9 on the Richter scale making it the most powerful in the world in the last 40 years. At least 2,200 people were killed in and around Sumatra by floods and collapsing buildings, officials said. But, most of the destruction was caused by seismic waves or tsunami that hit India, Sri Lanka, Malaysia and Thailand within two hours of the first impact of the quake.

Fishermen, tourists and people living on the coast were unprepared for the waves that rose as high as six metres (20 feet) throughout the Indian Ocean and the Andaman Sea. In India, more than 3,000 people were killed in Tamil Nadu, Pondicherry, Andhra Pradesh and Kerala. Tamil Nadu alone accounted for 1,705 deaths. The toll is expected to rise. In Chennai, early morning walkers and children playing cricket on the beach were washed away. The toll: 131. Nagapattinam was worst hit in the State with the toll put at 788. In Kanniyakumari, 392 people died.

Late reports said at least 1,000 people had died in the Andamans. Pondicherry reported 280 deaths, 211 in Karaikal alone. In Kerala, at least 100 people have died. The toll in Andhra Pradesh was 84.

Sri Lanka, whose capital, Colombo, is 1,806 km west of the epicentre, suffered extensive damage with reports putting the number of people killed at 4,500. One million more were affected by the surging seawater that flooded coastal towns including Colombo. The Government called Sunday's events a national disaster and appealed for emergency relief.

Nearly 300 were confirmed dead in Thailand, among them holiday revellers from around the world. The toll in Malaysia was 428, including foreign tourists. Thousands of people, mostly fishermen, were reported missing.

The United States Geological Survey recorded the magnitude 8.9 earthquake off Sumatra as lying centred 10 km below the seabed. Aftershocks struck in the magnitude 7 range.

The earthquake was the world's fifth most powerful since 1900 and the strongest since a 9.2 temblor slammed Alaska in 1964, U.S. earthquake experts said. The quake occurred at a place where several massive geological plates push against each other with massive force. The survey said a 1,000-kilometer (620- mile) section along the boundary of the plates shifted, motion that triggered the sudden displacement of a huge volume of water.

The force of it shook unusually far afield, causing buildings to sway hundreds of miles away, from Singapore to the city of Chiang Mai in northern Thailand, and in Bangladesh. At least 2 children were killed when a boat capsized in Bangladesh, local authorities said.

The Port Blair airport in Andaman and Nicobar islands was damaged and it will not be operational for at least a month. However, flights have not been affected in Chennai and other cities.

Railway tracks on the east coast of India were also damaged in the tsunami and train services have been suspended in some sectors.

The Hindu

24 WHEN DISASTER STRIKES…

Focus
Disaster Management
Subject
Geography / Language
Place
Indoor
Duration
35-minutes
Group Size
Entire Class
Materials
Writing material, erasers and colours.

Objective
To help students express their perception of the past and present, and their vision of the future, in the event of a disaster.

Activity
Tell the students that in this activity, they are reporters who report for various newspapers. Their task is to compile news articles (stories) for the main page. At the end of this activity, they have to write and present articles that appear on two successive days.

Day 1
On day 1 they have to report a disaster that has hit their town on the evening of the previous day. The disaster has caused loss of life and destruction of property. Several people have been injured. All support services have also been disrupted. They have to report this disaster as it would appear on the main page on the day after it occurred, and one day later.

Day 2
They would need to feature the disaster and its after-effects; the response of people, government, international community, NGOs, etc. Let them bear in mind that a lead story of the day has photographs and prominent headlines, along with brief write- ups on the first page.

Tell them to look up various newspapers to see how news is organized on the main page. Let them also observe how many news items feature on the main page. Ask them to note the proportion of space allocated or photographs.

Variation
Past, present and future scenes of a disaster can also be represented by drawing and painting. The three scenes (before, during, and after) could be depicted on three separate sheets. An interesting way to depict could be a bird's eye view of the place struck by a disaster.

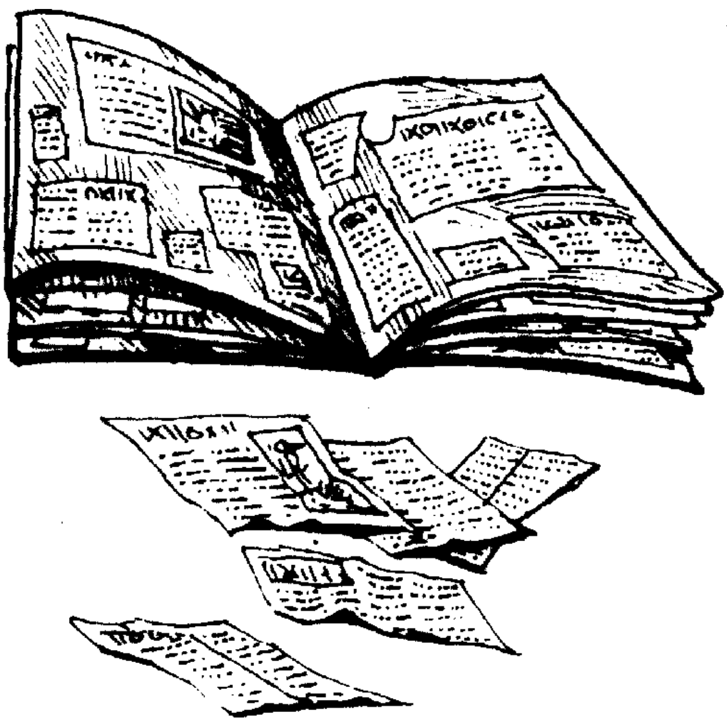
Once the students have completed the work, the creations may be put together onto a large sheet under the relevant titles, e.g., ‘X: Before the Disaster, X: After the Disaster’, and ‘My dream X of tomorrow’. Each student group can explain their creation. Writing essays or making a newspaper collage are some other ways to do the same activity to understand how disasters affect people and places.

Discussion

Highlight how emergency preparedness is crucial for reducing impacts of disasters.

What an: the services that students think are essential for relief operations?

Ask the students to put together a Disaster Management Plan for the community Panchayat District.



25 'DROP, COVER AND HOLD'

Focus
Disaster Management/ Earthquake
Subject
Geography
Place
Classroom
Duration
35-minutes
Group Size
Entire School / Class
Materials
Dishes, pans, sticks, etc. to generate sound effects.

Objective

To help students practice a mock earthquake drill.

Activity

Explain that a mock earthquake drill is going to be undertaken.

A mock drill helps people to be prepared and to react properly in an emergency and follow a disaster preparedness plan. By conducting or participating in a mock drill, people learn to react quickly and move to safety when a disaster strikes.

Direct students to practice the following actions when they hear the cry "Earthquake! Drop, Cover and Hold,".This is the memory jolting clue that students should respond to as quickly as possible.

The Drill:
a. Get under a table or desk.
b. Turn away from the windows.
c. Put a hand on the back of your neck.
d. Tuck your head down.
e. Hold on to the legs of the table or desk and be prepared to move with it.

To make the simulation more effective, appoint student helpers. Ask one student to dick the lights on and off several times, and then turn them off. Appoint another to act as timer for this activity. Designate students to help create earthquake sound effects, such as:

· Rattling glass
· Scraping desks
· Scraping tables
· Opening drawers
· Barking dogs
· Meowing cats
· Books falling
· Trees scraping the building
· People shouting
· Babies crying

· Bricks falling (drop several pencils)
· Doors banging shut
· Hanging plant falling (drop an unbreakable dish or pan)

When the drill begins, students given the task of making sound effects initiate their activity. Other students follow the "Earthquake! Drop, Cover and Hold" instructions during the simulation.

Repeat the simulation a second time, selecting different students to provide the effects, so that each student has an opportunity to practice the "Earthquake! Drop, Cover and Hold" procedure.

Take time after the simulation to let students discuss the actions and clarify doubts.

Encourage them to ask questions and discuss their fears and concerns, including the unpleasant, worried and frightened feelings that they might experience.

Mock drills need to be conducted periodically.

Note: It is not recommended excusing children with special needs from participating in earthquake drills. Children who are visually or aurally challenged, or have impaired mobility, especially need experiences which build confidence in their ability to avoid and cope with dangers. Plan with parents, other teachers and students to determine quake-safe actions for these children.

It may not be possible for children with impaired mobility to get under a desk or table. They can, however, learn to react quickly and turn away from windows; move away from light fixtures and unsecured bookcases; and use their arms or whatever is handy to protect their heads. If the child is wheelchair-confined, you might suggest attaching a hard hat on the wheel-chair, such that it is accessible to the child if the ground starts shaking.

Discussion

Ask students to come up with disaster preparedness and response plans for the school and family. Select the disaster— floods, cyclones, fires, landslides, or industrial accidents depending on the area they live in. Discuss the plans with the family, community or residents of the housing society. Conduct periodic mock drills.

26 TRACKING A CYCLONE

Focus

Weather

Subject

Geography

Place

Classroom / Home

Duration

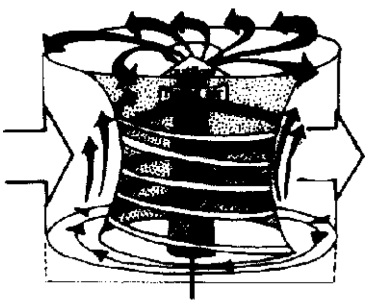
35-minutes

Group Size

Entire Class

Materials

Map of India, writing material.



Objective

To understand how cyclones are traced by the meteorological department and how cyclones change their path.

Activity

Ask the students to listen to radio and television weather reports for some days, preferably during October to December or April-May. If development of a low-pressure area or a cyclone is reported, mark the position of the cyclone on the map along with the date. Also, they must note down the direction or place where the weather office predicts the cyclone is headed. Let them keep listening to watching the news for the next few days. Every day, ask them to mark the position of the cyclone, with date and its predicted course.

Let them note down these readings until the cyclone has withered down. Observe how the cyclone moved. Did it follow the path as predicted'? Discuss how difficult it is to predict the path of a cyclone and hence its exact place of landing. Discuss with students cyclones of different categories.
Tell them to make posters for cyclone preparedness based on the tips, and put these up in the school

Tips for Cyclone Preparedness

· Plan where you would stay during the cyclone, at home or in a cyclone shelter.
· Stay indoors during cyclones. Do not venture out as cyclones are accompanied by winds that could snap electric lines, uproot trees and displace rooftops.
· Stock food and other necessities like food, water, medicines, and batteries to run transistors and torches at home. You may not get a chance to move out during the cyclone.
· Monitor radio and TV broadcasts on updates of cyclone regularly.

Cyclones Severity Categories

Cyclones are classified into the following categories based on the wind speed, in the ascending order of their severity.
1. Depression: 32-50 km/h
2. Deep Depression: 51-61 km/h
3. Cyclonic Storm: 62-68 km/h
4. Severe Cyclonic Storm: 89-117 km/h

The risk of property and crop damage, shore erosion and danger to life increases with each category. Using this severity scale, communities must assess the degree of the cyclone threat to take appropriate action.

Discussion

Who is at risk in case a cyclone hits? Identify ways to alert communities, establishments and visitor's recreation spots and places of worship along the coast. Also find out what else could be affected by the cyclones.

Variation

Given with this activity are satellite pictures of India when there was a cyclone in the Bay of Bengal along with the weather report. Let the students study the report and note how the cyclone travelled in the Bay.

Depression over Bay
CHENNAI, OCT. 2.

A depression has formed over southeast Bay of Bengal and lies centred this morning at 0830 hours IST about 750 km east southeast of Chennai. It is likely to intensify further and move in a north-westerly direction. Rainfall occurred at a few places over Tamil Nadu, Kerala, Lakshadweep, Karnataka, Rayalaseema and Telangana. Isolated rainfall occurred over coastal Andhra Pradesh. Chickanavahanahalli Tumkur dt.) recorded a heavy rainfall of 9 cms.

Depression moves north-west
CHENNAI, OCT. 3.

Yesterday's depression over southeast Bay of Bengal moved North-westwards and lies at 0830 hours IST of today over west central Bay of Bengal about 500 inn. Northeast of Chennai. It is likely to intensify further and move in a north-westerly direction and cross Andhra coast between Machilipatnam and Kallngapatnam by Monday afternoon.

The southwest monsoon has been vigorous over Kerala and active over north interior Karnataka. Rainfall occurred at most places over Kerala, Lakshadareep and coastal Karnataka, at many places over interior Karnataka, and a few places over Tamil Nadu and Andhra Pradesh.

Thundershowers likely in Tamil Nadu
CHENNAI, OCT. 4.

Yesterday's depression over West central Bay of Bengal moved north wards and now lies centred at 0830 hours IST of today the 4th October 2004 about 50 km south of Kallingapatnam. It is likely to intensify further and move in a northerly direction and cross north Andhra coast near Kalingapatnam by today afternoon. Southwest monsoon has been vigorous over Kerala and coastal Andhra Pradesh and active over Telangana and south interior Karnataka.

Rainfall occurred at most places over Kerala, Lakshadweep, Coastal Karnataka and coastal Andhra Pradesh at many places over Telangana and south interior Karnataka and a few places over Tamil Nadu, north interior Karnataka and Rayalaseema.

Source: Online edition of the Hindu newspaper.

27 WINDS OF CHANGE

Focus
Weather
Subject
Geography
Place
Indoor
Duration
30-minutes
Group Size
Entire Class
Materials
Photocopies of the figures, writing material.

Objective

To understand the relation between pressure and wind speeds, and to be able to draw isobars.

Activity

Air, in the form of wind, moves from areas of high pressure to low pressure. The speed of the wind depends on the difference in air pressure between two points. Greater the difference in pressure, greater is the wind speed.

Isobars are lines drawn through paints of equal atmospheric pressure and so connect places of equal air pressure. These are shown on weather maps. Air pressure is measured in hectopascals, with isobars normally drawn at intervals of two hectopascals. If isobars are close together, this means the pressure difference between two points is great and therefore the winds will be strong. If they are apart, winds will be lighter.

Also, due to the Coriolls Effect caused by the rotation of the earth, winds do not move in a straight line, but are deflected. Due to this, the wind circulation in the Southern hemisphere is clockwise into the centre of a low pressure area, and anti-clockwise out from the centre of a high pressure system. The opposite occurs in the Northern hemisphere.

Discuss this with students, and following that, ask students to study the following figures carefully and answer the questions given below:

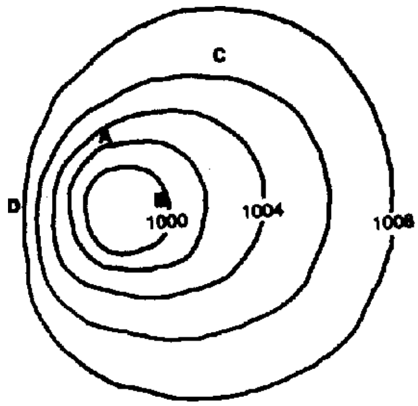


Fig 1

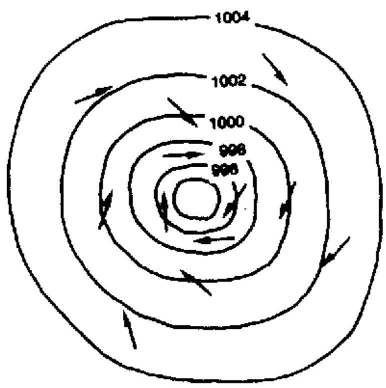


Fig 2

Q1. Which of the locations in Fig 1 has the highest air pressure?
A B C D
Q2. Which of the locations in Fig 1 has the lowest air pressure'?
A B C D
Q3. Which of the locations in Fig 1 has an air pressure of reading of 1003 hectopascals?
Q4. Which of the locations in Fig 1 is likely to experience the highest wind speed?
A B C D
Q5. Which of the locations in Fig 1 is likely to experience the lowest wind speed?
A B C D
Q6. Is the pressure system shown in Fig 2 from southern or northern hemisphere3 Give reasons.

Discussion

Weather maps are designed to depict the horizontal pressure distribution across an area of land, but atmospheric pressure also varies vertically, i.e., with altitude. To eliminate any consideration of the vertical variations of pressure, the barometer readings at all stations are reduced to their corresponding sea-level pressures before the isobars are drawn.

Isobars are used to define cyclones (low-pressure regions) and anticyclones thigh-pressure regions).

Winds get deflected due to earth's rotation which sets up an apparent force, called the Coriolls force, which pulls the winds to the night in the Northern Hemisphere (and to the left in the Southern Hemisphere). So when a low pressure starts to form north of the equator, the surface winds will flow inward, trying to fill in the low pressure and will be deflected to the right and a counter-clockwise rotation will be initiated. The opposite (a deflection to the left and a clockwise rotation) will occur south of the equator.

28 WEATHER CLUES

Focus

Weather

Subject

Geography

Place

Indoor

Duration

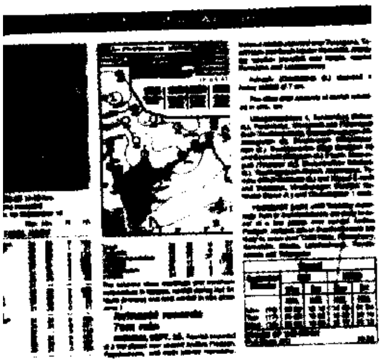
1 hour

Group Size

5

Materials

Graph paper, map of India, coloured pencils and ruler.



Objective

To help students correlate weather parameters to geographical location.

Activity

Divide the class into Ave groups. Make one copy of each of the five data sets.

Assign one data set to each group, but ensure that they do not know which place that data pertains to. Ask them how they could most effectively and appropriately depict the different data given to them, Bar graph for rainfall data and line graph in two different colours for maximum and minimum temperatures may be appropriate. Based on the discussion, ask each group to represent their data graphically.

Let each group study the data represented graphically and note:

i. The highest and the lowest temperatures recorded

ii. The months that record highest /lowest temperatures

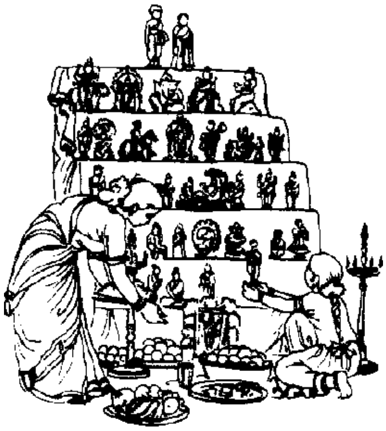
iii. The highest rainfall recorded and

iv. The months which record high rainfall and their number.

Now, ask each group to guess the region their meteorological data is likely to represent. Let them bear in mind that weather of a place is determined by its latitude, altitude and its distance from the coast (inland or coastal), etc. 'More clues' given with data sets will be helpful. Make the table given here on the board and ask each group to All it with the information pertaining to their data set.

Now, disclose the station to which that the data belongs. Ask each team to present the findings to the class describing how they tried to correlate the given weather data to arrive at the conclusion. Ask them to point out the station on the India map, and provide interesting facts related to the climate and weather of that region.

	Group 1	Group 2	Group 3	Group 4	Group 5
Monthly recording highest temperature					
Monthly recording lowest temperature					
Monthly recording highest rainfall					
Our guess about the region is that this station belongs to					
And the station is...					



Discussion

Everything about a place is influenced by weather. Weather is the condition of the atmosphere at any given time with respect to such factors as temperature, humidity, barometric pressure, wind speed and direction, precipitation and cloudiness. Averaging the weather pattern for a particular region or location over long periods of time (approximately 30 years), gives us the climate of the place. Climate of a place influences the biodiversity (plants, animals and microbes), agriculture, architecture, local customs and traditions, festivals, the kind of clothes people wear and the food they eat.

Data set 1

Month	Mean Temperature ^{0}C		Mean Total Rainfall (mm)	Mean Number of Rain Days
	Daily Minimum	Daily Maximum		
Jan	20.6	28.4	16.2	-
Feb	21.2	29.9	3.7	-
Mar	23.1	31.9	3.0	-
Apr	25.9	33.6	13.6	-
May	27.6	36.4	48.9	-
Jun	27.2	36.6	53.7	4
Jul	25.9	34.7	97.8	7
Aug	25.3	33.9	149.7	9
Sep	25.3	33.5	109.1	7
Oct	24.3	31.4	282.7	10
Nov	22.8	29.2	350.3	10
Dec	21.6	28.1	138.2	6

More Clues

1. Bharatanatyam is the classical dance form of this region.
2. Pongal is a harvest festival celebrated in the state to mark the withdrawal of the Southeast monsoon and when the sun passes from one Zodiac sign to another. Pongal is a sweet dish made out of rice, paruppu (pulses) and jaggery during the festival.

Data Set 2

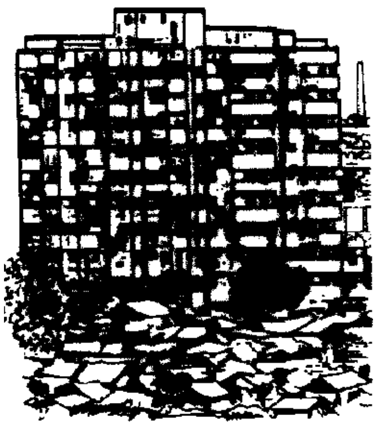
Month	Mean Temperature °C		Mean Total Rainfall (mm)	Mean Number of Rain Days
	Daily Minimum	Daily Maximum		
Jan	16.4	30.6	0.6	-
Feb	17.3	31.3	1.5	-
Mar	20.6	32.7	0.1	-
Apr	23.7	33.1	0.6	-
May	26.1	33.3	13.2	-
Jun	25.8	31.9	574.1	15
Jul	24.8	29.8	868.3	24
Aug	24.5	29.3	553.0	22
Sep	24.0	30.1	306.4	14
Oct	23.1	32.9	62.9	3
Nov	20.5	33.4	14.9	-
Dec	18.2	32.0	5.6	-

More Clues

1. This place has three railway lines — Western, Central and Harbour, all of which get paralysed due to water-logging during monsoons, bringing life in the megapolis to a virtual halt.

2. People relish a favourite delicacy, 'til gul' during the festival Makar Sankrant. (Makar Sankranti is celebrated in the month of Magha when the sun passes through the winter solstice from the Tropic of Cancer southwards. It takes 6 months for the sun to move from the Tropic of Cancer to Tropic of Capricorn.)

3. The River Godavari rises in the hills in this state.



Data Set 3

Month	Mean Temperature °C		Mean Total Rainfall (mm)	Mean Number of Rain Days
	Daily Minimum	Daily Maximum		
Jan	7.8	22.5	7.9	-
Feb	10.7	25.7	11.7	-
Mar	15.8	31.5	6.1	-
Apr	21.4	37.0	4.1	-
May	25.4	40.3	16.2	-
Jun	27.2	39.3	66.0	4
Jul	25.5	33.9	216.3	11
Aug	24.3	32.0	231.2	12
Sep	22.9	33.2	80.3	5
Oct	18.6	33.4	22.6	-
Nov	13.1	29.0	3.2	-
Dec	9.1	24.4	3.3	-

More Clues

1. This region has the oldest mountain range in our country.

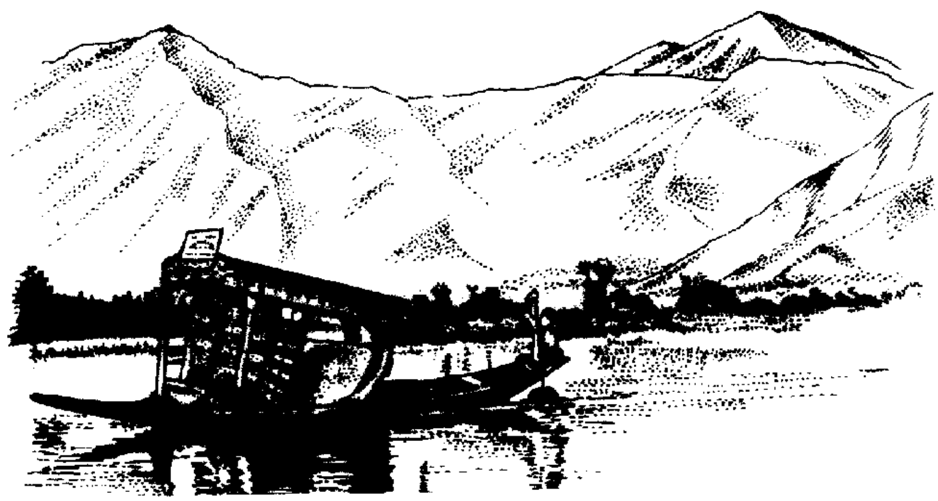
2, This region has a relatively dry climate with precipitation insufficient for many trees or shrubs to grow, The absence of greenery and lack of colours in their surroundings is compensated by the people who wear colourful clothes.

Data Set 4

Month	Mean Temperature °C		Mean Total Rainfall (mm)	Mean Number of Rain Days
	Daily Minimum	Daily Maximum		
Jan	-2.3	4.7	56.5	5
Feb	-0.6	7.8	64.9	5
Mar	3.8	13.6	98.5	8
Apr	7.7	19.4	87.5	7
May	10.7	23.8	71.9	6
Jun	14.7	29.2	37.2	3
Jul	18.2	30.0	48.7	4
Aug	17.5	29.7	69.7	5
Sep	12.9	27.8	33.3	3
Oct	6.1	21.9	36.4	2
Nov	0.9	14.7	27.0	2
Dec	-1.6	8.2	43.3	3

More Clues

1. This state has two capitals, a summer and a winter capital.
2. The weather here is conducive for growing the most expensive spice in the world, saffron.



Data Set 5

Month	Mean Temperature °C		Mean Total Rainfall (mm)	Mean Number of Rain Days
	Daily Minimum	Daily Maximum		
Jan	15.7	7.2	11.0	-
Feb	17.3	8.9	46.0	3
Mar	20.5	12.5	240.0	9
Apr	21.7	14.5	938.0	19
May	22.4	16.1	1214.0	22
Jun	22.7	17.9	2294.0	25
Jul	22.0	18.1	3272.0	29
Aug	22.9	18.2	1760.0	26
Sep	22.7	17.5	1352.0	21
Oct	22.7	15.8	549.0	10
Nov	20.4	12.3	72.0	3
Dec	17.0	8.3	29.0	

More Clues

1. Two places separated by no more than 10 km in this region have been vying to clinch a world record in one of the weather parameters.
2. Despite heavy rainfall, there is a dearth of drinking water in this beautiful place.

Comments

Climatological information is based on monthly normal for the 30-year period 1951-1980for Jaipur, Srinagar, Mumbai and Chennai. Climatological information is based on monthly normal for the 20-yearperiod 1971-1990 for Cherrapunji.

Mean number of rainy days = Mean number of days with at least 2.5 mm of rain ·— indicates less than 2 days of rainfall.

The answers

Set 1= Chennai
Set 2 = Mumbai
Set 3 = Jaipur
Set 4 = Srinagar
Set 5 = Cherrapunji

29 HEALTH AUDIT

Focus
Health
Subject
Science / Social Studies
Place
Classroom
Duration
45-minutes
Group Size
Entire Class
Materials
Writing material.

Objective

To enhance, through an auditing exercise knowledge of common diseases caused due to lack of sanitation.

Activity

An audit is the systematic collection and analysis of information to evaluate the situation and identify existing problems. It is the backbone for planning actions required to deal with problems associated with a system or an issue.

Health audit undertaken periodically in a school or home would help;
1. Assess health status
2. Identify causes to the problem
3. Identify opportunities to prevent illnesses

Let the students do a Health Audit of their class.

Ask them to look into the attendance register of the class and find out how many classmates were absent in the last 4-6 months.

Ask the absentees to recollect why they could not attend school. Alternately, or look up the leave-letters file. You would find that many could not attend school as they were unwell. Take note of what they were suffering from. (e.g., cold and cough, stomach problem, fever, etc.)

Tabulate the information. A table like the one given below could be used.

Name of the student absent	No. of days absent	Month	Illness	Infections?	Possible reason for contracting the illness

Let them analyze if there is any linkage between the time of the year (summer, monsoon, winter), the kind of illness and the number of absentees.

Ask students to make a general list of 'does and don'ts' that should be followed to ward off diseases. Put this up on the class notice board. The advice on the notice board could be modified according to season or at the first indication of an illness that is likely to spread.

How many of the illnesses could be linked to polluted air, water, or those spread by dirty surroundings, garbage, etc.?

How many students were absent because of injuries caused in the classroom, on the playground, etc.?

How many of them remained absent from school because of injuries? What can be done to reduce such injuries?

Extension / Variation

Students can share information on the diseases and their prevention with younger students.
Let students describe the problems they faced because of the illness at school and home.
The students can prepare a "Family Health Report" for the previous three months, noting illnesses and probable causes.

Discussion

Ill health has implications on quality of life and ability to work. There is a cost involved for people and businesses because productive person-days are lost. How do you think ill health affects the earnings and lives of people who are on daily wages?

30 WHO IS HEALTHY?

Focus
Health & Nutrition
Subject
Science / Social Studies
Place
Indoor
Duration
30-minutes
Group Size
5
Materials
Copies of the 'Health list' and 'Health Report'.

Objective
To help understand the factors influencing human health and the degree of control individuals have on their health.

Activity
Make copies of the 'Health List' (see next page), along with the accompanying 'Health Report' format, one for each group of students.

Divide the students into groups of five each.

Give one copy of 'Health List' and 'Health Report' to each group.

Tell the students that they have to make a health report for the people in the list in the given format.

Health Report

Person	Health Status	Causes	Who / What Influence Health Satus?
Woman 30 yrs.	Anaemia	Poor nutrition	Husband

Give the students 15 minutes for the task.

After the groups finish making the report, ask them to rank the persons on the 'Health List' from the healthiest to the least healthy. Students also have to specify the reasons for the ranking they decide upon. They have 10 minutes to complete the ranking exercise.

Ask the groups to present their health reports and the health ranks. The other groups can give their feedback and comments.

Discussion

How is human health influenced by the environment?

In addition to infection, and nutritional deficiency, what are some other causes for ill health, as indicated by the 'Health List'

Are individuals always in control over their own health?

Tell them to keep in mind that the health of an individual may not always be within his / her control. A number of social, political, economic and environmental factors can influence and impact human health, For example, while a person living in a slum may know that boiling water before drinking is good, he / she may not be able to do so due to economic reasons.

Health List

1. 30 year old woman. Mother of six children aged between 15 years and 1 year. Daily wage labourer. Anaemic. Main earning member of the family with an alcoholic husband and an aged mother-in-law dependent on her.
2. 25 year old man. Narcotic addict. Initiated into drug abuse by friends. Has severe withdrawal symptoms when he does not inject the drug. Suspicious of de-addiction centres.
3. 15 year old boy. Rag picker. Poor and illiterate. While rummaging garbage dumps, subjected to chemical poisons and infections. Because of malnutrition, suffers from anaemia. Regularly exposed to hazardous materials. Has to work because his family needs extra income.
4. 50 year old farmer. Uses pesticides without protective gear. Unaware of the harmful effects of pesticides. Unwilling to stop using chemical pesticides due to fear of poor yield and reduced profits.
5. 13 year old girl. Frequently gets bouts of diarrhoea. Lives in a slum settlement, with poor sanitation facilities. The only source of water for 25 households is a single public tap.
6. 55 year old senior executive. Works indoors for 12 hours each day for seven days a week. Highly stressful but sedentary job in a large city corporate office, Most meals consist of rich foods at expensive restaurants. Experiences bouts of depression.

31 WHAT'S ON THE MENU?

Focus

Health & Nutrition

Subject

Science / Social Studies

Place

Indoors

Duration

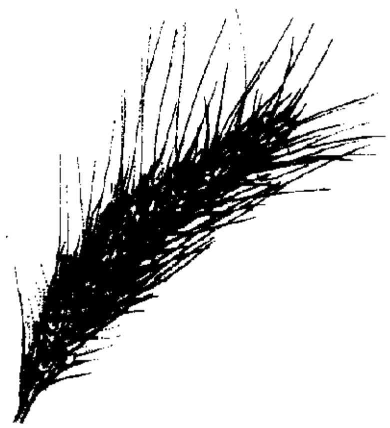
45-minutes

Group Size

6-8

Materials

Food chart and Minimum Requirements chart for display. People Cards and writing material.



Objective

To become aware that people often cannot or do not eat the right type or quantities of food.

Activity

Divide the class into live groups of about 6-8 students each.

Give one 'People Card' (see page 80) to each group.

Display the 'Food Chart' at a location from where all the students can see it. (Ask them to calculate 'Calories per Rupee' and 'Amount per Rupee' and fill up the columns in the 'Food Chart')

Ask each group to read their 'People Card' and prepare a menu for the person on the card, using the food items available on the chart. The group should try to make a menu that meets the calorie and nutritional requirements of the person within the person's budget.

Give the students 15 minutes to complete this task.

Then, ask each group to present their menu to the rest of the class.

Food Chart

Items	Calories per 100 gms	Caloreis per Rupee	Cost per 100 gms	Amount per Rupee
Cereals				
Rice	345		Rs. 1.50	
Wheat	341		Rs. 1.20	
Pulses				
Redgram	335		Rs. 3.00	
Green Leafy Vegetables	51		Rs. 1.00	
Other Vegetables	32		Rs. 1.00	
Roots & Tubers				
Potato	97		Rs. 1.00	
Onion	50		Rs. 1.00	
Milk				
Buffalo milk	117		Rs. 2.00	
Oils	900		Rs. 4.00	
Others				
Sugar	398		Rs. 1.60	

Minimum Nutritional Requirements				
Green Leafy vegetables	100 gms			
Other vegetables	100 gms			
Roots and Tubers	100 gms			
Milk	300 ml.			
Pulses	60-90 gms.			
Cereals	300 - 700 gms			

People Cards

Cut a piece of chart paper into cards of the size 10 cm x 15 cm. Write the following paragraphs, one on each card:

Software professional: 25 year old woman. Works for 9 hours a day. Most of the work is programming on the computer. Spends about 2 hours each day working for home (buying groceries, cooking, etc.). Needs about 1,900 calories a day. Can afford to spend Rs. 100 on her food each day.

Construction worker: 40 year old male. Works for 10 hours a day lifting loads, digging, etc. Needs 3,900 calories a day. Can afford to spend Rs. 15 on his food each day.

Shopkeeper. 35 year old male. Works for 10 hours a day. Much of his work is collecting payments in his shop, sitting at the billing counter. Needs about 2,400 calories a day. Can afford to spend Rs. 50 on his food each day.

Farm labourer: 20 year old woman with a three month old child. Works on the farm (weeding, digging, feeding animals, etc.) for about 6 hours each day, and for the home (collecting fuel wood, fetching water, cooking, etc.) for about 3 hours. Needs about 3000 calories a day. Can afford to spend Rs. 10 on her food a day.

School student: 15 year old. Is at school for 7 hours a day. Plays for 1 hour, attends tuition classes for two hours and does home work for another hour each day. Needs about 2,360 calories a day. Family can afford to spend Rs. 30 on his / her food each day.

Discussion

Which menus were easier to make and which were more difficult to make? Why?

Which of the people in the 'People Cards' could meet their nutritional requirements? Why?

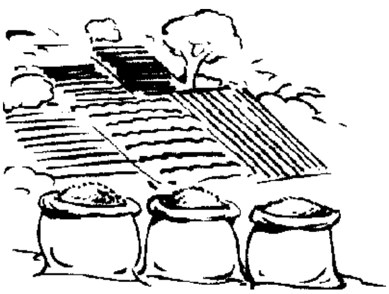
Not all the people featured in the 'People Cards' may be able to meet their nutritional requirements, the main reason for this being lack of purchasing power.

Is there a difference in the type of food chosen for the different people? Why?

Does everyone who can afford it, eat a healthy diet?

32 REAPING WHAT YOU SOW

Focus
Agriculture
Subject
Science / Social Studies
Place
Outdoor
Duration
30-minutes
Group Size
5 - 7
Materials
One Farmer's Card for each group, papers and pencils, Data Sheet for each group, or data displayed prominently.



Objective

To help students understand factors that influence choices made by farmers, which in turn have a bearing on the sustainability of agriculture.

Activity

Divide the students into five groups of about 5-7 students each. Give each of the five groups a different Farmer's Card.

Tell them that they are farmers who have to make a decision on the kind of seeds that they will sow, Display the 'Data Sheet' prominently or give copies to each group.

Data sheet

	Seed Varieties	
	Alpha	Beta
Yield (kg/hectare)	3300	4700
Water Demand	12 units	36 units
Fertilizer Requirement	50 units	90 units
Pesticide Requirement	30 units	20 units
Grain: Straw ratio*	1 : 6	1 : 1

**Grain: Straw ratio is the ratio of the amount of grain produced to the amount of straw produced. The ratio 1: 6 means that for every one unit of grain that is produced, 6 units of straw is produced.*

Tell them that as a farmer, they need to keep the following in mind while making their decisions:

Yield of the crop: Their choice will depend on: the number of members in their families, whether they would like to market their produce, if agriculture is the only source of their income, etc.
Water, fertilizer end pesticide demand: All of these will require expenditures to be made.
Straw production: Their choice will depend on the number of livestock they possess and their ability to buy animal feed if required.
Sustainability: Their choice will depend on their perception whether they can continue farming in the same manner in the future. For example, if they choose a seed variety which needs more water than is naturally available in the area, irrigation may be required, irrigating an arid area may cause the soil to become saline over a period of time and become unproductive.

Give them 15 minutes to make the decision and to list down the reasons for taking the decision.

Ask each group to present their decisions and the reasons behind the decisions. The reasons should not be just the data already given for the seed varieties, but they will need to expand on this.

For example, a statement which says, ‘We chose the Alpha variety because it requires 50 units of fertilizer’ is not valid. The groups have to say something like, ‘We chose the Alpha variety because it requires 50 units of fertilizers. We feel we cannot afford to buy the 90 units of fertilizer that the Beta variety requires.’

Discussion

What factors governed their decision regarding the kinds of seeds they will sow?

What are the kinds of seeds available to farmer’s today?

What governs farmer’s decision about which seed to sow?

Does the choice of seed influence agricultural practices?

Does the choice of seed influence the sustainability of agriculture?

Farmer’s Cards

Cut a piece of chart paper into cards. The dimensions of each should be approximately 10 cm 15-cm. Write the following paragraphs, one on each card:

Farmer 1: You are a poor farmer with one hectare of land. Agriculture on this land is your only source of income. You do not own any livestock. You live in a dry area and are totally dependent on the rains for agriculture. There are six members in your family.

Farmer 2: You are a poor farmer with one hectare of land. You also own two cows and four goats. Produce from the land and the livestock is your only source of income. You live on the plains close to a perennial river, which is the main source of water for irrigation. There are two members in your family.

Farmer 3: You are a middle class farmer with two hectares of land. You also own three cows. The produce from the land and from the livestock are the main sources of your income. You live in an arid area where the availability of water for irrigation and fodder for cattle is a perennial problem. There are eight members in your family.

Farmer 4: You are a middle class farmer with three hectares of land and four goats. You also have a small business. Both agriculture and business contribute to your income. You live in a fertile, well irrigated area. ?here are six members in your family.

Farmer 5: You are a rich farmer with six hectares of land. You do not own any livestock. You have a profitable business in a nearby town. The business is the major source of your income, while agriculture is a secondary source. Your fields are irrigated by water from a canal close by. There are five members in your family.

MEASURING TURBIDITY

Focus
Water
Subject
Science
Place
Outdoors
Duration
40 - 45 minutes
Group Size
Individual or in groups
Materials
A thick stiff plastic sheet; a nylon rope; a cutter; black, whete and red waterproof paint; brush and any heavy object, like a bolt.

Objective
To make a Secchi (pronounced *sek-kee*) disk and measure the turbidity of water.

Activity
Before you begin the activity, tell the students that when the water is muddy and murky, it is said to be 'turbid'. Turbidity affects water clarity and can impede the passage of sunlight through the water.

Ask the students to take a thick plastic sheet, and cut out a circle of 10-cm radius. Now ask them to divide the circle into four quadrants (parts). Paint the alternate quadrants with black and white paint.

Let them bore a hole in the centre of the circle. Attach a rope through the centre of the disk. Tie a heavy object e.g., a bolt, to the underside of the disk to give steadiness to the disk while carrying out the experiment in flowing waters.

Using black paint, tell them to mark the length of the rope at every tenth-of-a-metre. And, mark every one metre increment on the rope with a red line. The Secchi disk is now ready for use.

Now take the students to a water body.

They have to make two readings

1. The depth where the disk disappears
2. The depth where the disk reappears

While taking the readings, let them make sure the Secchi disk hangs horizontally when suspended.
Tell the students to lower Secchi Disk into water until it just disappears (Reading A3 and record the length of rope submerged to the nearest one-tenth metre (i.e., let than note the point where the rope and water line meet).
Next, tell than to raise Secchi Disk until it just appears (Reading B) and record the length of rope submerged to the nearest one-tenth metre where the rope and waterline meet.

The Secchi depth is the average of these two readings. (Add readings A and B, divide by 2)

This gives the limit of visibility in the water body being studied.

Secchi disk measurements are most accurate when taken on relatively calm, sunny days during the middle of the day.

Note: If the disk hits the bottom before dropping out of sight, note this observation and record the bottom depth of the water body.

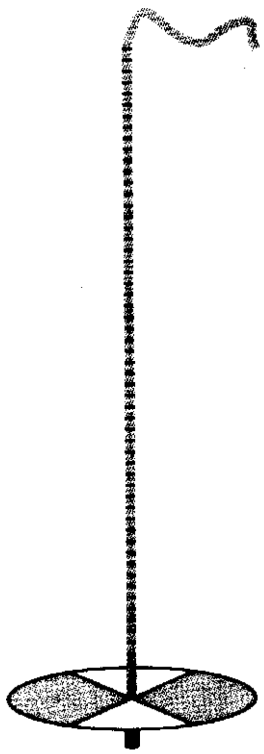
Discussion

Turbidity is a relative measure of clarity of water. Murkier the water, greater the turbidity. It is usually expressed as nephelometric turbidity units (NTU) or as metres depth.

Ask students to list the probable causes of turbidity. Some of the reasons could be soil erosion, waste discharge, and urban runoff, dredging operations along a coast or harbour, or algal growth.

Tell them how water quality is fundamentally important for fish and aquatic plants, and muddy waters limit growth of both.

As turbidity increases, the ability of water to support diverse aquatic life diminishes. Lack of sunlight, caused by too much turbidity can have a detrimental ! harmful affect on aquatic life. Suspended solids may clog the gills of the fish, reduce their growth rates and decrease their resistance to disease.



34 POLLUTION WATCH

Focus
Pollution
Subject
Science / Social Studies
Place
Outdoors
Duration
Spread over a few days
Group Size
4 - 5
Materials
Writing materials

Objective

To become aware of pollution caused by small establishments in a locality.

Activity

With the class, decide a compact area neighbourhood around the school. Ask the students to identify five types of establishment - e. g., workshops, automobile garages, carpentry, electrical workshops, kiosks, hospitals and clinics, tea stalls, restaurants, grocery stores, etc., in this area.

Let each group choose one type of establishment. They must study it in detail and also find out the number of such units in the study area. Ask them to record the type of waste being generated by each type of establishment. Let them make an approximate estimation (this may not be possible if it is gaseous waste) being generated by each unit, and estimate total waste generated by all the units present in one square kilometre radius of the study area. They could use a table like one given here to record their observations.

Type of establishment	Type of waste generated; Solid, liquid, gaseous, hazardous	Estimate of quantity of waste	Number of such establishments in the study area

Discussion

Ask the students to identify some of the possible health impacts of these pollutants.

Tell them to do some library research or take the help of a scientist or a doctor to discuss the impacts of these pollutants.

Discuss how pollutants may be dispersed by wind or flowing water far away from the original source.

Discuss how pollutants also have a harmful effect on the environment (air, water, soil), which in turn affects flora and fauna.

Besides these establishments, what are the other sources of pollution in the area?

Discuss that noise and heat are also forms of pollution.

35 WHY IS THE WATER DIRTY?

Focus
Pollution
Subject
Science
Place
Indoors
Duration
30-35 minutes
Group Size
4-5
Materials
Wall map of States / Country, slips with various pollution related events written on them (see list), stick-on slips of paper, felt pens or coloured marker pens.

Objective

Understand the various sources and types of pollution.
On a State map locate the areas with different kinds of pollution.

Activity

The activity here is based on examples from Gujarat. Events need to be changed depending on the area you would like to do it for.)

Put up a map of Gujarat on the wall. Divide the class into groups of 4-5 students each.

Give each group a slip with a brief description of an environmental event written on it. Each description is also numbered.

Give the groups 15 minutes to discuss among themselves the event, its likely causes, and consequences, the kind of pollution responsible for it, and the possible locations in the State where it could have occurred.

Have one student from each group walk up to the map, take a stick-on slip and write the number corresponding to their slip on it, and stick it on the map at the place where the event could have occurred. Have the students read out the event, and explain why they think that it occurred at the place which they have marked.

It is possible that some kinds of pollution may occur in many places. The students' explanation would therefore help you decide whether to accept or reject the location that they identify on the map.

After the identification ask students from each group explain the causes of the event, the kind of pollution that caused it, the source of the pollution, other areas that are likely to be similarly affected, and its Impact on the environment.

Discussion

How many different kinds of pollution did the various events represent? (e.g., air pollution, water pollution, etc.)

What are the different kinds of pollution that affect different parts of the chosen State / UT?

How many different sources of pollution can they identify? (E.g. vehicular emissions, industrial effluents, sewage, etc.)

Which are the examples of point (i,e., single identifiable source that discharges pollutants— E.g., a chimney of a power plant or factory, the exhaust pipe of a vehicle) and non-point sources of pollution (i.e. large and dispersed areas such as agricultural fields that are responsible for the runoff of fertilizers and pesticides.)

Which instances of pollution are accidental?

Which of the events would affect the largest area? Why?

Which upstream events affect downstream communities and environment? How?

Which do you think are the most polluted parts the chosen State/UT? Why?

What are some of the ways of dealing with pollution?

Discuss control, which includes cleaning up pollutants after they have been produced, and prevention, which reduces or eliminates the production of pollutants through the use of technology, better practices such as reuse, recycling, and the use of less harmful chemicals or processes. Clarify that although both are needed, it is increasingly being realized that pollution prevention pays.

Events

No.1 A major fish kill was reported in a river that has been subjected to agricultural runoff. *(Kheda District or Middle Gujarat)*

No.2 The collapse of a major urban sewer has resulted in the contamination of the municipal water supply, leading to an outbreak of cholera. *(This could be any municipal corporation like Baroda, Ahmedabad, Surat, Porbandar. etc.)*

No.3 Tests reveal high levels of pesticide residue in the droppings of the *Sarus* crane. *(Bharuch / Gandhinagar District, Nalsarovar area of Surendranagar District)*

No.4 An 80-km stretch of this river is covered with pink foam, Part of this scum comes from industrial effluents illegally let out by chemical units into storm-water drains, But what is more worrying is that some of it comes from the Municipal Corporation s Sewerage Treatment Plant. *(Vapi)*

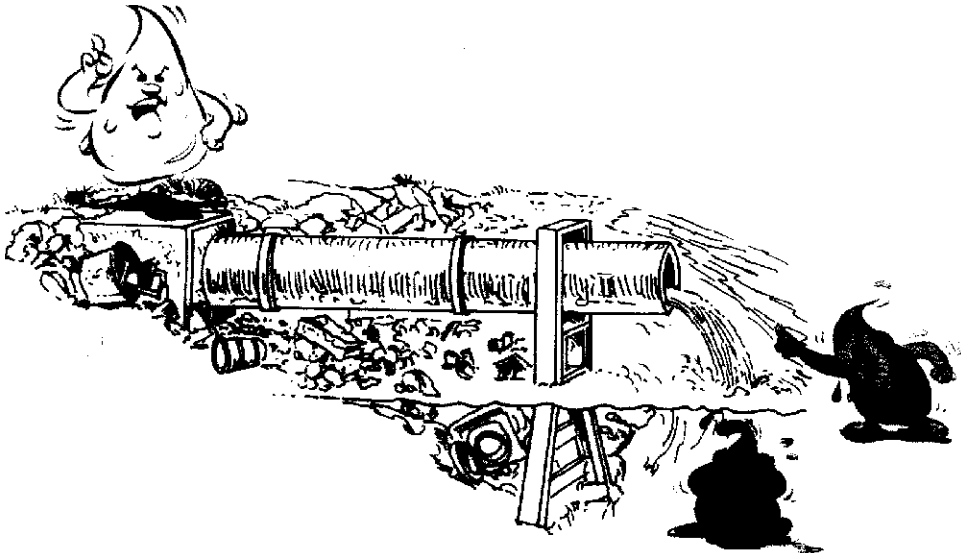
No.5 Excessive pumping of groundwater for the irrigation of the cotton crop has resulted in the ingress of salty sea water into the groundwater aquifer. *(Coastal areas of Saurashtra)*

No.6 The oil remaining in the fuel tanks of large ships brought here to be broken down in the ship-breaking yards, regularly spills into the sea, killing marine life. *(Alang in Bhavnagar District)*

No.7 Salt pans discharging brine and other pollutants in the coastal zone have caused an imbalance in seawater quality and stunted the growth of mangroves. *(Mithapur, Okha District)*

No.8 An Indian pollution survey declared this city as the most polluted in the country, with its air pollution level 300 percent higher than the accepted standards. This city is home to 45, 33,298 two-wheelers and 2, 51,644 three wheelers. *(Number of motor vehicles registered as on 31 Oct 2002 Source: Commissioner of Transport, Gujarat State, Ahmedabad.)*

No.9 The industry lobby is seeking de-notification of the Marine National Park with its fragile mangroves and coral reefs, in order to lay a pipeline to carry crude oil from Oman to central and north India. Already oil spills have affected vast stretches of mangrove forests in the Gulf of Kachchh. *(Coast of Jamnagar)*



36 TOO MUCH

Focus
Water Pollution
Subject
Science
Place
Indoors
Duration
40-50 minutes for the activity
Group Size
Individual
Materials
List of detergents, writing material.

Objective

To help students understand how various detergents used in homes cause water pollution.

Activity

Explain to students that a detergent is a surface active agent (surfactant), which aids in removal of dirt from surfaces such as human skin, textiles and other solids.

Phosphates present in the detergent soften the water in order to improve the cleansing action. But they also contribute to an oversupply of nutrients to water bodies, and hence leading to eutrophication of lakes and ponds.

Brainstorm a day before doing this activity on kinds of detergents used in households. Make a list of these and put it up in the classroom.

Kinds of Detergents

Detergents to wash clothes, including woollens (bars, powders and liquids)
Detergents to clean dishes (bars, pastes, liquids and powders)
Detergents to clean floors (liquid cleaning agents)
Detergents to clean bathrooms (liquid cleaning agents)
Detergents to clean glass and electronic items (liquid cleaning agents)

Now ask each student to make an inventory of detergents used in their home. Let them take the help of their parents or check the monthly grocery list, to find out how many and how much detergent is consumed per month.

Let them calculate the amounts of various cleaners consumed over a period of one year.

Detergents have molecules with one end that attracts water [hydrophilic), and another end that attracts oils and fats (hydrophobic), The hydrophillc side attaches to water molecules, and the hydrophoblc side attaches to oil molecules. This action causes soil droplets to break up into smaller droplets, surrounded by water. These smaller droplets of oil are no longer stuck to the material to be cleaned, and are washed away. Phosphates presents in detergents soften the water, but phosphates are excellent fertilizer for algae in rivers and oceans.

When excessive phosphate nutrients enter a water body, it leads to a massive proliferation of algae and other plants. This affects the water bodies in two ways. Firstly, it decreases the clarity of the water by blocking sunlight, and thus limits growth of submerged plants. Second, as the algae and other plants decompose, they consume more and more oxygen, leading to depletion of Dissolved Oxygen (DO) in the waterbody, resulting in fish kills. Over a period of time, native fish species disappear, to be replaced by species more resistant to the new conditions.

Discussion

Explain to the students that eutrophfcation as such is a natural aging process of a lake, pond, or slow-moving stream. Organic matter and nutrients accumulate and eventually the water body fills in and becomes dry land. However, this process is being seriously accelerated by addition of detergents containing phosphorus, leaching of fertilizers, sewage and toxic dumping, and warm water from the cooling systems of power plants and other industries.

Ask students to and out the difference between soap and a detergent.

Discuss the implications of the quantity of detergent used in households with students. What would be the impact of these detergent residues on water bodies and the life within it?

Point out that wastewater treatment plants are inadequate in handling the variety of chemicals that are washed down our sinks and flushed down the toilet.

Ask the class to brainstorm on possible ways to help reduce detergent use in homes.

37 THE RAIN ON OUR ROOFS

Focus
Water Harvesting
Subject
Social Studies
Place
Classroom
Duration
40 - 45 minutes
Group Size
Individual or in groups
Materials
Writing material, average rainfall data.

Objective

To appreciate the potential of rainwater harvesting to help mitigate water shortage problems.

Activity

Tell students that rooftop water harvesting is a method of collecting and storing rainwater which falls on the roofs of houses establishments. The water collected from a roof is of good quality. It can be stored in tanks sumps, either for direct use or can be diverted to an existing bore well open well percolation pit for groundwater recharge.

Tell the students that they will be doing an exercise to understand how much water can be collected through this technique from roof of their home or school.

Let students measure the length and breadth of the roof to calculate the area of the roof.

Area of roof = length x breadth (measured in metres)

Let the class find the average rainfall that the city/town /village receives annually or per month during the monsoons. This would be in millimetre.

Volume of rainfall that can
be collected over the roof : Area of roof x Average rainfall
Average quantity of rainfall in metres: Average rainfall in mm / 1000
All the rain that falls on the roof cannot be collected due to seepage or spillage. Therefore, it is normally assumed that about 60 per cent of the rainfall can be effectively harvested.

Volume of the water
harvested would be : Volume of rainfall x 0.6

Considering the average water requirement is 10 litres for drinking and cooking, let the students find out the amount of water harvested would serve their family for how many days.

Discussion

Discuss with students some of the other advantages and benefits of harvesting rainwater. Some of these are:

- Areas around houses, offices and schools are paved with concrete or tar and do not allow water to percolate through, while groundwater extraction has increased manifold in the recent years. It is therefore very essential to find ways to replenish the groundwater table.

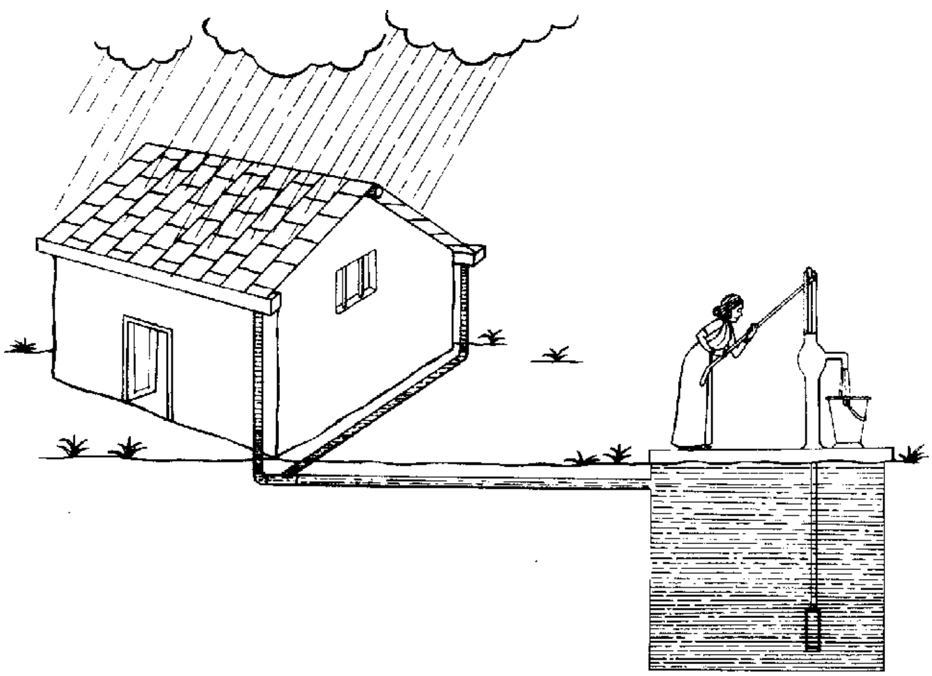
- Rainwater is a pure form of water and when added to the relatively poor quality of groundwater, the quality of that water will improve due to dilution. More the water harvested, better will be the result.

- It avoids subsidence and salt water intrusion in coastal areas.

- Makes dug wells and bore wells sustainable.

- Flooding of low lying areas during rains can be avoided to a large extent.

In cities like Chennai and Hyderabad, it is mandatory to have recharge pits in every house, society and apartment complex. Do students agree that it should be made mandatory for all buildings to harvest rainwater?



MEASURING A CANOPY

Focus
Biodiversity / Mensuration

Subject
Science / Mathematics

Place
Outdoors

Duration
40 - 45 minutes

Group Size
4 - 5

Materials
Chalk powder to mark the shadow, a measuring tape, and writing material.

Objective
To find the area of the canopy of a tree.

Activity
A canopy is the cover formed by leafy upper branches of a tree. Can we measure the canopy area of a be? Tell the students that in this activity they can find the area of the canopy, without actually climbing up a tree!

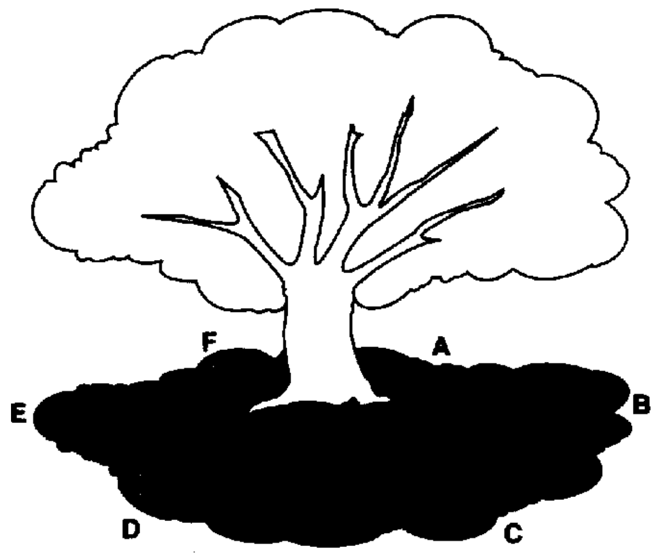
During midday, 12 noon, when the sun is overhead, tell the students to demarcate the shadow the canopy of the tree with chalk powder. Mark points A, B, C, along the demarcated line. Let the base of the tree be O.

Measure distances OA, OB, and OC, etc.

Find the area of different triangles and add them up. This will give the approximate canopy area of the tree.

Note: Sun has to be overhead. Sun in any other direction will not give the exact canopy area.

Discussion
Why do trees attain different heights and place their canopies differently. How does it help various insects, birds and animals?
What kind of biodiversity is found in the canopies?



39 A QUICK COUNT OF DIVERSITY

Focus

Biodiversity

Subject

Science

Place

Outdoors

Duration

40-45 minutes

Group Size

5

Materials

For each group: A ball of string (about 25 metres in length), measuring tape, four sticks or pegs each about 15-cm long, magnifying lens, printout of Survey Sheet and a pencil.

Objective

To enable students to understand the concept of biodiversity, to appreciate biodiversity around them, and to build skills of observation and recording.

Activity

Take students to an area where there is a fair amount of vegetation. Divide students into groups of five. Ask each group to mark out a 10 m x 10 m plot in the area. If the area is very dry, mark out a 20 m x 20 m plot. Mark the corners with pegs or sturdy sticks, and tie a string or rope from one peg stick to the next, so that the plot is enclosed. The string marks the perimeter of the plot.

Students should record the numbers of each type of plant, mammal, amphibian, reptile, insect and bird observed within the plot. Ask them to use a magnifying lens if required, to observe some of the smaller life forms.

Students could use the format given below to record their observations, As the intention is to understand the diversity of life, it is not necessary that students name each species they see and record. They could record different species as Bird 1, Bird 2, Grass1, Grass 2, Creeper, etc., along with a short description.

Biodiversity Survey sheet

S. No.	Plant / Insect/ Amphibian / Reptile / Bird / Mammal	No. of samples found	Local / Common Name	Scientific Name (optional)
1				

If students are interested in identifying the plant or animal species, ask them to use field guides. Alternately, they could of the field guide.

Warn students that they must not disturb anything in the plot, nor should they collect any specimens.

After all the groups have made observations in their respective plots, ask them to compile the observations into;

1. Number of plants animals observed in the study plot.
2. Numbers of different types of plants, mammals, reptiles, amphibians, insects and birds in the study plot.

Variation
Similar surveys can be carried out in different areas. For example, one group could survey a plot in an area with some wild growth while another group could examine a garden near their school. A third group could visit a local pond and survey the life forms in it. At the end of the survey, groups could present and compare their findings.

Surveys specifically on birds, insects, or plant life can also be carried out.

Discussion
Were the numbers and types of plant and animal species recorded different for different study areas? What could be the reasons for these differences? Discuss possible human impacts on the biodiversity of a region.

40 FOOD HISTORY

Focus
Biodiversity
Subject
Science
Place
Indoors and Outdoors
Duration
One day for collection and compilation of information
Group Size
Individual
Materials
Writing material, Food History table.

Objective
To become aware of the diversity of food we eat everyday and the concept of loss of biodiversity.

Activity
Ask each student to interview grandparents and parents and or neighbours, relatives or others belonging to those two generations. Students should find out;

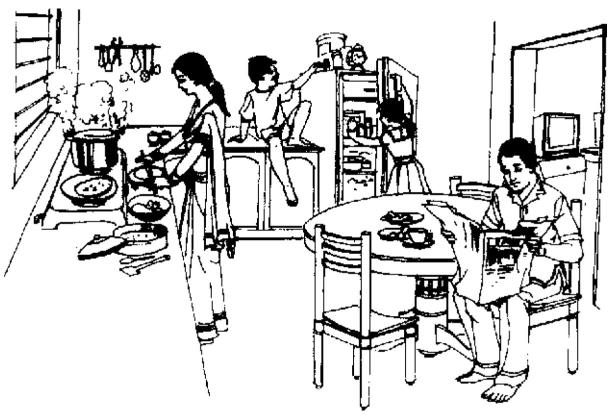
1. Vegetables, fruits, pulses, cereals, meats and fish that the persons used to eat when young; dishes cooked for breakfast and other meals on a typical day; beverages (tea, coffee, milk, *lassi* buttermilk, etc.) they consumed.
2. Vegetables, fruits, pulses, cereals, meats and fish that were available then, but not any more.
3. Vegetables, fruits, pulses, cereals, meats and fish that were not available then, but now are.
4. Special foods associated with different seasons.

Students can use the 'Food History' to record the information.

Ask students to begin by listing, in the appropriate column, items mentioned by grandparents. Against each item they could put either a tick (Yes) mark or a cross (X) in the other two columns depending on whether parents and they themselves also eat those items of food. Add any items mentioned by parents but not by grandparents in the "parents" column and mark, as appropriate, in the other two columns.

Finally the students should add items to their own column which are available now but were not mentioned by either or both of die other groups.

Students should ask both groups why some of the varieties of foods are not eaten or available any more. They could record the reasons in the "Remarks" column.



Food Category	Grand Parents	Parents	Myself	Remarks
Vegetables 1. Tomatoes 2. 3.	No	Yes	Yes	Tomatoes were seasonal during my parents time, but are now available in all seasons.
Beverages 1. 2. 3.				

Extension

The students could find out about the kind of dishes that were customarily made on different occasions like; festivals, rituals and celebrations like weddings, in all the three generations.

Is there any change in the way certain dishes are cooked and prepared today as compared to before3 For instance, how is *baingan ka barttaa made*? These days, the brinjals are either roasted ongas stoves or micro-waved, while earlier they were roasted on coals.

Have students do a market survey of the five food categories (vegetables, fruits, cereals, pulses and meats) mentioned above. Ask them also to check out what is available in the government ration shops. Does the Public Distribution System sell *bajra, jowar* and other nutritious cereals? Why is this?

Discussion

List vegetables, fruits, cereals, pulses and meats (e.g., fish, fowl) which seem to have either disappeared from the range of foods available now, or have become rare. Discuss why this might have happened, e.g., loss of forests, grasslands, water bodies that harboured these plants or animals, monocultures, changing lifestyles.

Ask students to name items that they eat but their parents or grandparents did not. What does this indicate? What is the role of modern agriculture and transportation in this? What is the role of technologies such as refrigeration?

Discuss the importance of biodiversity.

41 HOW MANY HERE?

Focus
Population Pressure

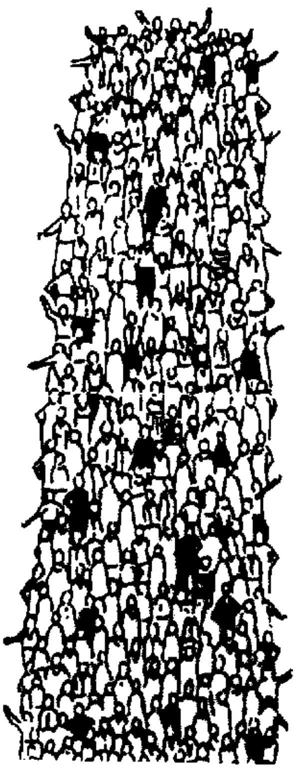
Subject
Science / Social Studies

Place
Outdoors

Duration
1 hour

Group Size
10 to 15

Materials
Fuelwood Cards with weights written



Objective

To understand the concept of overpopulation in terms of the carrying capacity of an area.

Activity

Mark out a large area on the floor or in the playground. Place cards representing wood (green wood or fuel wood) randomly on the ground in the marked out area on the cards, in such a way that the writing faces the ground.

Tell the students that the area marked out on the ground represents a wooded area near a village. It has fuel wood that can be collected and green wood that cannot be collected.

Each one of them is a fuel wood gatherer from the village and needs to kilograms of fuel wood daily, unless otherwise specified.

The cards represent pieces of fuel wood of different weights that can be collected.

Each student is allowed to collect a maximum of 10 cards.

Besides the fuel wood cards, there are other cards marked 'Green'.

These cards represent green wood which cannot be collected.

Divide the students into four groups.

Group 1: The first group represents children and they are physically not capable of collecting a large quantity of fuel wood. To represent this, they have to hop while they are gathering fuel wood.

Group 2: The Second group represents mothers with babies in their arms. They have to use only the thumb and the little finger of their left hands to collect the fuel wood.

Group 3: The third group members come from families with 10 members each. They need to cook more food and need more fuel wood than the others. They have to collect 20 kg each.

Group 4: The fourth group represents people who have no special restrictions or requirements, and can collect the fuel wood cards normally.

On a signal, each one of the participants must start collecting the cards. As the maximum number of cards that each person can collect is limited to 10, the participants have to pick and choose between the cards. For example, if a person collects ten 'A' cards, they will not add up to the 10 (or 20) kg he / she may require. Pushing and shoving is not allowed.

When all the cards have been gathered, ask the participants to calculate the quantity of fuel wood they have gathered.

Discussion

How many kilograms of fuel wood did each participant gather?

How many participants could gather enough fuel wood to meet their requirements?

What is the total amount of fuel wood available in the area?

The total amount of fuel wood available in the area amounts to 135 kilograms.

How many people's fuel wood requirements can the area support if each person needs 10 kg- what is the area's carrying capacity in terms of fuel wood collection?

Are the numbers of fuel wood collectors more or less than the number that the area can support? What could happen when the number of fuel wood collectors exceeds the carrying capacity?

Fuel wood and Green wood cards

Mark the weights on cards preferably of the size of visiting cards. Mark on one side of the card only.

You could also use ice cream cups— cleaned after use—in place of cards.

In this case, you will need to mark the weights on the outside bottom of the cups.

Details

50 cards marked '500 grams' (to represent fuel wood of weight 500 grams each)

25 cards marked '1 kilogram' (to represent fuel wood of weight 1 kilogram each)

15 cards marked '2 kilograms' (to represent fuel wood of weight 2 kilograms each)

9 cards marked '5 kilograms' (to represent fuel wood of weight 5 kilograms each)

1 card marked '10 kilograms' (to represent fuel wood of weight 10 kilograms each)

20 cards marked 'G' (to represent green wood which cannot be collected)

24 HOURS

Focus

Gender / Population

Subject

Science / Social Studies

Place

Indoors

Duration

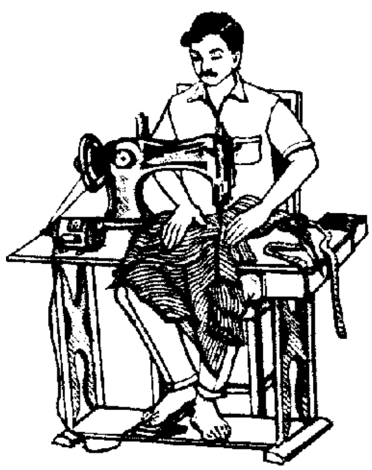
1 - hour

Group Size

About 5

Materials

Two pieces of card paper cut into circles (each having a diameter of about 30-cm), two sets of colour pencils, paper)



Objective

To help students become aware of the different roles and tasks performed by men and women.

Activity

Divide the students into 5-8 groups. Give two circles of cards to each group. Ask them to divide the circles into twenty-four equal sectors. Now, ask each group to choose a particular type of family- e.g., a family where husband and wife are college professors.

Tell them, as a group they have to agree on the situation of the family. For example: What is the income class of the couple? What are their ages? Are they from a rural or an urban background? They should choose a situation that they are familiar with. After this, the group should break up into two sub-groups. Each should have one card. One of them will take 'the man' as the subject and the other will take 'the woman' as the subject.

Tell the sub-groups that their task is to make a list of all the activities their subjects perform each day and the average time spent on each of these activities. They may interview any person who matches their subject for information.

Now, ask the students to make a pie chart of the time their subjects spend on each activity on the card circle. They can use different colour codes for different activities.

After mapping, ask each group to make a presentation of their time circles.

Discussion

Is there any difference between the tasks that men and women do?
What are the differences?
Is there any difference in the time that men / boys and women / girls spend on different tasks? What are the differences?
What are the reasons behind these differences?
Are the roles and responsibilities taken up by men /women the same for all men /women?
What impact do the roles of men and women have on their time?

Discuss whether 'men' and 'women' are homogenous groups, i.e. are all men the same, or all women the same. For example, the roles and responsibilities of a woman who is a landless labourer in a village may not be the same as the roles and responsibilities of a woman who is a marketing executive in Mumbai. Yet there are similarities. For instance, both the women may be expected to be primarily responsible for the rearing of their children.

43 SERVING THE PEOPLE

Focus
Civic Services
Subject
Social Studies
Place
Classroom and Outdoors
Duration
40 - 45 minutes
Group Size
6 - 7
Materials
Notebooks, guidelines, chart paper, crayons.

Objective

To make students aware of the roles and responsibilities of people providing various civic services.

Activity

Ask the students to divide themselves into groups of 6-7.
Tell then that each group would be required to meet and interview one civic service provider, (e.g, Sarpanch, Taluka Development Officer, District Development Officer, District Collector, Postman, Talati Tehsildar), policeman, Nurse or Health worker, Doctor, etc.) about their functions.
Allow the students to choose a civic service provider that they would like to interview. Try and bring in as much variety as possible in the selection.
Provide each group with a list of questions that could be asked during the discussion. The following questions are indicative and not exhaustive.

- What are the functions of the selected civic service provider?
- How does their work help people?
- What are timings of their duty?
- What do they like about their work?
- What are the difficulties faced by them in their work?
- What is the response of the people and communities towards their work?
- What would help them to do their job better?
- What motivates them and what discourages them?

At the end of this activity, ask each group to make a presentation to the class.
Interaction through such interviews would help the students in gaining firsthand information about the functions and responsibilities of the officials and the goals of the organizations institutions that they belong to.
In particular, it gives students insights into how these officials can be approached. It helps them learn about the realities and difficulties in carrying out their duties and functions.
This will further help students understand their role as citizens.

Extension / Variation

You could invite any of the civic service providers to the school for an interaction with the students.

INFORMATION PACKED

Focus
Consumer Education
Subject
Social Studies
Place
Indoors
Duration
30 - minutes
Group Size
5
Materials
Containers of a variety of different products.

Objective

To understand the importance of information on packages in relation to consumer's right to information, and to examine claims made by manufacturers about their products.

Activity

Draw the table given on this page on the board. Ask the students whether any particular piece of information is necessary for the mentioned products. Put a YES or NO depending on the consensus.

Product Information	Cosmetics	Clothes	Insecticides	Electrical Gadgets	Medicines	Ready to cook food products
Date of manufacture						
Expiry date						
Ingredients						
Licence Number						
Name and address of manufacturer						
Name and address of packer						
Name and address of distributor						
Price of the product						
Instructions for use						
Precautions in use						
Any other						

Now ask each group of students to collect containers (bottles, tin cans, tetra-packs, and cardboard boxes, plastic or polythene bags) of four different types of branded packaged items. These could include food items (processed and unprocessed), medicines, toiletries (soaps, shampoos, face powders etc.), and household electrical items (mosquito repellent devices, hand mixers etc.).
Ask them to fill details about each item in the table below.

	Item 1	Item 2	Item 3	Item 4
Product name				
Type of package				
Date of manufacture				
Expiry date				
Ingredients				
Licence Number				
Is the name, address of manufacturer given?				
Is the name, address of paker given?				
Is the name, address of distributor given?				
Price of the product				
Are instructions for use given?				
Are precautions for use given?				

Does the reality match with what they set out as desirable in the previous table? What could be the problems arising from not having specific information in the relation to specific product categories?

Discussion

As consumers students can play a role in preventing widespread sale of sub-standard, spurious or counterfeit products. Spurious products do not follow any quality parameters and use substandard or even harmful ingredients. Counterfeits also cause economic loss to the government as the manufactures of such goods do not pay excise, sales, and other taxes.
They must carefully check the brand, logo and details of manufacturer of goods they buy; be wary of unusually low priced goods; buy from known shops or dealers.

Extension / Variation

About 48 per cent of Indians are not literate. What should be done so that necessary information reaches consumers who are not literate?

45 AD-AD WORLD….!

Focus
Consumer Education

Subject
Civics

Place
Indoors

Duration
About a week

Group Size
5 - 6

Materials
Newspapers, magazines, writing material.

If you come across ads that are offending, misleading or making tall / false claims, in the press, on TV or any media, write to
CONSUMER EDUCATION AND RESEARCH SOCIETY
Suraksha Sankul
Thaltej
Ahmedabad - Gandhinagar Highway, Ahmedabad
380 054

Objective

To understand the power of advertising to inform and influence.

Activity

Ask each group to check out the front page of a daily newspaper, the Sunday edition of a newspaper; and the middle pages of a popular magazine. Ask them to observe how much space is devoted to advertisements, and how much of it carries editorial matter and news features. Ask them also to watch TV and listen to radio for half an hour at prime time and note the same details.

Ed vs. Ad

	Daily Newspaper (In coloumn cm)	Sunday Newspaper (In coloumn cm)	Magazine (In coloumn cm)	TV Channel (In minutes)	Radio (In minutes)
Ed:					
Ad:					

Let them discuss what this means for the promoters of media and what this implies for the readers viewers?

Ask them to identify ads that try to link to any aspect of the environment. Are there ads that highlight some environment- friendly feature of the product? Are there ads that promise to include natural herbal ingredients for reducing the product's impact on the environment (e.g. less polluting)

Ask them to critically look at 20-25 TV or print commercials (ads) and note the products and their logos / symbols used to advertise these. Which of those used an element of the environment in the logo? Let them make a list of the products and their logos and record their observations.

Product	Environment related logo	Possible reason for use of such logo	Ad accurate / realistic / positive	Ad reinforces positive / negative image.	

Discussion

Nowadays many public interest causes (rainwater harvesting, recycling, no to smoking, no to speeding, etc.) employ advertising to reach out to the public with their messages. Can the students recall seeing any such ad? Did it make them sit up and think?

46 PLAYING DETECTIVE

Focus
Consumer Education
Subject
Civics
Place
Classroom
Duration
Two hours
Group Size
2 - 4
Materials
50-ml milk, 20 grams each of ghee, butter, vegetable oil, chilli powder, cinnamon powder, black pepper, Asafoetida (Heeng), Bengal gram, red gram, tea leaves, filter coffee powder, water, blotting paper, lactometer, hydrochloric acid, furfural solution, nitric acid, iodine solution, writing material.

Objective

To carry out simple tests and observations to help detect adulteration in foodstuffs.

Activity

Ask students to collect the following food items from the local market or from home:
50 ml milk, 20 grams each of ghee, butter, vegetable oil, chilli powder, cinnamon powder, black pepper, asafoetida (*Hing*), Bengal gram, red gram, tea leaves, coffee powder

Help them to conduct the following tests and note down their observations and conclusions.

Chilli Powder

Sprinkle the powder on the surface of a glass of water. If wood shavings float on the surface and water turns red, it shows adulteration with saw dust and artificial colours.

Cinnamon

Add cinnamon powder to water and stir. If it dissolves in water, it shows the presence of cassia bark, which resembles cinnamon in taste and colour.

Black Pepper

Soak the pepper in water. If adulterated with papaya seeds, these will float to the surface of water.

Asafoetida

Dissolve the contents in water. The powder should dissolve and form a milky solution. If it does not dissolve, it reveals adulteration with resin or gum.

Pulses (Bengal gram / Red gram)

To the pulse, add five ml. of water and a few drops of hydrochloric acid. If the colour turns pink, it reveals adulteration with Kesari dal (*Lathyrus sativa)* that has been artificially coloured yellow with coal tar dye metanil yellow.

Tea leaves

Moisten tea leaves and place on blotting paper. If spots of yellow, pink and red colour appear, it indicates adulteration with used tea leaves that have been artificially coloured.

Coffee

Add a small quantity of filter-coffee powder (not the instant coffee powder) to cold water and shake well and let the entire set-up remain undisturbed. If chicory has been added, it will sink to the bottom and stain the water into a brownish red colour.

Butter and Ghee

Take equal quantities of butter or ghee, and hydrochloric acid. Add 2-3 drops of furfural solution to the mixture. Shake well and let it stand for a few minutes. The appearance of pink colour at the bottom of the add layer shows adulteration with *vanaspati.*

Heat vegetable oil with nitric acid. Appearance of red colour implies that *Argemone* oil has been added.

Milk and Milk Products

Use a lactometer to measure specific gravity. It should range between 1.020 and 1.034. If the specific gravity is not within this range, it indicates adulteration with water.

Add a drop of iodine to a little milk. If it turns blue or grey, it shows addition of starch to thicken milk.

Extension

Ask students to collect some packaged food items and study it to see if the details required to answer the questions below appear in the information provided. These are essential labelling requirements as covered by Prevention of Food Adulteration Act (PFA), 1954

Does the packaged food bear the name and complete address of the manufacturer, packer, vendor and importer?
Does it give the name and trade name of the product?
Are the ingredients listed in descending order of composition?

Does the information on the packing give net weight or volume, distinctive batch number or lot number?

Do the date, month and year of packaging appear in capital letters and does it come with ‘Best before use’

If the product is irradiated, does it come with proper labelling that it is radiated food? Are the prescribed doses of radiation mentioned?

Is there extraneous colouring matter natural or synthetic that is added and is it displayed in capital letters just beneath the ingredients on the label?

Does it display maximum retail price?

Discussion

Invite a doctor to talk to the class about the impact of adulterants on health.

Initiate a discussion to help the students understand that adulteration may occur at any stage of the chain, from production to selling of the food—i.e. growth, harvesting, storage, processing, transportation and distribution.

Also, adulteration could be incidental or intentional. Incidental adulteration occurs due to ignorance, negligence or lack of proper facilities for processing, storing or transporting material, while intentional adulteration includes the intentional addition, subtraction or addition of substances, which adversely affect the nature, substance and quality of food. In either case, quality of food is lowered.

47 COUNT DOWN

Focus
Sustainable Development
Subject
Science, Social Science
Place
Indoors
Duration
35 - minutes
Group Size
5-6
Materials
Writing material

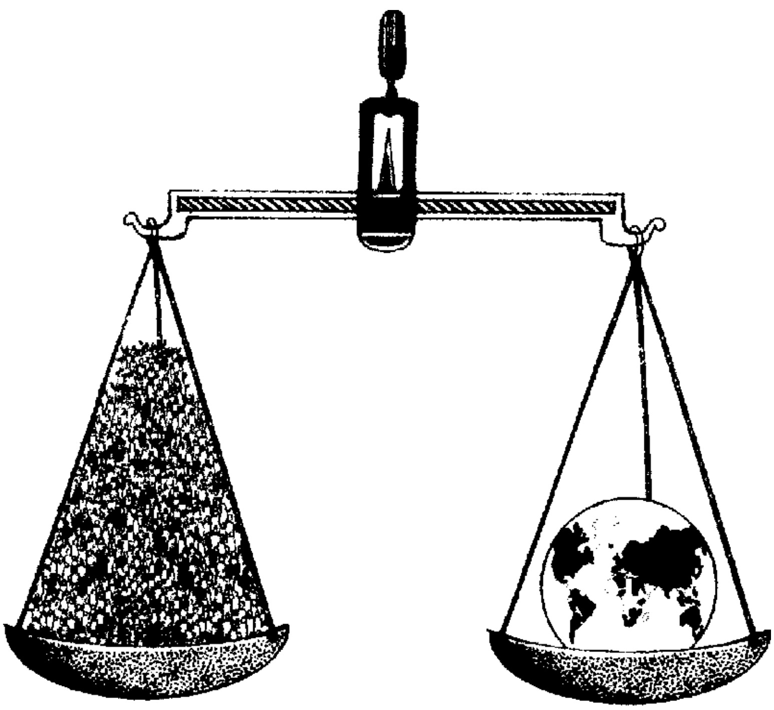
Objective

To enable students to distinguish between need and wants.

Activity

Divide the class into teams of 5-6 players each. Ask each team to be ready with a paper and a pencil. Tell the players that they are escaping from their home town because of a sudden disaster that has hit their locality. Each team represents a family. Each family has time to take just 20 things from their homes before they leave their town (and before their homes are destroyed). They are not allowed to take money. They do not know where they are going, when they will reach another place where they can find help, and what facilities and services they may get at the new place. They also do not know when, if at all, they will return to their town and whether their homes will be standing there. Which are the twenty things the family will choose to take? Give the players live minutes to discuss and make a list of those twenty things.

After the players have made the list, give the next instruction. Tell them that the truck which is to take them out of the town is already overloaded, and so they have to drop any five of the 20 things they are carrying with them. Which five will they choose to drop? Ask the players to strike off from their list those five things. On their way out of the town, the truck has a breakdown and everyone has to walk. They cannot carry 15 things, as the walk is too long. Which five things will they discard now? Ask the players to strike out five more items from the list. On their way they are stopped by a gang of dacoits who demand that they part with any live items out of the ten they carry. Which five items will they give up? Ask the players to strike out five more items from the list.



Finally each team will have a list of five items. Ask them to read out their original list and their final list of five. If there are only a few teams (up to five) you may be able to write these on the board.

Extension / Variation

The players may be asked to make a list of things they own but which they can easily do without.

Discussion

What are needs, wants and luxuries?

END OF BOOK